FILED
January 13, 2016
INDIANA UTILITY
REGULATORY COMMISSION

STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

IN THE MATTER OF THE VERIFIED PETITION OF INDIANA MICHIGAN POWER COMPANY FOR APPROVAL OF AN ADJUSTMENT TO ITS RATES THROUGH ITS DEMAND SIDE MANAGEMENT AND ENERGY EFFICIENCY PROGRAM COST RIDER COMMENCING WITH THE BILLING MONTH OF JANUARY 2016 AND FOR APPROVAL OF ALTERNATIVE REGULATORY PLAN FOR DEMAND SIDE MANAGEMENT (DSM) AND ENERGY EFFICIENCY (EE) PROGRAMS FOR 2016 AND ASSOCIATED ACCOUNTING AND RATEMAKING MECHANISMS, INCLUDING TIMELY RECOVERY THROUGH I&M'S DSM/EE PROGRAM COST RIDER OF ASSOCIATED COSTS, INCLUDING ALL PROGRAM COSTS, NET LOST REVENUE, SHAREHOLDER INCENTIVES AND CARRYING CHARGES, DEPRECIATION ON CAPITAL EXPENDITURES AND OPERATIONS AND MAINTENANCE EXPENSE.

CAUSE NO. 43827 DSM 5

SUBMISSION OF DIRECT TESTIMONY AND EXHIBITS

Citizens Action Coalition of Indiana, Inc. ("CAC"), respectfully submits the testimony and exhibits of Natalie A. Mims in the above referenced Cause to the Indiana Utility Regulatory Commission ("Commission").

Respectfully submitted,

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STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

VERIFIED PETITION OF INDIANA MICHIGAN)
POWER COMPANY REQUESTING THE)
INDIANA UTILITY REGULATORY)
COMMISSION TO APPROVE CERTAIN)
DEMAND SIDE MANAGEMENT PROGRAMS)
AND GRANT COMPANY AUTHORITY TO) CAUSE NO. 43827 DSM 5
RECOVER COSTS, INCLUDING PROGRAM)
COSTS, INCENTIVES AND LOST MARGINS,)
ASSOCIATED WITH THE DEMAND SIDE)
MANAGEMENT PROGRAMS PURSUANT TO)
SENATE ENROLLED ACT 412 AND 170 IAC 4-8-)
1 ET. SEQ. VIA THE COMPANY'S DEMAND)
SIDE MANAGEMENT ADJUSTMENT)

Direct Testimony And Exhibits of Natalie Mims on Behalf of Citizens Action Coalition of Indiana, Inc.

Direct Testimony of Natalie Mims
On Behalf of Citizens Action Coalition of Indiana, Inc.
Cause No. 43827 DSM 5
January 13, 2016

I. INTRODUCTION

Q. Please state your name and business address.

A. My name is Natalie Mims of Mims Consulting, LLC, and my business address is 1035 Santa Barbara Street, Suite 9, Santa Barbara, California 93101.

Q. Please describe your professional background and experience.

A. I have testified as an expert before the Florida, Georgia, Hawaii, Indiana, North Carolina, and South Carolina Public Service Commissions regarding Investor Owned Utility energy efficiency program plans, cost recovery, performance incentives, lost revenue adjustment mechanisms and evaluation, measurement and verification reports. My resume is attached as Exhibit NM-1.

Q. Have you testified previously before the Indiana Utility Regulatory Commission ("Commission" or "IURC")?

A. Yes. I filed written testimony in 43955 DSM 3 (Duke 2016-2018 EE Plan) on September 3, 2015, in 44634 (NIPSCO 2016-2018 EE Plan) on September 4, 2015 and in 44645 (Vectren 2016-2017 EE Plan) on October 7, 2015.

Q. On whose behalf are you testifying?

A. I am testifying on behalf of Citizens Actions Coalition of Indiana, Inc. ("CAC").

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to provide my expert opinion as to whether or not the 2016 energy efficiency plan of Indiana Michigan Power Company ("I&M" or "the Company") is (1) in the public interest as an Alternative Regulatory Plan and/or (2) reasonable as an energy efficiency plan, assuming I&M's references to Ind. Code § 8-1-8.5-9 are meant to apply as a back-up in case the Commission rejects this plan as an Alternative Regulatory Plan.

I&M petitions the Commission for approval of its 2016 DSM/EE Programs as an Alternative Regulatory Plan ("ARP") pursuant to Ind. Code § 8-1-2.5-6.[1] In determining whether an ARP is in the public interest, the Commission must consider:

> (1) Whether technological or operating conditions, competitive forces, or the extent of regulation by other state or federal regulatory bodies render the exercise, in whole or in part, of jurisdiction by the commission unnecessary or wasteful.
> (2) Whether the commission's declining to exercise, in whole or in part, its jurisdiction will be beneficial for the energy utility, the energy utility's customers, or the state.
> (3) Whether the commission's declining to exercise, in whole or in part, its jurisdiction will promote energy utility efficiency.
> (4) Whether the exercise of commission jurisdiction inhibits an energy utility from competing with other providers of functionally similar energy services or equipment.

Ind. Code § 8-1-2.5-5.

Although I am not an attorney, CAC's counsel has informed me that while the Commission is not mandated to factor in the substance and declaration of Ind. Code § 8-1-2.5-1[2] when making decisions on ARPs, it typically does so. Ind. Code § 8-1-2.5-1 provides the following declaration from the Indiana General Assembly:

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[1] I&M's Verified Petition and Request for Administrative Notice, pages 1 and 4 (Sept. 11, 2015).
[2] *See, e.g.,* IURC Cause No. 44478, page 16 (Feb. 11, 2015).

> (1) That the provision of safe, adequate, efficient, and economical retail energy services is a continuing goal of the commission in the exercise of its jurisdiction.
> (2) That competition is increasing in the provision of energy services in Indiana and the United States.
> (3) That traditional commission regulatory policies and practices, and certain existing statutes are not adequately designed to deal with an increasingly competitive environment for energy services and that alternatives to traditional regulatory policies and practices may be less costly.
> (4) That an environment in which Indiana consumers will have available state-of-the-art energy services at economical and reasonable costs will be furthered by flexibility in the regulation of energy services.
> (5) That flexibility in the regulation of energy services providers is essential to the well-being of the state, its economy, and its citizens.
> (6) That the public interest requires the commission to be authorized to issue orders and to formulate and adopt rules and policies that will permit the commission in the exercise of its expertise to flexibly regulate and control the provision of energy services to the public in an increasingly competitive environment, giving due regard to the interests of consumers and the public, and to the continued availability of safe, adequate, efficient, and economical energy service.

Ind. Code § 8-1-2.5-6(e) allows the Commission to approve, reject, or modify an energy utility's proposed Alternative Regulatory Plan if the Commission finds such action is consistent with the public interest after weighing the evidence presented.

I&M also references Indiana Senate Enrolled Act 340 (2014) codified under Ind. Code § 8-1-8.5-9,[3] but it appears that I&M is not asking for relief under this statute besides referencing its compliance with allowing industrial customers the opportunity to opt out of utility energy efficiency programs.

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[3] I&M's Verified Petition, pp. 3-4.

Finally, I&M appears to attempt to also comply with certain elements in Indiana Senate Enrolled Act 412 (2015) codified under Ind. Code § 8-1-8.5-10.[4] Ind. Code § 8-1-8.5-10(f) says: "plan" refers to the goals, programs, program budgets, program costs, and procedures submitted by an electricity supplier to the commission under subsection (h). I&M's plan is not compliant with Ind. Code § 8-1-8.5-10(h) or reasonable under Ind. Code § 8-1-8.5-10(j) for many reasons.

Overall, I&M's plan is (1) not in the public interest as an Alternative Regulatory Plan ("ARP"); (2) not reasonable under Ind. Code § 8-1-8.5-9; and (3) not reasonable under Ind. Code § 8-1-8.5-10. I&M's plan should be rejected until all the recommendations that I have set forth below are incorporated into I&M's plan. While I&M works to incorporate my recommendations into its plan, I recommend that the Company continue to offer its DSM programs as it has under its 2015 plan for purposes of consistency, marketplace certainty, and for the benefit of I&M's customers.[5]

Q. Please summarize your conclusions and recommendations.

A. In order to rectify these issues and present a plan that the Commission could and should approve, I&M would have to:

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[4] *See, e.g.*, I&M Witness Walter Testimony, pp. 3, lines 17-20, which references energy efficiency goals, budget, and plans for stakeholder input—all explicit requirement of Ind. Code § 8-1-8.5-10.

[5] I am aware that the Commission granted I&M interim authority on November 18, 2015, to continue offering its current DSM programs and recovering associated costs as approved in the Commission's December 3, 2014 Order in Cause No. 44486 through April 30, 2016.

1. Present a DSM plan that is consistent with an IRP that reasonably balances energy resources through comparable consideration of both supply and demand-side resources.
2. Pursue all reasonably achievable savings by increasing the goals for those programs unaffected by opt-out customers to levels consistent with Action Plan, and spending entire DSM budget.
3. Modify new construction and low income programs; re-evaluate if the Neighborhood Energy and Moderate Income are appropriate programs to offer, and provide an explanation if the Company finds they are not appropriate; offer a program for multifamily homes, new manufactured homes, direct install for schools, and non-residential self-direct programs; and modify its opt-out letter to include details on the benefits of EE.
4. Require I&M's Oversight Board guidance to return to the pre-Settlement oversight requirements.
5. Demonstrate that it is experiencing lost revenues and then limit lost revenue recovery to 36 months or the life of the measure, whichever is shorter.
6. Include a performance incentive that is based on multiple performance metrics and subject to financial cap. A performance incentive should only be proposed if lost revenue recovery is limited to 36 months or the life of the measure, whichever is shorter.
7. File clear EM&V in all future DSM proceedings.

II. I&M'S PLAN IS NOT IN THE PUBLIC INTEREST, AND THE COMMISSION SHOULD NOT DECLINE TO EXERCISE ITS JURISDICTION.

Q. Please describe Ind. Code § 8-1-2.5-5 and how, in your opinion, it applies to I&M's plan.

A. An Alternative Regulatory Plan ("ARP") pursuant to Ind. Code § 8-1-2.5-6 uses factors from Ind. Code § 8-1-2.5-5 to help the Commission determine if the plan is in the public interest. I am not an attorney, but it does not seem logical to use Ind. Code § 8-1-2.5-5 as the governing statute, considering the recently enacted Ind. Code §§ 8-1-8.5-9 (2014) and 8-1-8.5-10 (2015) that directly relate to electric utility-sponsored demand side management. In fact, it seems wasteful and a poor use of stakeholder resources. Ind. Code § 8-1-2.5-5 focuses on whether the Commission declining jurisdiction will serve the public interest. My expert opinion is that the public interest will not be served by the Commission declining jurisdiction, rather the public interest will be harmed if the Commission does not step in to order better program administration from I&M. This is especially so considering the fact that I&M is required to file a plan under Ind. Code § 8-1-8.5-10 by 2017.

Ind. Code § 8-1-2.5-5(b)(1)-(4) lists four different matters for the Commission to consider when deciding whether the public interest will be served by the Commission declining its jurisdiction. The first is "whether technical or operating conditions, competitive forces, or the extent of regulation by other state or federal regulatory bodies render the exercise, in whole or in part, of jurisdiction by the commission unnecessary or wasteful." Ind. Code § 8-1-2.5-5(b)(1).

Q. **Do you believe that technical or operating conditions, competitive forces, or the extent of regulation by other state or federal regulatory bodies render the exercise, in whole or in part, of Commission jurisdiction unnecessary or wasteful?**

A. No. I am not an attorney, but in my expert opinion, the Commission's jurisdiction is necessary and prudent in this instance. The Commission's expertise in this subject area and the recent statutes seem to indicate the legislature's preference for the Commission to handle such matters. It appears that because I&M's plan does not meet the threshold of Ind. Code § 8-1-8.5-9 or §8-1-8.5-10, I&M is using this ARP statute as a way around it. The Commission should not accept I&M's invitation to circumvent the applicable statutes.

Q. **Do you believe that I&M, I&M's customers, or the State of Indiana will benefit by the Commission declining to exercise its jurisdiction, in whole or in part, as contemplated in Ind. Code § 8-1-2.5-5(b)(2)?**

A. No. If anything, I&M should be working toward compliance with Ind. Code § 8-1-8.5-10, which is squarely within the Commission's jurisdiction. Any delay toward achieving compliance with the new legislation is harmful to I&M's customers and the State, in particular, especially with the recently enacted federal Clean Power Plan. Any savings left on the table will make it harder for the State of Indiana to comply with the Clean Power Plan.

Q. Do you believe that the Commission declining to exercise its jurisdiction, in whole or in part, will promote energy utility efficiency, as contemplated in Ind. Code § 8-1-2.5-5(b)(3)?

A. No. If the amount of energy efficiency in I&M's plan was higher than its Market Potential Study or IRP, then perhaps this would make more sense, but as I will describe below, I&M's energy efficiency goal is woefully inadequate.

Q. Do you believe that the exercise of Commission jurisdiction inhibits I&M from competing with other providers of functionally similar services or equipment?

A. No. This is especially the case with I&M as it has brought in house a significant amount of its EE/DSM services, much to the detriment of ratepayers, in my expert opinion.

Q. If Ind. Code § 8-1-2.5-5 should not apply, please describe Ind. Code § 8-1-8.5-9 and how, in your opinion, it would be applied to I&M's plan.

A. Ind. Code § 8-1-8.5-9(c) defines "energy efficiency program" as a program that is: (1) sponsored by an electricity supplier or a third party administrator; and (2) designed to implement energy efficiency improvements (as defined in 170 IAC 4-8-1 (j)) for customers. Energy efficiency improvements in 170 IAC 4-8-1-(j) means reduced energy use for a comparable level of energy service.

Ind. Code § 8-1-8.5-9(m) states that an electricity supplier may offer a cost effective portfolio of energy efficiency programs to customers, and the Commission must determine that the portfolio included in the proposed energy efficiency program is reasonable and cost effective. If the Commission makes that decision, the electricity supplier *may* recover program costs, lost revenues, and incentives approved by the Commission.

I&M's plan is neither reasonable nor cost effective, especially when considering the amount of savings left on the table and I&M's proposal for lifetime recovery of lost revenues.

Q. **If Ind. Code § 8-1-2.5-5 should not apply, please describe Ind. Code § 8-1-8.5-10 and how, in your opinion, it would be applied to I&M's plan.**

A. Section (h) of Ind. Code § 8-1-8.5-10 states that a plan shall include (1) energy efficiency goals, (2) energy efficiency programs through which the energy efficiency goals will be achieved, (3) program budgets and costs, and (4) independent evaluation measurement and verification ("EM&V"). Section (c) defines "energy efficiency goals" as all energy efficiency produced by cost effective plans that are (1) reasonably achievable; (2) consistent with an electricity supplier's integrated resource plan; and (3) designed to achieve an optimal balance of energy resources in an electricity supplier's service territory.

I am not an attorney, but based on my review, I&M's plan does not meet the definition of an energy efficiency goal (Section (h)) because it does not meet Section (c) (1) - (3) requirements of Ind. Code § 8-1-8.5-10.

Q. **What role did I&M's IRP play in establishing its energy efficiency goals for 2016?**

A. I&M filed its petition in this case on September 11, 2015. At that time, the 2013 IRP was the most recently completed and the 2015 IRP was under development, but was filed less than two months later on November 2, 2015. The 2013 IRP provided no meaningful assessment of energy efficiency compared to other potential resources. As IURC Electricity Director Brad Borum's final report on I&M's 2013 IRP states, "I&M did not allow EE to compete with supply-side resources in an optimization process over the full planning horizon."[6] Further, "[it] is clear that I&M assumed a specified level of EE in the resource plan and that this impact was based on management judgment through 2019."[7]

Nor can the 2015 IRP reasonably have influenced the level of proposed savings in this DSM plan. "Incremental" energy efficiency was only made available to the Plexos optimization model starting in 2018.[8]

For these reasons, I&M cannot claim to satisfy Section (c) in Ind. Code § 8-1-8.5-10 or to be achieving the public interest under Ind. Code § 8-1-2.5-5(b). I&M also cannot it claim to be reasonable and cost-effective under Ind. Code § 8-1-8.5-9, because a reasonable comparison of supply versus demand side measures is necessary to demonstrate cost-effectiveness.

Q. What are the energy efficiency programs I&M is proposing in this filing?

A. I&M is proposing to offer ten residential programs and five non-residential programs (including two pilots) as shown in Table 1 below.[9]

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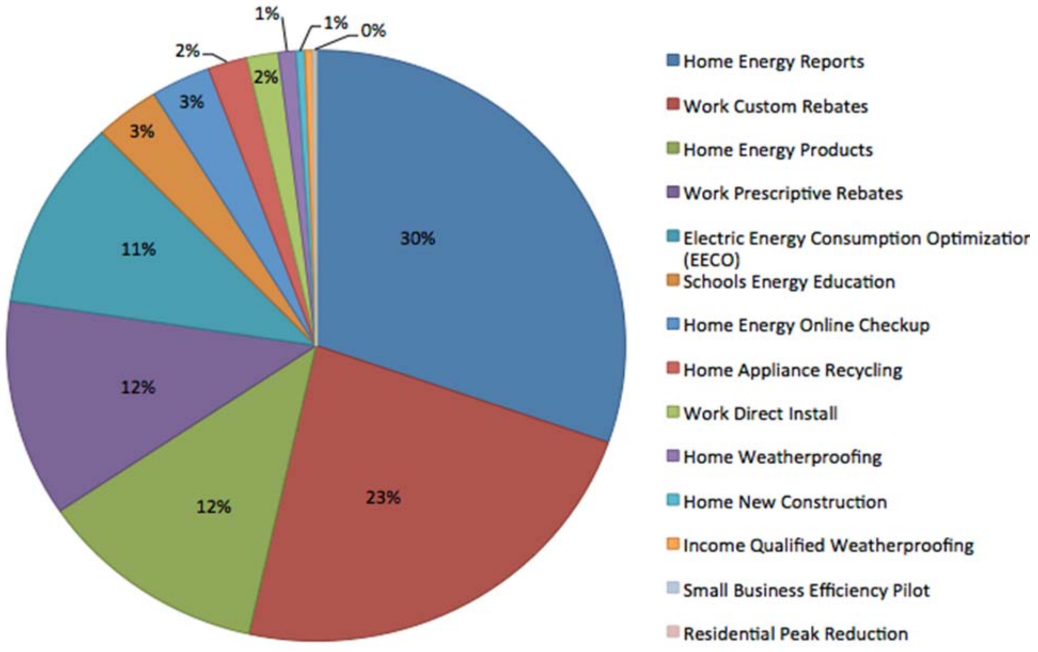
[6] Director's Final Report at page 5 (CAC Administrative Notice Exhibit 1).
[7] *Id*. at 6.
[8] Indiana Michigan Power Integrated Resource Planning Report to the Indiana Utility Regulatory Commission, November 2, 2015 (CAC Administrative Notice Exhibit 2), page 91.
[9] Petitioner's Verified Petition, page 4, paragraph 9.

Table 1. I&M Proposed 2016 DSM Programs

Residential Programs		Non-Residential Programs	
1.	Home Energy Products	1.	Work Prescriptive Rebates
2.	Income Qualified Weatherproofing	2.	Work Custom Rebates
3.	Schools Energy Education	3.	Work Direct Install
4.	Home Appliance Recycling	4.	Electric Energy Consumption Optimization
5.	Home New Construction	5.	Small Business Efficiency Pilot
6.	Home Weatherproofing		
7.	Home Online Energy Checkup		
8.	Home Energy Reports		
9.	Residential Peak Reduction		
10.	Home Comfort & Efficiency Pilot		

Chart 1. I&M Proposed 2016 DSM/EE Plan Energy Savings



Q. How much energy does I&M propose saving in its 2016 Plan, and how does that compare to the former Energy Efficiency Resource Standard ("EERS") established by the IURC's December 9, 2009 Order?

A. I&M proposes saving 141 gigawatt-hours in 2016, as shown in Table 2. I&M's proposed goal is lower than both the I&M Updated Action Plan for Electric Demand Side Management (DSM) Programs: Final Report[10] ("Action Plan") and the former EERS. This is not reasonable and not in the public interest to leave cost effective energy efficiency on the table. I&M's portfolio is dominated by its Home Energy Report and Work Custom Rebates programs, as shown above in Chart 1, which is becoming a concerning trend as shown in Chart 2, below.

Table 2. I&M Efficiency Goals and Former EERS

	GWh	**% of sales[11]**
2014 Savings	127	0.69%
2015 Goal	155	0.85%
2015 Year To Date[12]	69	0.38%
2016 Goal[13]	141	0.77%
2016 Action Plan[14]	236	1.3%
2016 Former State Target[15]	225	1.2%

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[10] I&M Discovery Request Response to CAC Set 1, Q6, Updated Action Plan (Exhibit NM-2).

[11] All savings are calculated as a percent of 2014 retail sales, including all sales to industrial customers as reported on I&M EIA Form 861.

[12] Based on I&M December Oversight Board meeting, which provided savings through October 2015. I&M DSM/EE Program Scorecard October 2015 (Exhibit NM-3).

[13] I&M Witness Walter's Testimony, Attachment JCW-2.

[14] I&M Discovery Request Response to CAC Set 1, Q6, Updated Action Plan (Exhibit NM-2).

[15] Cause No 42693-S1, Submission of Redacted MCR Report, Figure 3, June 27, 2013, available at:

Q. How does I&M's 2016 goal compare to its 2015 goal?

A. I&M's 2016 goal is lower than the 2015 goal. I&M has eliminated six programs from its portfolio since 2014, and is concentrating more and more of its savings into fewer programs, such as the Home Energy Report program and Work Custom Rebates program. This is concerning because, for example, I&M is proposing to halve the energy efficiency goal for its residential low income program, and double the Home Energy Reports program from 2015-2016. I will discuss this in more detail below. Shifting the majority of the portfolio savings into a few programs may not provide robust energy efficiency opportunities to all of I&M's customers, and may create a very cost-effective but unreasonably unbalanced portfolio that is not in the public's interest.

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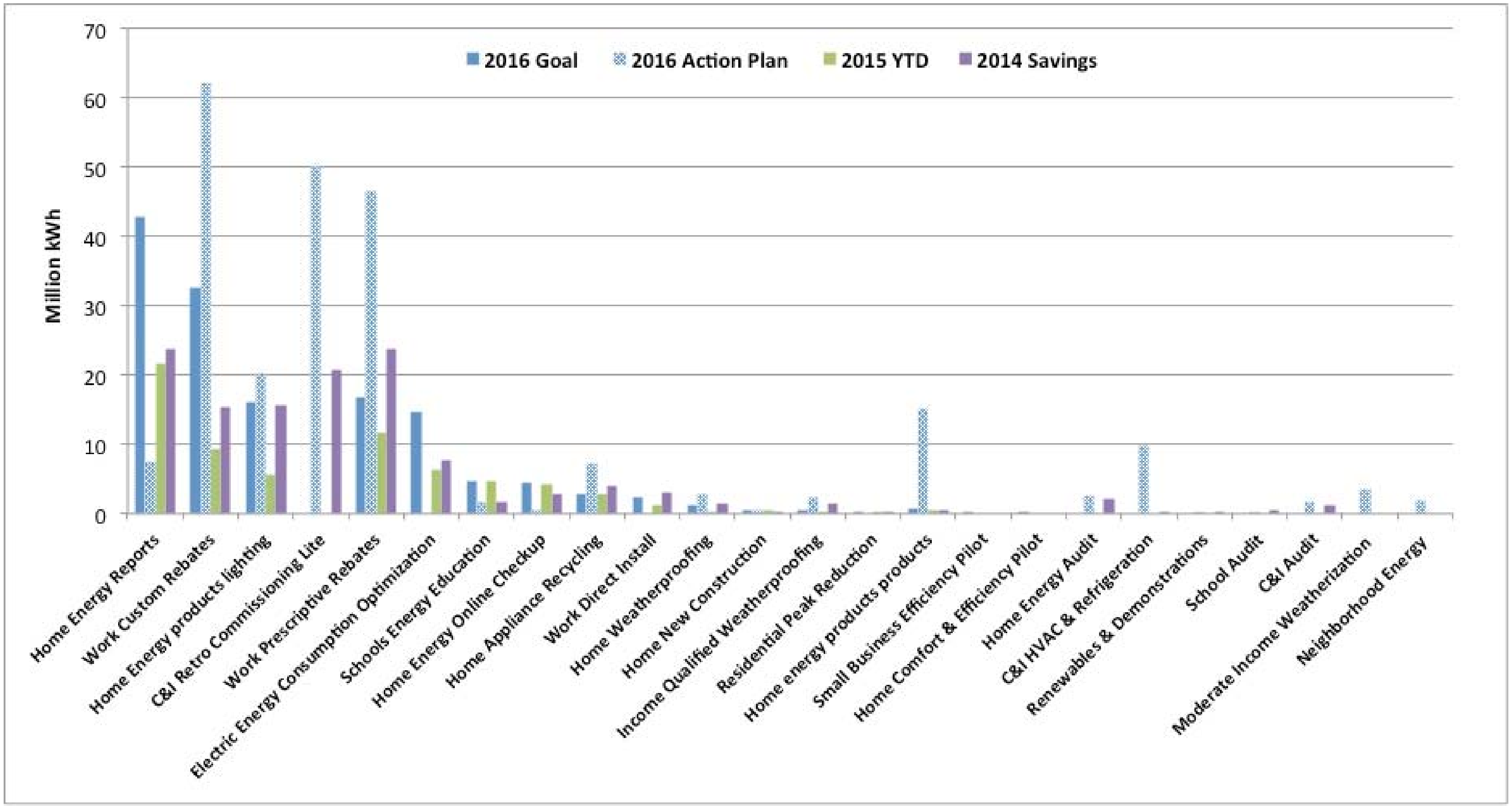
https://myweb.in.gov/IURC/eds/Modules/Ecms/Cases/Docketed_Cases/ViewDocument.aspx?DocID=0900b631801a1dfc (CAC Administrative Notice Exhibit 3).

Chart 2. I&M Program Comparison 2014-2016[16]



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[16] I&M Data Request Response to CAC 4-01. I and M DSM EE Program Score Card – EMV December 3.16.15.xlsx (Exhibit NM-4); I and M DSM EE Program Scorecard October 12.08.15.xlsx (Exhibit NM-3); I&M Data Request Response to CAC 1-06 Final Report – Updated Action Plan.pdf (Exhibit NM-2); I&M Witness Walters Testimony, Attachment JCW-2. Please note that 2015 year-to-date (YTD) savings are savings up to October 2016, the latest data available.

Table 3. I&M EE Program Impacts and Savings as a Percent of Sales[17,18]

	2014 Savings		2015 YTD		2016 Goal		2016 Action Plan	
	GWh	% Portfolio Savings	GWh	% Portfolio Savings	GWh	% Portfolio Savings	GWh	% Portfolio Savings
Home Energy Reports	24	19%	22	31%	43	30%	8	3%
Work Custom Rebates	15	12%	9	13%	33	23%	62	26%
Home Energy Products Lighting[19]	16	12%	6	8%	16	11%	20	9%
Home Energy Products Products	1	<1%	<1	1%	1	1%	15	6%
Work Prescriptive Rebates	24	19%	12	17%	17	12%	47	20%
EECO	8	6%	6	9%	15	10%	0	0%
Schools Energy Education	2	1%	5	7%	5	3%	2	1%
Home Energy Online Checkup	3	2%	4	6%	4	3%	<1	<1%
Home Appliance Recycling	4	3%	3	4%	3	2%	7	3%
Work Direct Install	3	2%	1	2%	2	2%	Not offered	
Home Weatherproofing	1	1%	<1	<1%	1	1%	3	1%
Home New Construction	<1	<1%	<1	1%	1	<1%	<1	<1%
Income Qualified Weatherproofing	2	1%	<1	<1%	1	<1%	2	1%
Res. Peak Reduction	0	0%	<1	<1%	<1	<1%	0	0%
Home Comfort and Efficiency Pilot	Not offered		Not offered		<1	<1%	Not offered	
Small Business Efficiency Pilot					<1	<1%		
Res. Neighborhoods					Not offered		2	1%
Moderate Income Weatherization							4	2%
Home Energy Audit	2	2%					<1	1%
C&I Retro Commissioning Lite	21	16%					50	21%
C&I HVAC Refrigeration	<1	<1%					10	4%
Renewables & Demonstrations	<1	<1%					<1	<1%
School Audit	1	<1%					<1	<1%
C&I Audit	1	1%					2	1%

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[17] I&M Data Request Response to CAC 1-04, I and M DSM EE Program Score Card – EMV December 3.16.15.xlsx (<u>Exhibit NM-4</u>); I and M DSM EE Program Scorecard October 12.08.15.xlsx (<u>Exhibit NM-3</u>); I&M Data Request Response to CAC 1-06 Final Report – Updated Action Plan.pdf (<u>Exhibit NM-2</u>); I&M Witness Walter Testimony, Attachment JCW-2.

[18] Programs that achieve less than one GWh of savings are shown as <1 in the table.

[19] Residential lighting is a component of home energy products program. *See* I&M Witness Testimony, Attachment JCW-3 Program Tables.

C&I Peak Reduction	<1	<1%					<1	<1%
Total	127	100%	69	100%	141	100%	237	100%

Q. How much peak demand reduction does I&M propose in its 2016 Plan?

A. I&M proposes about 31 megawatts in peak reduction in 2016 in its Residential Peak Reduction Program.[20] Interestingly, this program does not pass the Ratepayer Impact Measure (RIM) Test. This is unusual for a demand response program as DR programs typically save capacity without saving much energy, which can create high amounts of lost revenues (costs in the RIM calculation). In a typical DR program, the RIM test is above one because there are relatively few lost revenues, yet this is not the case for I&M's demand response programs, including the Residential Peak Reduction Program. The program receives little lost revenues as it does not save much energy – in 2016, I&M estimates that the program will create $2,253 of net lost revenues (using the half year convention). There is not a discussion in the application about why this program does not pass any of the cost-effectiveness tests, nor is there an explanation as to what costs and benefits are used to calculate the benefit-cost ratios (although in I&M's 2013 Action Plan which is Exhibit NM-2, the program was expected to have a TRC of 1.5). Even with this program, the portfolio remains cost-effective; however, it would be beneficial if I&M provided more detail as to why this program is not cost-effective.

Another observation is that I&M's data is ambiguous about if the Residential Peak Reduction Program has energy savings. In the Action Plan which is Exhibit NM-2, there are no energy savings associated with the

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[20] I&M Witness Walter Testimony, Attachment JCW-2.

Residential Peak Reduction Program as shown in Table 3 above. In response to a CAC data request, I&M indicated that there were energy savings in 2010 associated with this program, but not in any other year.[21] However, in the 2014-2015 Oversight Board information, and in this application, I&M attributed 30-60 MWh[22] of annual energy savings to this program.

Q. What are the new energy efficiency programs I&M is proposing in this filing?

A. I&M is proposing two pilot programs, the Home Comfort & Efficiency Pilot and the Small Business Efficiency Pilot. The goal of the Home Comfort & Efficiency Pilot is to evaluate and verify the cost and energy savings associated with residential HVAC zone control through devices, thermostats, or other technology such as mini split ductless heat pumps. The goal of the Small Business Efficiency Pilot is to engage smaller business customers and encourage their participation in the Work Direct Install Program.

Currently neither of these pilot programs are cost-effective under the TRC or UCT, but the overall portfolio remains cost-effective even with the inclusion of these programs. I applaud I&M for exploring additional program offerings, and encourage them to strive to make the programs cost-effective as they gain experience with program implementation.

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[21] I&M Discovery Request Response to CAC 5-02, DSM Historic Performance in Forecast.xls (Exhibit NM-5).

[22] Because these savings are less than 1 GWh, the range of 30-60 does not show up in Table 3.

Q. **Are there additional opportunities for energy efficiency beyond what the Company is proposing here?**

A. Yes, I&M could save much more energy than it projects, which makes I&M's plan unreasonable and not in the public interest for several reasons. First, I&M's Action Plan (Exhibit NM-2) identified that the Company could, in 2016 alone, achieve more than 1.5 times as much energy efficiency, or 95 GWh more than what it is proposing here.[23] Second, I&M has opportunities to modify its existing programs to achieve greater savings. Third, there are new programs I&M can offer to reach markets that it is not currently serving.

Q. **Are there opportunities for additional savings within the existing efficiency budget?**

A. Yes. It appears that I&M could simply spend its entire planned budget and achieve more efficiency. As of December 2014, I&M has under recovered almost $17M. While this may appear to be beneficial to consumers, under investing in the most cost-effective resources available to the utility does not help customers, it hurts them. Concurrently, I&M barely achieved is 2013 energy efficiency goals, did not achieve its 2014 goals, and does not appear to be on track to achieve its 2015 goals, shown in Table 4 below.

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[23] I&M Discovery Request Response to CAC 1-06, Updated Action Plan, Tables 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40, 43, 47, 50, 53, 56, 59, 62, 65, and 68 (Exhibit NM-2). Savings are not listed as net or gross.

Table 4. I&M Energy Efficiency Performance 2012-2015

	% to Goal of Gross Energy Impacts
2012	62%
2013	101%
2014	80%
2015 YTD	44%

This under recovery and under performance begs the question as to why I&M did not reallocate funding to successful programs in underperforming years, or try new program delivery and implementation options to achieve its efficiency goals. As I discuss more below, there are many opportunities for I&M to use this funding on cost-effective energy efficiency programs.

Q. Are the efficiency impacts identified in I&M's Action Plan still valid given the change in program administration resulting from Senate Enrolled Act 340 and Senate Enrolled Act 412?

A. Yes. While the 2016 residential savings in the Action Plan (Exhibit NM-2) are approximately the same as what I&M is proposing in this application, the proposed savings, as mentioned above, are concentrated in just a few residential programs. Notably, the Home Energy Reports Program will comprise 57% of the residential savings for 2016, and the lighting component of the Home Products Program comprises 22%. While these are both cost-effective programs, I am concerned that the concentration of almost 80% of residential savings in two programs may not be a prudent efficiency decision.

It is important to note that the Action Plan (Exhibit NM-2) did not take into account non-residential customers' ability to opt-out when evaluating I&M's

efficiency potential. The reduction in eligible sales, due to customers opting-out of participating in I&M's non-residential program, does reduce the amount of C&I energy efficiency the Company is able to achieve.

Q. Did I&M make reasonable adjustments to its Action Plan to respond to Senate Enrolled Act 340 and non-residential customer opt-out?

A. No. Based on I&M's Discovery Request Response to CAC, only ten percent of its eligible C&I customers have opted out their energy efficiency programs, yet I&M's 2016 DSM plan proposes a C&I energy efficiency goal that is 100 GWh, or approximately forty percent less than the identified Action Plan savings for 2016, shown in Table 5.[24]

Table 5. 2016 Commercial & Industrial DSM and Action Plan Goal (GWh)

	Action Plan	**Proposed Goal**
Work Custom Rebates	62.1	32.8
Work Prescriptive Rebates	46.6	16.8
EECO	0	14.7
Work Direct Install	2.3	0
Small Business Efficiency Pilot	0	0.1
Renewable & Demonstration	0.02	0
C&I Peak Reduction	0	0
C&I Retro Commissioning Lite	50.0	0
C&I HVAC and Refrigeration Optimization	9.9	0
C&I Audit	1.8	0
EE Schools Audit	0.1	0
Total	169.0	66.7

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[24] I&M Discovery Request Response to CAC 1-11, Attachment 1 (Exhibit NM-6).

Clearly, even after reducing the C&I savings by ten percent, adopting Action Plan levels of energy efficiency, including more diverse residential program offerings, will result in I&M achieving additional cost-effective savings in 2016. While the level of savings identified in the Action Plan may not be achievable in 2016, particularly because the Company filed its application so late in 2015, it is a reasonable longer-term goal for I&M to achieve the level of savings that were identified as being cost-effective in the Action Plan (Exhibit NM-2).

Q. What existing programs can I&M modify to increase savings?

A. I&M should improve their Residential New Construction Program, increase their low income program budget to 2015 levels, and improve their low income program implementation.

Q. How should I&M modify its Residential New Construction Program?

A. In 2014, I&M began their Residential New Construction Program, and it underperformed, reaching approximately 45% of its unit goal for 2014 by providing rebates to 204 out of a targeted 449 homes. This corresponded to reaching 80% of the program budget goal, 41% of its kWh goal, and more than 300% of its kW goal.

In 2015, as reported at the October Oversight Board/Public Stakeholder meeting,[25] I&M had more participants than in 2014, but the program was still underperforming. I&M determined in the third quarter of 2015 that it would reduce its goal for new construction participation. The program, according to

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[25] I&M DSM/EE Program Scorecard October 2015 (Exhibit NM-3).

I&M 2014 EM&V,[26] is based off of NIPSCO's program and both programs are administered by CLEAResult. One of the perspectives offered in I&M's 2014 EM&V was that there were problems with builder recruitment because, curiously, builders participating in NIPSCO's program and who also build houses in I&M's territory were not participating in the program with I&M. This was attributed to 2014 being the first year of program operation, but it is unclear if this was an issue that was resolved in 2015.

Table 6. Estimated and Actual Residential New Construction Participation

	2014[27]	**2015**[28]	**2016**[29]
Housing Starts[30]	119,128	119,628	120,285
Goal (units)	449	449	360
Actual (unit)	204	280	N/A
Goal (percentage of starts)	0.4%	0.4%	0.3%
Actual (percentage of starts)	0.2%	0.2%	N/A

I&M should increase its efforts to reach new home builders with this program as they are barely scraping the surface of the new housing market in the

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[26] I&M Witness Walter Testimony, Attachment JCW-11, 2014 PY5 Core Plus EM&V Report, pages 612-613.

[27] *Id*. at 613.

[28] I&M DSM/EE Program Scorecard October 2015 (Exhibit NM-3).

[29] I&M Witness Walter Testimony, Attachment JCW-3, 2016 DSM Plan Program Tables. -.

[30] "Housing starts" mean the number of new houses begun during a particular time period. I&M Discovery Request Response to CAC 8-01, I&M Housing Stock Statistics for Counties in Service Area (Exhibit NM-7). Single family homes only listed in Table 6 to err on side of caution because program is only available to residential single family, duplexes and end units of multiple family homes.

counties that I&M serves in Indiana. Best practice residential new construction programs have reached 25-30% of new housing starts since the economy has bounced back from the recession.[31] Further, the NIPSCO program that I&M's program is based off of should achieve 90% of its goal in 2015, which will likely surpass I&M's goal. This level of performance is indicative of what I&M's program is capable of. I strongly suggest that I&M, instead of reducing their new construction goal, adopt best practices from the region and country to achieve higher participation rates.

Q. What are your recommendations for I&M's 2016 low-income program, budget, and program implementation?

A. I&M currently plans to offer an Income Qualified Weatherproofing Program, which is, and will be, available to customers at or below 200% of the Federal Poverty Line. The program offers similar measures to the Home Weatherization Program, but targets income qualified electric heat customers and pays 100% of the cost of the improvements. In its application, I&M stated that customer participation was a challenge and that the Company will provide targeted outreach and seek partnerships with community organizations in the hopes of improving participation during the fall of 2015.[32] The Company's October 2015 Oversight Board scorecard (Exhibit NM-3) indicates that the program is still at 0% of its goal of 1 GWh of savings, and has spent ~$193,000 on the program. In 2016, the

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[31] York, et al. Expanding the Energy Efficiency Pie: Serving More Customers, Saving More Energy Through High Program Participation. American Council for an Energy Efficiency Economy. January 2015.

[32] I&M Witness Walter Testimony, page 29, lines 12-20.

Company anticipates cutting the budget and the savings target in half, shown in Table 7, which seems like the incorrect solution to the participation problem; particularly as there are an ample number of qualified customers in I&M's service territory to participate in the program as shown in Table 8. This raises many questions about the quality of I&M's delivery and administration of programs.

Table 7. I&M Income Qualified Weatherization Budget and Savings Goals

	2015	2016[33]
Budget	$1,205,905	$567,971
MWh	1,030	589

Table 8. Poverty Levels in I&M Service Territory

City/State	Percent of Population Below Poverty Line (2014)
Fort Wayne[34]	18.7%
Muncie[35]	33.4%
Indiana[36]	15.4%
Detroit, MI[37]	39.3%
Michigan[38]	16.8%
South Bend, IN[39]	27.8%
Marion, IN[40]	26.0%

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[33] I&M Witness Walter Testimony, Attachment JCW-2.
[34] http://quickfacts.census.gov/qfd/states/18/1825000.html
[35] http://quickfacts.census.gov/qfd/states/18/1851876.html
[36] http://quickfacts.census.gov/qfd/states/18/1851876.html
[37] http://quickfacts.census.gov/qfd/states/26/2622000.html
[38] http://quickfacts.census.gov/qfd/states/26/2622000.html
[39] http://quickfacts.census.gov/qfd/states/18/1871000.html
[40] http://quickfacts.census.gov/qfd/states/18/1846908.html

Based on the fact that there appears to be a great need in I&M's service territory, yet there is a lack of participation in I&M's low income program, I recommend that it adopt new delivery mechanisms for its existing program and increase its budget and savings goals to 2015 levels, at a minimum. Further, because the program currently only targets electric heat customers, I&M should coordinate its low-income offering with the gas companies that serve its customers. Doing so would likely improve the cost-effectiveness of the program since it will leverage gas and electric measures simultaneously, and it will broaden the number of potential participants.

DTE Energy, a Michigan based utility, provides a great example of how I&M might modify, instead of reducing, its low income program. DTE offers a Low Income Self-Sufficiency Program (LSP) to customers that fall <110% - 150% of the poverty line. The program links DTE's utility bill assistance with energy efficiency program offerings, which helps lower customer bills and stretch bill assistance dollars further.

First, DTE uses its bill payment assistance program to inform customers of energy efficiency opportunities. Working through bill assistance creates income qualified leads for DTE's EE programs, and customers are more likely to participate because they already have a relationship with bill assistance. DTE's bill payment assistance program is only provided to customers that fall at or below DTE's consumption cap, and when customers begin to hit the consumption cap, DTE encourages them to participate in efficiency programs to reduce their consumption. The consumption cap is set based at the average Detroit residential energy consumption. DTE offers four low-income programs to reduce customer consumption:

(1) Weatherization. Customers receive a full home audit that determines what improvements are needed, upgrades are provided at no cost. Similar to I&M's Residential Weatherproofing and Income Qualified Weatherproofing Program, the DTE program focuses on measures such as: energy efficient lighting, insulation, air sealing, programmable thermostats and hot water saving devices. In addition, DTE also offers incentives on high efficiency heating equipment, which I&M includes in their Home Energy Products Program.

(2) Lighting Distribution. DTE partners with local food banks to distribute LEDs and CFLs to clients coming to pick up food from the food bank. High efficiency light bulbs are offered to these customers at no cost.

(3) Refrigerator Replacement. DTE replaces old refrigerators at no cost and recycles the unit. I&M could modify their existing appliance recycling program by offering unit replacement for refrigerators exceeding a certain age.

In addition to using bill assistance to generate efficiency program participation, DTE's LSP program provides customers with the option for a fixed monthly bill, based on their income. The bill ranges from $50-60 per month for customers that are <110 - 150% of the federal poverty line, and receive only electric service from DTE. This range of bill puts the customer's energy bill at six percent or less of the customer's income, a level DTE has identified as an affordable energy burden. Finally, DTE eliminates 1/16th of the customer's pre-program arrears for each quarter they participate in the program, and keep their consumption below Detroit's average residential consumption. Effectively, if the customer stays in the program for four years, all pre-program arrearages will be forgiven.

The funding to pay the difference between the customer's fixed payment and the actual bill is partially provided through a grant from the state of Michigan, so identification of a funding source for the fixed bill component of the program is necessary. DTE has identified a number of non-energy benefits that accrue to all customers due to the LSP program offerings including: reduced truck rolls to turn energy on and off, reduced customer service phone time, and reduced carrying costs on arrearages.

The Low Income Self Sufficiency Program has been very successful in keeping customers out of the disconnect cycle, bringing the service disconnect rate for customers down to two percent, as compared to 55 percent with other low income program offerings. Further, 97% of these customers are able to keep their energy consumption at or below the Detroit residential average energy consumption, as compared to 50 percent with other low income program offerings.

Q. What additional programs and measures should I&M offer?

A. There are many additional program opportunities that I&M should pursue, including: (1) low income neighborhood and moderate income weatherization programs identified in I&M's Action Plan; (2) an upstream manufactured home program; (3) a multifamily program; (4) a modified version of Energizing Indiana Third Party Administrator's school audit direct install program; and (5) a self-direct program for non-residential customers. I will discuss each of these recommendations in detail below.

Q. What is your recommendation regarding the Residential Neighborhood and Moderate Income Weatherization programs that were included in I&M's Action Plan?

A. In the 2013 update to I&M's Action Plan, one of the program recommendations was the "Residential Neighborhoods" program. This program is targeted primarily to households at or below 150 percent of poverty. The program offers similar measures to the proposed Income Qualified Home Weatherproofing, but the implementation is neighborhood focused. The program administrator identifies a specific neighborhood with approximately 60 percent low-income customers and approaches local leaders in an organized effort to secure community participation. I&M's consultant estimated that this program would save 1.8 GWh in 2016.[41]

Another program is the "Moderate Income Weatherization" program. This program provides a home weatherization inspection audit, blower-door leak tests, and recommendations to the homeowner for incented weatherization measures. This program targets electrically heated homes that have incomes above the qualification criteria for the Core Income Qualified Weatherization program but below 300% FPL. The program is designed to ensure the retrofit installation of

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[41] I&M Discovery Request Response to CAC DR 1-6, Updated Action Plan, page 80 (Exhibit NM-2).

major weatherization measures in households. I&M's consultant estimated that this program would cost-effectively save 3.6 GWh in 2016.[42]

Based on the Oversight Board/Public Stakeholder program reports, it does not appear that I&M offered either of these programs in 2014 or 2015. It is unclear why I&M did not adopt these programs if their consultant's report which is paid for by ratepayers included this recommendation. It is also unclear if I&M considered shifting from its current low income program to either of these programs to increase participation.

I recommend that I&M re-evaluate if these are appropriate programs to offer, and provide an explanation if the Company finds they are not appropriate. In particular, the Residential Neighborhood program is generally cost-effective when implemented in other jurisdictions; so unlike I&M's existing low-income weatherization program, it provides cost-effective benefits both to program participants and to all customers through system wide fuel and energy reductions. Subsequently, I&M should consider offering this program in addition to the Moderate Income Weatherization and modified low income weatherization program with better delivery mechanisms discussed above.

Q. What are your recommendations for an upstream manufactured home program?

A. I am aware that I&M's Action Plan shied away from making a new manufactured home program recommendation due to the "relatively small stock and yearly

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[42] I&M Discovery Request Response to CAC DR 1-6, Updated Action Plan, page 62 (Exhibit NM-2).

increment of manufactured homes in I&M's territory."[43] However, I am skeptical of this conclusion given that there are approximately 33,000 new manufactured homes installed per year in the counties that I&M serves.[44] While this may only represent five percent of new housing starts, I believe the highly cost-effective savings that are available are worth investing in.

Further, given the use of manufactured homes as affordable housing and I&M's poor performance serving its low income customers with EE programs, it is a critical opportunity that I&M should not dismiss. Robust EE programs for low- and fixed-income households are essential to ensuring that all customers are able to afford basic utility service on a sustainable basis, particularly because low-income residents tend to live in less efficient housing. Given the absence of a program that serves the new manufactured home market, I recommend I&M implement an upstream efficiency program that is targeted at manufactured home producers, similar to a program offered by the Tennessee Valley Authority ("TVA"). In TVA's program, it pays the manufacturer of the homes to build homes to ENERGY STAR or ENERGY STAR plus standards. When the consumer purchases a new home, there is no cost differential between the heat pump version and the electric resistant heat version, yet there are tremendous

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[43] I&M Discovery Request Response to CAC DR 1-6, Updated Action Plan, page 63 (Exhibit NM-2).
[44] I&M Data Request Response to CAC 8-01 (Exhibit NM-7).

energy savings. TVA estimates each home saves approximately 12,000 kWh a year.[45]

I&M should also consider Idaho Power's Rebate Advantage program, where customers that purchase new all-electric ENERGY STAR manufactured homes receive a $1000 sales rebate and sales consultants receive a $200 sales bonus every time they sell a new all-electric ENERGY STAR manufactured home to an Idaho Power customer.[46]

Finally, I&M should clarify that its Home Energy Products, Home Weatherproofing, Home Energy Reports, Home Online Energy Checkup Income Qualified Weatherproofing, and Home Comfort & Efficiency Pilot, are in fact available to manufactured home owners and renters.

Q. What is your multi-family program recommendation?

A. I&M could target a program at the traditionally hard to reach affordable, existing multi-family buildings. I&M allows multifamily tenants and owners to participate in a few of its proposed programs,[47] but does not offer a program specifically targeting this sector. A nationwide effort, led by the Natural Resource Defense Council and The National Housing Trust, has created a program that is referred to as Energy Efficiency For All. In Minnesota, Xcel Energy and Centerpoint Energy

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[45] ACEEE's Third National Review of Exemplary Energy Efficiency Programs, June 2013, http://bit.ly/18jRRhL.

[46] Idaho Power, 2014 DSM Annual Report, http://www.puc.idaho.gov/fileroom/cases/elec/IPC/IPCE1404/20140317DSM%20ANNUAL%20REPORT%202013.PDF.

[47] Home Energy Products Program allows multifamily tenants or owners in buildings with less than 12 units to participate in the program; Residential Peak Reduction Program allows multifamily homeowners to participate, and the Home New Construction allows end units of multifamily buildings to participate.

used the NRDC/National Housing Trust program model to develop a program targeted at multifamily building owners that created a “one-stop shop” for building efficiency improvements.[48]

Franklin Energy, the Minnesota utilities’ implementer, works with a building owner to conduct a building assessment to identify efficiency improvements and, at the same time, direct installs efficient lighting and low-flow water equipment. The implementer then identifies efficiency opportunities and develops a series of upgrade options to achieve various energy savings levels. The information is presented to the building owner in the form of a pre-approval of the potential projects. Building owners that have multiple properties can work with the program implementer to prioritize buildings based on the size of the efficiency opportunity.

The building owner selects improvements and the implementer creates job specs, a timeline, assesses bids by contractors and assists the building owner with selecting a winning bid. After the contractor performs the efficiency improvement, the implementer oversees QA/QC to ensure that the improvements were made correctly. After the program implementer certifies that the improvements were correctly made, the building owner receives the incentive payment. Xcel Energy and Centerpoint Energy provide tiered incentives based on the amount of energy saved, as shown in Table 9 below.

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[48] Minnesota Department of Commerce, Docket No. E, G-002/CIP-12-477 and Docket No. G-008/CIP-12-564. Request for Modification: Proposing a New Multi-Family Building Efficiency Program. Filed February 20, 2015, approved May 27, 2015.

Table 9. Xcel Energy and Centerpoint Energy Multifamily Incentives[49]

Achievement Level	Whole-Building Energy Savings Achieved	Incentive Level	Low Income Incentive Level
Tier 1	15%	25% of cost	50% of cost
Tier 2	20%	35% of cost	70% of cost
Tier 3	25%	40% of cost	80% of cost

The incentive level is applied to the total cost of installing approved energy related measures; and if the building is qualified as low income, it is eligible for twice as much incentive. As proposed, the program was cost-effective for Xcel's and Centerpoint's gas and electric customers, shown in Table 10, and the utilities will conduct EM&V at the end of 2016 to evaluate the program performance.

Table 10. Xcel and Centerpoint Energy Benefit-Cost Scores

Utility	**TRC**		**UCT**	
	2015	2016	2015	2016
Xcel Electric	0.95	1.08	1.25	1.50
Xcel Gas	N/A		0.92	0.92
Centerpoint Gas	N/A		1.31	1.56

In December 2015, a similar program was approved for Consumer Energy by the Michigan Public Service Commission.[50] Consumer Energy also focused on the "one stop-shop" delivery mechanism, and will offer similar incentives for installation of multiple measures, participation by subsidized income qualified properties and unsubsidized affordable housing. Consumer Energy anticipates that

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[49] http://www.xcelenergy.com/Energy_Solutions/Business_Solutions/Customized_Solutions/Multi-Family

[50] Michigan Public Service Commission, Order Approving Settlement Agreement, Case No. U-1771. December 22, 2015. Available at http://efile.mpsc.state.mi.us/efile/docs/17771/0031.pdf

it will save 7.8 GWh with this program in 2016 alone, significantly more than the 1.1 GWh that I&M proposes it will save with its Income Qualified Weatherproofing and Home Weatherproofing combined.

Finally, based on a May 2015 report by the Natural Resource Defense Council, this type of affordable multifamily program could save 19-32% of electricity, relative to sales forecast in 2034, in Illinois and 26-37% in Michigan.[51] The report did not look at the efficiency opportunity in Indiana, but these two neighbor states are a strong indicator of the significant savings associated with multifamily energy efficiency.

Q. Please describe your non-residential school audit direct install program recommendation.

A. I&M should re-implement its School Audit Direct Install program. In 2014, I&M (through its Third Party Administrator) achieved over 415 net MWh with the School Audit Direct Install (SADI) Program, a program that provided audits and direct installation of certain measures in schools.[52] This equates to over 560% of I&M's goal for this program. Based on I&M's 2014 EM&V, the SADI program offered direct installation of: vending machine timers, smart power strips with

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[51] Potential for Energy Savings in Affordable Multifamily Housing Final Report. Prepared for NRDC by Optimal Energy, May 2015. Available at http://www.energyefficiencyforall.org/sites/default/files/EEFA%20Potential%20Study.pdf

[52] 2014 Energizing Indiana Evaluation Report, May 1, 2015, page 104, Table 134, available at: https://myweb.in.gov/IURC/eds/Modules/Ecms/Cases/Docketed_Cases/ViewDocument.aspx?DocID=0900b631801c7d3d (CAC Administrative Notice Exhibit 4).

occupancy sensors, CFLs, room occupancy sensors and LED exit signs.[53] The SADI program is different than I&M's Energy Efficient School program because the SADI program focused on the installation of measures at the school, while I&M's Energy Efficient School program focuses on student education and outreach. The 2014 EM&V report found that when evaluating spillover, 96% of the recommendations offered in the audit were not eligible for an energy efficiency program incentive.[54] For I&M, there were 243 MWh of savings that schools took on their own accord and that showed up as spillover.[55] While it is fantastic that these schools implemented measures without incentives, it is likely that even more uptake would occur if the School Audit and Direct Install program, or Work Prescriptive program, offered incentives to cover these measures. In fact, the number one recommendation for the program in the 2014 EM&V report was to consider providing financing mechanisms.[56] While rebates are not financing, they certainly reduce the upfront capital required to make energy efficiency investments. The most common measures identified in the audit that were installed by schools were: lighting, air temperature controls and information technology.[57] Other measures installed in the 2-5 year timeframe were: occupancy sensors, HVAC, and building re-commissioning.[58] At minimum, I&M should consider offering incentives on these measures through their Work

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[53] *Id*. at 83-84.
[54] *Id*. at page 103.
[55] *Id*. at page 104.
[56] *Id*. at 120.
[57] *Id*. at 118.
[58] *Id*. at 103.

Prescriptive Program to reduce the upfront capital cost for schools to install these measures.

Q. Please discuss your non-residential self-direct program recommendation.

A. I&M should offer its large customers a self-direct program, particularly because of its low opt-out rate. In Cause No. 44310, a proceeding to investigate a self-direct program, the Commission found that:

> Based on the significant change in the statutory landscape and the resulting impact on the manner in which DSM programs are designed…we find that any further consideration of a structured self-direct DSM program for large customers should occur when an electricity supplier submits its plan for Commission approval.[59]

Energy efficiency is the lowest cost resource, and I&M should look for reasonably achievable ways to attract and retain energy efficiency program participation from their large customers. Accordingly, I recommend that I&M offer a self-direct program as it is reasonable and in the public's interest. It is worth mentioning that without revisions to the net lost revenue recovery, I do not think that any industrial customer will participate in an energy efficiency offering from any utility in Indiana.

Self-direct programs offered by other utilities could serve as models for I&M's program. For example, Rocky Mountain Power offers a self-direct credit program that is available to Utah business customers who meet minimum usage requirements of 5,000,000 kWh per year or have a peak load of at least 1,000 kW

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[59] IURC Cause No. 44310 Order of the Commission, May 20, 2015, available at https://myweb.in.gov/IURC/eds/Modules/Ecms/Cases/Docketed_Cases/ViewDocument.aspx?DocID=0900b631801c712b (CAC Administrative Notice Exhibit 5).

in the prior 12 months. Customers are responsible for providing the energy engineering work necessary to document the energy savings of proposed projects. Incentives of 50-80% of the eligible expense are provided in the form of credits used to offset the DSM Cost Adjustment surcharge on the monthly bill and are available for both new construction and retrofit projects.[60] In this example, participants in the self-direct program would opt-in to the utility program, and the customers would pay the DSM tariff, but then receive a credit to offset the tariff. The utility would be able to count the savings toward their efficiency goal, and the non-residential customers would be required to pay lost revenue. As I mentioned above, without a revision to the current lost revenue structure, this is not likely to be appealing to non-residential customers.

Another option with a self-direct program would be to continue to allow customers to opt out, but require that those customers opting out of the program achieve verifiable efficiency savings.

Q. **Do you have other recommendations for the self-direct program?**

A. Yes. As discussed in CAC's testimony in Cause No. 44310, (1) projects should generate capacity savings and not just time-shifting of energy consumption; (2) projects started prior to being approved as a self-direct project should not be eligible for funding or credit; and (3) self-direct customers should be required to

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[60] Evaluation Report for Utah's Self-Direction Credit Program (PY 2012 through 2013) Prepared by Navigant for Rocky Mountain Power, available at: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2015/Self-Direction_Program_Evaluation.pdf.

share their plans with the administrator or other parties interested in implementing similar projects, subject to scrubbing the plans for confidentiality.

Q. Do you have recommendations about self-direct EM&V?

A. Yes. I recommend that third party evaluation, measurement and verification occur on a comparable schedule to I&M's EM&V schedule and be required to use the same standards for data collection as I&M's efficiency programs. Important features of the EM&V are that it is consistent across customers, transparent and accountable. Without verification of energy efficiency savings, the reduction in load that occurs from these customers' energy efficiency projects will not be attributed to energy efficiency. This is important because it provides the utilities with an idea of how much energy their large customers are saving, and insight into how much they will save in the future. This is useful for system-wide planning and ensuring that the Company can provide Indiana ratepayers with the lowest cost, reliable electricity system. In fact, this Commission has recognized energy efficiency as "the most cost effective way of meeting future energy supply needs and [that it] has the corresponding benefit of reducing the need to build additional generation capacity."[61]

Further, without greater accountability, these customers that do not install energy efficiency measures on their own can act as "free riders" that receive, at no cost, the system-wide benefit of energy efficiency savings produced by participating customers. One of these system-wide benefits is the Demand Reduction Induced Price Effect ("DRIPE"), which refers to the price suppression

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[61] IURC Cause No. 42693, Phase II Order at 30 (December 9, 2009).

that occurs when reduced demand on a system reduces the market-clearing price, and the price paid by all load. Recent research on DRIPE found that a one percent reduction in load over Illinois and a large part of MISO would reduce Illinois market prices by about two percent. Specifically, a reduction in load in ComEd's territory would reduce ComEd's generation bills by 36-70% of the ComEd avoided energy cost.[62]

Q. In Phase II of Cause No. 44441 regarding requests for Commission consideration of other issues related to or arising as a result of the industrial customer opt out provided for in Senate Enrolled Act 340, the Commission ruled that a number of issues were not appropriate for consideration in that docket, but that they may be appropriate issues to discuss in individual utility DSM tracker or program approval proceedings.[63] What are those issues?

A. There were seven (of nine) issues presented by CAC that the Commission identified as being potentially appropriate to discuss in program approval proceedings:

- Issue 1–the impact on regulated electric utilities and customers of a utility resource portfolio that does not include industrial energy efficiency resources;
- Issue 2–whether industrial customers that opt out should be considered "free riders" and continue paying the fixed costs of DSM programs;

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[62] Resource Insight Memorandum on Analysis of Electric Energy DRIPE in Illinois, September 2014, available at: http://switchboard.nrdc.org/blogs/pkenneally/IL%20DRIPE%20Memo%20Final.pdf.

[63] IURC Cause No. 44441, Phase II Order at https://myweb.in.gov/IURC/eds/Modules/Ecms/Cases/Docketed_Cases/ViewDocument.aspx?DocID=0900b631801bcbda (CAC Administrative Notice Exhibit 6).

- Issue 4–whether and how energy and demand savings from industrial customers that opt out can be used by regulated electric utilities in the IRP process;
- Issue 6–whether the Commission should adopt rules or guidelines to assist customers in complying with the opt out provision in SEA 340 or to require opt out customers to provide EM&V reports concerning the customers' own energy efficiency measures;
- Issue 7–whether an oversight board should be established to monitor and evaluate compliance with SEA 340;
- Issue 8–determination of a mechanism to be used by opt out customers to pay for the regulated electric utilities' administrative expenses related to implementing the opt out provisions; and
- Issue 9–establishment of criteria for determining "reasonable and cost effective" DSM programs and the role of various oversight boards in developing DSM programs.

Q. Would you like to discuss any of these issues from Cause No. 44441, Phase II?

A. Yes, I would like to discuss two issues in this testimony: issue six, specifically, whether the Commission should adopt rules or guidelines to assist customers in complying with the opt out provision in Senate Enrolled Act 340; and issue nine, specifically, reasonable and cost-effective DSM programs.

Q. Please describe the status of opt-outs by large customers from I&M's programs.

A. Qualifying industrial and large commercial customers may opt out of I&M's efficiency programs and associated rider by providing the Company with notice by November 15 of the year prior to the desired opt-out year. Unfortunately, 10% of I&M's eligible load and almost half of the eligible load for both NIPSCO and DEI have opted out of utility DSM programs as shown here in Table 11.

Table 11. EE Opt Out as Percentage of Eligible Load

	Opt out
NIPSCO[64]	42%
DEI[65]	49%
Vectren[66]	75%
I&M[67]	10%

Q. Has I&M taken any action to reduce its opt-out rate?

A. It does not appear that the Company has taken any targeted action to bring opted out customers back into its programs. In response to CAC's inquiry about what actions the Company has taken, I&M discussed the ability of customers to view opt out information on-line.[68] The Company also mentioned their letter discussing the opt-out process and deadlines (which I recommend in this testimony should be amended).

Q. Are there reasonable and cost-effective DSM programs that I&M could and should offer to bring its opted out customers back to its programs?

A. Yes. As noted above, a self-direct program should be implemented. Also, upon review of I&M opt out letter, it appears that the Company should modify the language to focus on the benefits the customer is declining when it opts out of efficiency programs. Currently, the language focuses on the ease with which the

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[64] Cause No. 44634, NIPSCO Discovery Request Response to CAC Set 2-006, Attachment A (Exhibit NM-8).

[65] Cause No. 43955 DSM 3, Duke Witness Douglas' Public Workpaper #2 (Exhibit NM-9).

[66] Cause No. 44645, Vectren Discovery Request Response to CAC 2-5 (Exhibit NM-10); *see also* Cause No. 44645, Petitioner's Exhibit No. 2 (Huber), p. 24, lines 13-14, which says approximately 76% of eligible load has opted-out.

[67] I&M Discovery Request Response to CAC Set 1-11, Attachment 1 (Exhibit NM-6).

[68] I&M Discovery Request Response to CAC 1-13 (Exhibit NM-11).

customer can opt out of the program. I&M should consider adding an additional page with a case study of a successful energy efficiency project likely applicable to the customer as an example of the upside of the energy efficiency programs. Finally, I&M should consider additional programs that will entice opt out customers in its particular service territory back into participation in the programs, such as a program geared towards fabricated metals processes, health and social care facilities, printing, machinery manufacturing, and plastic manufacturing.

Q. Two of your program recommendations that you offered, the low income and multifamily programs, were based on programs implemented in Michigan. How is I&M performing on energy efficiency in Michigan?

A. As an electric utility in Michigan, I&M is required to achieve 1% of prior year sales with energy efficiency savings each year after 2012, so the Michigan arm of the Company is saving more energy than here in Indiana, where I&M achieved approximately 0.77% savings in 2014. As I discuss more below, I recommend that I&M's performance incentive be based off of a model recently approved by the Michigan Commission.[69]

Q. Do you have any other concerns about I&M's program administration or Oversight Board?

A. I am not a member of the I&M Oversight Board ("OSB") but I am aware from conversations with CAC that, through a Settlement Agreement, I&M recently

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[69] I am aware that I&M has a financial incentive that is based on multiple performance metrics and was authorized from 2014-2015. My recommendation is based on Consumers Energy's incentive because it is simpler and promotes the utility adopting all cost-effective efficiency.

changed its OSB structure in an effort to increase operational efficiencies, but the outcome has been unsatisfactory to CAC. Generally, there has been a lack of substantive conversations about the portfolio performance at the I&M OSB meetings, and the Company has not been providing the scorecard to members in advance of the meeting or distributing the materials via email. This creates operational inefficiencies, which was not the goal of the structure change.

Further, as discussed above, there are clear opportunities for I&M to improve its program implementation, and spend its designated budget on cost-effective energy efficiency to benefit its customers. CAC does see value in the public participation aspect that is currently in place and recommends that aspect remain, but that the OSB return to the pre-Settlement requirements to ensure that I&M has more oversight and is actually delivering robust and effective programs. Additionally, CAC sees great value in the Commission staff being involved on I&M's OSB, considering the program delivery problems I&M has faced this year.

Q. Please summarize your program recommendations.

A. I recommend that I&M: (1) pursue all reasonably achievable savings by increasing the goals for those programs unaffected by opt-out customers to levels consistent with Action Plan; (2) spend their entire DSM budget, (3) modify new construction and low income programs; (3) re-evaluate if the Neighborhood Energy and Moderate Income are appropriate programs to offer, and provide an explanation if the Company finds they are not appropriate; (4) offer a program for multifamily homes, new manufactured homes, direct install for schools, and non-residential; (5) implement an upstream efficiency program that is targeted at manufactured home producers; (6) offer a school energy efficiency program that compliments the use of energy efficiency service companies; (7) offer a C&I self-direct program that meets the criteria I discussed, and requires robust evaluation, measurement and verification; and (8) offer more complete information about the available C&I programs to opt out eligible customers, especially when I&M sends out opt out notification letters and forms, as well as offer more programs specifically catered to these customers to entice them back into participation; and, (9) I&M's OSB return to the pre-Settlement oversight requirements.

IV. I&M'S PLAN IS NOT REASONABLE, NOT IN THE PUBLIC INTEREST, AND NOT COST EFFECTIVE AS IT RELATES TO I&M'S PROPOSED LOST REVENUE RECOVERY.

A. I&M'S PROPOSED LOST REVENUE ADJUSTMENT MECHANISM IS ASSYMETRICAL.

Q. How are lost revenues defined in Indiana?

A. The IURC defines lost revenues as "the revenue lost less the variable operating and maintenance costs saved as a result of not generating electricity because of a utility sponsored DSM program."[70] Lost revenues is undefined under Ind. Code § 8-1-8.5-9 and is not even mentioned under the ARP statute. But, Senate Enrolled Act 412 (2015) as codified in Ind. Code § 8-1-8.5-10 defines lost revenues as "the difference, if any, between: revenues lost; and the variable operating and

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[70] 170 IAC 4-8-1, Section 1(u). Please note, however, that a rulemaking involving both 170 IAC 4-8 and 170 IAC 4-7 is currently underway in IURC RM # 15-06. CAC is requesting that the outcome of this proceeding be made subject to the outcome of IURC RM #15-06.

maintenance costs saved; by an electricity supplier as a result of implementing energy efficiency programs."

Q. In theory, do you support allowing I&M to recover lost revenue?

A. Yes, if there is actual "lost" revenue. Consistent with prior CAC testimony, if recovery of lost revenues is allowed, it should be limited to the amount associated with decreases in sales that are directly attributable to the implementation of Commission approved EE programs and only to the extent it impacts the Company's authorized cost recovery.

This would be consistent with Ind. Code § 8-1-8.5-9 and its requirement that the portfolio be cost-effective, which I&M's plan cannot be without adjusting its lost revenue proposal significantly. This would also be consistent with Indiana's relevant definitions of "lost revenues" in Senate Enrolled Act 412 (2015) as codified in Ind. Code § 8-1-8.5-10: "the difference, if any, between: revenues lost; and the variable operating and maintenance costs saved; by an electricity supplier as a result of implementing energy efficiency programs."[71] Furthermore, Ind. Code § 8-1-8.5-10(o) states that if the plan is found to be reasonable under subsection (h), the Commission shall allow "*reasonable* financial incentives" and "*reasonable* lost revenues" (emphasis added). The current structure of recovery of lost revenues for I&M, however, is not reasonable, not in the public interest, and not cost effective under all applicable statutes.

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[71] *See also* 170 IAC 4-8-1, Section 1(u). Please note, however, that a rulemaking involving both 170 IAC 4-8 and 170 IAC 4-7 is currently underway in IURC RM # 15-06.

Finally, 170 IAC 4-8-6 already requires consideration of freeriders. I&M should be required to include customer load growth, off-system sales, and changes in other revenue structures when proposing any lost revenue adjustment mechanism. Changes in these factors between rate cases provide the utility with additional cost recovery that should be offset in any lost revenue mechanism.

Q. Has I&M provided evidence that it has lost revenue due to the EE program implementation?

A. No. I&M stated, in its 2015 DSM Plan filing:

> The reduced customer usage that results from DSM programs leads to reduced revenue for the Company and thus reduced recovery of fixed costs during period between basic rate cases.[72]

Yet I&M did not substantiate its claim of reduced recovery of fixed costs in its DSM plan filing. It is unreasonable, not in the public interest, and not cost effective for I&M to recover lost revenues if there is no evidence the revenues are actually lost. This lack of quantitative support for lost revenue in the utilities' applications is why I&M's lost revenue adjustment mechanism ("LRAM") is asymmetrical – the utility makes no adjustment for increases in revenues due to activities unassociated with DSM and appears to assume that lost revenues due to DSM always occur.

Figure 1 below, taken from ACEEE's recent LRAM research, illustrates the potential for a utility to over earn if a LRAM is implemented without symmetry, or regard, for the overall utility rate of return. The black line represents a generic amount of revenue the utility is permitted to recover and the blue

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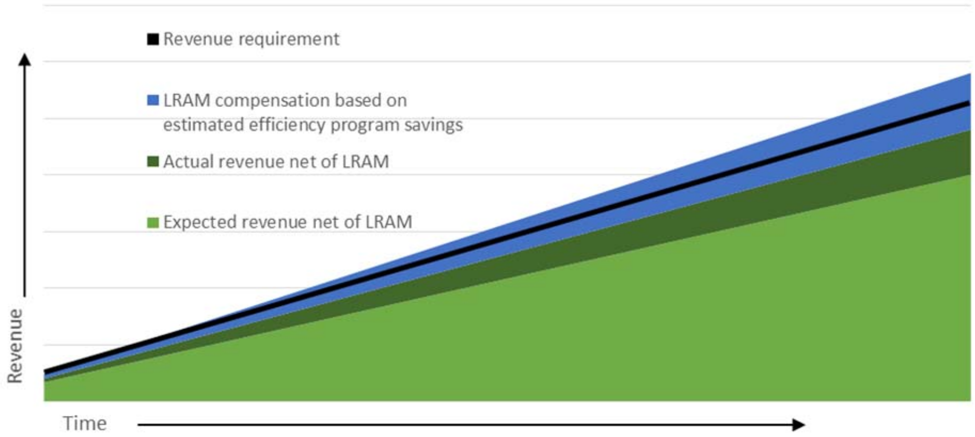
[72] Cause No 44486, Testimony of David Roush, page 4, lines 15-18.

triangle represents the amount of revenue the utility recovered due to its lost revenue adjustment mechanism. The bottom two green triangles represent the expected and actual revenue recovered. Due to additional sales, the dark green triangle pushes the blue triangle (lost revenues) beyond the utility's revenue requirement.

<u>Figure 1</u>. Illustration of Potential for Over-Earning with LRAM[73]



I&M's LRAM would be symmetrical if it took into account its actual revenues before and after the application of its lost revenue. If increased sales or other factors result in actual revenue pushing I&M past its revenue needs, it should not collect any lost revenue at all.

Q. How would I&M demonstrate that it did not recover necessary revenues because of its energy efficiency programs, and is in need of lost revenues?

A. I&M should compare sales in its test year to the actual sales, and if there is a difference between that test year and the actual year, then I&M may be eligible for lost revenues. If the actual sales, after the effects of EE are included, are still

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[73] American Council for an Energy Efficiency Economy, Review of Lost Revenue Adjustment Mechanisms. June 2015, page 4, Figure 2 (<u>Exhibit NM-12</u>).

sufficient to allow the Company to recover its authorized revenue (for example, when sales are above forecasted levels), there is no legitimate rationale to use ratepayer money to compensate the Company for "lost" revenues that were not incurred. This would be essentially asking utility ratepayers to guarantee excess revenues to the utility, and this is not reasonable. However, if the Company's sales, after the effects of EE, are insufficient to allow the Company to recover its authorized costs, then the Company would be eligible for lost revenues.

Q. After it has been established that a utility has actually "lost" revenue, what is a reasonable period of time to allow recovery of lost revenue?

A. Lost revenue recovery is meant to be a short-term solution to address revenue loss in between rate cases. As noted below, if recovery of lost revenue is allowed, it should be limited to three years or the life of the measure, whichever is shorter, to avoid the "Pancake Effect."

Further, based on ACEEE's recent LRAM research:

> It is most common for states to limit recovery to one to three years, although many states allow utilities to recover lost revenues for an indefinite period of time…Respondents indicated that in these cases, although rules might not be in play…utilities tend to bring [rate cases] forward every two to three years.[74]

Q. Has I&M been denied or otherwise had limits on lost revenue recovery in Indiana before?

A. Yes. It appears that I&M reached a settlement in Cause No. 43769, which allowed I&M to request lost revenue recovery in a future proceeding, meaning that I&M

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[74] American Council for an Energy Efficiency Economy, Review of Lost Revenue Adjustment Mechanisms. June 2015, page 21 (Exhibit NM-12).

apparently did not have authority to collect lost revenues at all prior to that. Thus, I&M filed for net lost revenue recovery in Cause No. 43827, which appears to have been granted without a limit on the time period of lost revenue recovery.[75] The Commission approved the net lost revenue recovery request in its Final Order on September 22, 2010.

Q. Have other states allowed lost revenue recovery for the life of the measure or until a rate case and determined that the LRAM policy should change?

A. Yes. After the Minnesota Public Utility Commission allowed the largest IOU (Northern States Power) to recovery 50-75 percent of reported lost revenues, the Minnesota Department of Public Service expressed the following concerns:

- The period between rate cases is much longer than that envisioned when [the lost margin policies] were approved, significantly increasing the level of lost margins accrued.
- Lost margins increase rates without any tangible benefits to ratepayers.
- True lost margins are shrinking because, in the long run, “fixed” costs become variable costs.
- Utilities have growing opportunities to sell their saved energy on the wholesale market.
- [I]t has now been 12 years since Otter Tail Power filed a rate case, 5 years since NSP-Electric filed, 4 years since Minnesota Power filed, and 3 years since Interstate filed. The frequency of rate cases is an important issue. The longer time lag has increased lost margins significantly, thereby raising the costs of electric utilities’ DSM investments to ratepayers.
- Clearly, [lost margin recovery was] intended to compensate utilities for short-term revenue losses between relatively frequent general rate proceedings. They were not intended to provide long-term windfall gains to shareholders.[76]

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[75] *See* Cause No. 43827, Direct Testimony of Roush, Exhibit DMR-1 (November 11, 2009).

[76] Minnesota Public Utility Commission, Docket No.98-443, Order issued June 24, 1998, Page 8.

Q. Why should lost revenues be limited to a short period of time?

A. As noted by the Minnesota Department of Public Service over fifteen years ago, lost revenue recovery is meant to be a short-term adjustment to address revenue losses in between rate cases. In the absence of requiring a rate case every 2-3 years, the amount of lost revenue the utilities recover should be limited. It is also important to note that the utility is able, through integrated resource planning and rate cases, to adjust their longer term plans to avoid spending revenue unnecessarily if efficiency can defer or eliminate the need for additional capital expenditures, and thus lost revenues. However, at this time, Indiana's policy allows the utility to collect revenues that would not be "lost" through prudent planning.

In Indiana, the rationale for a cap of 36 months of lost revenue can also be found in Senate Enrolled Act 412, which requires the utilities to submit energy efficiency plans at least once every three years.

In addition, there is a high risk that ratepayers will pay for revenues that are not actually "lost" if the Commission continues to allow I&M to collect lost revenues for the life of the measure, or until it has a new rate case because the energy baseline will change in the future. For example, the Energy Independence and Security Act ("EISA") of 2007 created a new baseline for lighting that had profound impacts on the DSM industry. If another lighting standard were introduced, the utility should not be able to recover lost revenue unless the measures go above the standard. In order to appropriately calculate lost revenues, the Company would need to track what types of lamps were installed in each year to determine if the measure continues to be above the baseline, and thus eligible for lost revenue recovery. This adds a layer of complexity and opacity that can largely be avoided by limiting the lost revenue recovery period.

Q. Do Duke Energy Indiana, NIPSCO, Vectren and I&M use the same methodology to calculate lost revenues?

A. No. Currently, there are significant inconsistencies in how DEI, I&M, NIPSCO and Vectren calculate their lost revenues as shown in Table 12.

Table 12. Qualitative description of specific components of NLR methodology

	Freeriders and Spillover	**Request for Demand Response LR Recovery**	**Tail or Average Rate**
Duke Energy Indiana	Includes both	Yes	Average rate for all classes
I&M	Includes freeriders for all programs and spillover for some programs[77]	No	Average rate for residential and commercial classes
NIPSCO	Includes freeriders	No DR programs offered	Tail rate for all 38 classes
Vectren	Includes both[78]	Yes	Tail, but most rate classes are only one block rate

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[77] Based on I&M's use of net savings to calculate lost revenues, and spillover discussed in the calculation of the net to gross ratios for the Residential Home Energy Reporting Program and Online Energy Check up Program.

[78] Cause No. 43405 DSMA 9S1, Petitioner's Exhibit RCS-1 (Sears), Page 8, lines 18-19.

Q. Are there other inconsistencies in the utilities' calculation of lost revenues?

A. Yes. In addition to using different methodologies, the utilities do not appear to be presenting the same information in their filings, nor are they presenting the information in a uniform fashion. While I am aware that each utility is unique, the Commission and interested stakeholders should be able to easily identify the annual and total lost revenues each utility is requesting in each application as well as the savings underlying those calculations. Under the current practice, this is nearly impossible. As discussed in the Commission's recent order in Cause No. 44634:[79]

> We note that the CAC also requested that the Commission initiate some type of formal process to develop a standard methodology for Indiana utilities to calculate lost revenues for an energy efficiency measure…we fully expect that this issue will be addressed in that future rulemaking.

In November 2015, the Lawrence Berkeley National Lab ("LBNL") answered this need by releasing a data tracking spreadsheet tool.[80] The tool is simple to use and provides clear guidance for planned and actual program spending and energy savings, lost revenues and performance incentives. Furthermore, LBNL is available to provide technical assistance to states interested in adopting the reporting tool, including assistance in customizing it to address state-specific requirements.

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[79] Cause No. 44634, IURC Order, page 39.
[80] https://emp.lbl.gov/sites/all/files/lbnl_energy_efficiency_reporting_tool_v._1.1.xlsx

Q. What is a reasonable approach to calculating lost revenues?

A. A reasonable approach would require that: (1) the utility show that implementation of energy efficiency programs has prevented the Company from recovery of authorized fixed costs; then (2) use a standard methodology across the State of Indiana to determine how to uniformly calculate lost revenue for a measure, and finally, (3) calculate the lost revenue for three years or the life of measure, whichever is shorter.

I&M's current methodology for calculating lost revenues appears to be unreasonable because it does not start with step one, determining if there are actual lost revenues. In addition, it is unreasonable to request lost revenue for the life of the measure or until the utility returns to the Commission for a rate case.

B. I&M'S REQUEST FOR RECOVERY OF LOST REVENUES FOR THE LIFETIME OF AN EE MEASURE CREATES AN EXPENSIVE PANCAKE EFFECT.

Q. Did the Commission approve I&M's current lost revenue adjustment mechanism methodology ("LRAM") indefinitely?

A. No. The Commission did not and, furthermore, the Commission's rules state that it may periodically review the need for continued recovery of the lost revenue as a result of the utility's DSM program, and that the approval of a lost revenue recovery mechanism shall not constitute approval of a specific dollar amount, the prudence, or reasonableness of which may be debated in a future proceeding before the Commission.[81] Also, the newly enacted Senate Enrolled Act 412, in Section (o), now includes the term "reasonable" in front of the term lost revenues.

Q. **Have there been any policy changes since I&M's current lost revenue methodology was approved in Cause No. 43827?**

A. Yes. Subsequent to I&M's lost revenue methodology being approved in 2010, Senate Bill 412 (2015) passed, even though I&M does not seem to be relying on this statute here. Senate Enrolled Act 412's Section 10(o) states that if the Commission finds a plan submitted by an electricity supplier under Section 10(h) to be reasonable, which the Commission should not do here, the Commission shall allow the electricity supplier to recover "[*r*]*easonable* lost revenues" (emphasis added). SEA 412 also directed the Commission to conduct rulemakings, which implicate 170 IAC 4-7 "Guidelines for Electric Utility Integrated Resource Plans" and 170 IAC 4-8 "Guidelines for Demand-Side Cost Recovery by Electric Utilities."[82]

Q. **What is the total amount of lost revenues that I&M is requesting in this proceeding for the implementation of its 2016 Plan?**

A. I&M is requesting $32.1 million. The $32.1 million includes legacy lost revenues that I&M is requesting or receiving but does not include the total lost revenue cost if I&M continues to be allowed to recover lost revenues for the life of the measure. Also, as shown in Table 13, if the full year values for 2016 are

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[81] 170 IAC 4-8-6 (c). Please note, however, that a rulemaking involving both 170 IAC 4-8 and 170 IAC 4-7 is currently underway in IURC RM # 15-06.

[82] Please note that CAC is requesting that the outcome of this proceeding be made subject to the outcome of IURC RM #2015-6.

calculated for lost revenues, I&M is requesting $9M as opposed to the filed half year convention figure of $4.6M. This would bring the budget for 2016 to $52.6M, about $7.7M more than I&M has in its application. Chart 3 and Table 13 below show the financial information that I&M provided in this application for its 2016 budget.

Chart 3. I&M 2016 DSM Budget ($52.6M)

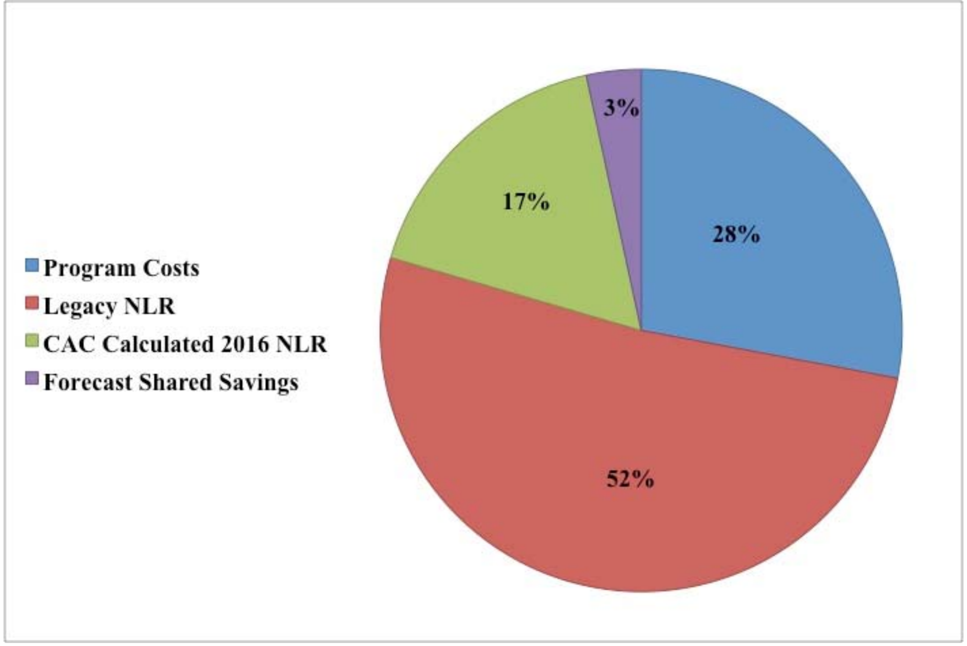

Table 13. I&M's Proposed 2016 Program Budget, Lost Revenue and Performance Incentive (million $)[83]

	Residential	Commercial	Total
Program Cost	$8.5	$6.2	$14.7
Legacy Lost Revenue	$10.8	$16.3	$27.1
Forecast 2016 Lost Revenue (Full Year, CAC calculated)	$6.0	$3.0	$9.0
Shared Savings	$0.87	$0.91	$1.8
Total	$26.2	$26.4	$52.6

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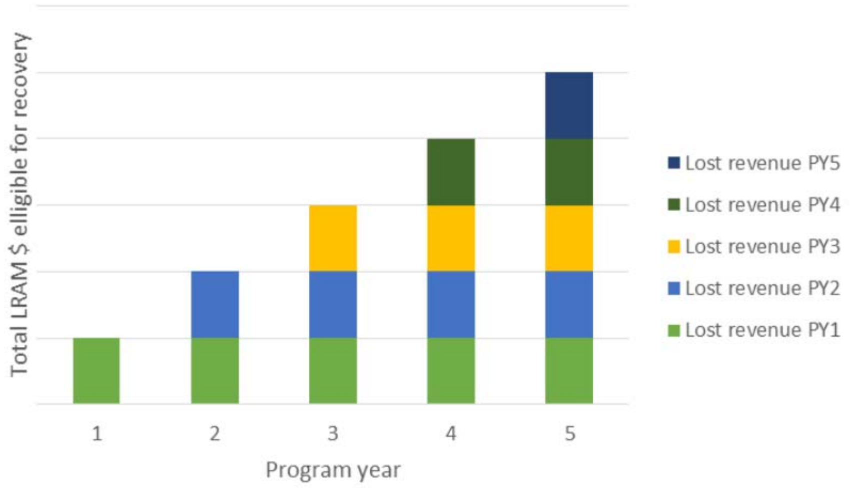
[83] I&M Witness Walter Testimony, Attachment JCW-10. Program cost includes EECO cost.

Q. **Is it reasonable, in the public interest, or cost effective to allow I&M to recover lost revenues for the life of a measure?**

A. No. A reasonable lost revenue policy—assuming that the Company can show it has actually lost revenues as a result of implementing energy efficiency programs—would allow the utility to receive lost revenues for three years or the life of the measure, whichever is shorter, which I discussed in the Section above.

As noted above, ACEEE labeled this scenario in which lost revenues for the life of the measure accumulate over a multiple-year period between rate cases as the "Pancake Effect" which is illustrated in Figure 3 below.[84]

Figure 3. The Additive Nature of Lost Revenues Results in a Pancake Effect



Q. **Would it be prudent to allow Indiana utilities to recover lost revenue until the utilities' next rate case?**

A. No. As discussed in the Commission's recent order:

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[84] ACEEE Review of Lost Revenue Adjustment Mechanisms, June 2015, page 12, Figure 7 (Exhibit NM-12).

> Although we have previously approved lost revenues over a measure's life or until a utility's next base rate case, whichever is shorter, Ms. Mims' and other parties concerns with pancaking and the increased length of time between base rate cases for utilities in Indiana raise a valid concern.[85]

Given the length of time between utility rate cases in Indiana, this could result in the utility recovering lost revenue for the life of the measures, which as discussed above is not reasonable. While I&M has conducted more frequent rate cases than some of the other Indiana electric IOUs, as a statewide policy, allowing utilities to recover lost revenues until there is a rate case is not prudent.[86] Even with I&M's last rate case in February 2011,[87] future rate case dates have not been established and there is no guarantee that the Company will return to the Commission in five, ten or even twenty years for its next rate case.

Q. What are the financial impacts of allowing I&M to recover lost revenue for the lifetime of the measure or until the next rate case?

A. I&M calculates its lost revenue by determining the annual net, verified kWh impacts of each program, and multiplying the verified net kWh by the average fixed cost per kWh for customers eligible for each program, based on I&M's current rates.[88] The summed, or total year, net lost revenue is calculated from the energy savings from all measures with remaining useful life for that program year, regardless of when they were installed,[89] which can range from five years

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[85] Cause No. 44634, IURC Order, page 38.
[86] ACEEE Review of Lost Revenue Adjustment Mechanisms, June 2015, page 12 (Exhibit NM-12).
[87] Cause No. 44075 (2013).
[88] Cause No. 44486, Testimony David Roush, page 5, lines 1-8.
[89] I&M Witness Walter Testimony, page 45, lines 19-21.

for a CFL lightbulb or fifteen to eighteen years for a LED lightbulb or HVAC unit.[90]

In the absence of a rate case,[91] I&M will continue to add lost revenues from prior years to existing years for energy efficiency measures that are still in service, which ACEEE has dubbed the "Pancake Effect."[92] This can become very expensive and dwarf the cost of the actual energy efficiency program implementation. It means that the utility, if it does not return to the Commission for a rate case, will recover lost revenues for the life of the measure.

Q. What would happen if Commission adopted NIPSCO 4 year Net Lost Revenue?

A. I commend the Commission for shifting from lifetime net lost revenue recovery to limiting lost revenues to four years. Due to the lack of granular data in the application regarding the amount of net lost revenue associated with measures that have a longer useful life than four years (and when those measures were installed), I am not able to quantify the amount of savings this policy decision would generate.

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[90] I&M Discovery Request Response to CAC 01-02; I&M DSM 5 2015 Plan Exhibits 9_10_15 Attach Final.xls; 2016 Res. Home Energy Products Tab (Exhibit NM-13).

[91] I am aware that Senate Enrolled Act 560 (2013) states that "A public utility that implements a TDSIC [Transmission, Distribution and Storage System Improvement Charge] under this chapter shall, before the expiration of the public utility's approved seven (7) year plan, petition the commission for review and approval of the public utility's basic rates and charges with respect to the same type of utility service."

[92] ACEEE Review of Lost Revenue Adjustment Mechanisms, June 2015, pages 7, 11-13 (Exhibit NM-12).

Q. Please summarize your lost revenue adjustment mechanism recommendations.

A. My recommendations for I&M's lost revenue recovery are: (1) the utility must show that implementation of energy efficiency programs has prevented the Company from recovery of authorized costs, then (2) it should use a standard methodology across the State of Indiana to determine how to uniformly calculate lost revenue for a measure, and finally (3) it should calculate the lost revenue for three years or the life of measure, whichever is shorter. In addition, I&M and the rest of the electric utilities in Indiana should be required to provide information in a standard format regarding lost revenues, with the recent LBNL tool as a fantastic option for clear reporting. The lack of data in the petition and direct testimony is very concerning.

V. <u>I&M'S PLAN IS NOT REASONABLE, IN THE PUBLIC INTEREST, OR COST EFFECTIVE WITH ITS PROPOSED PERFORMANCE INCENTIVE</u>.

Q. How did I&M's 2014 energy efficiency plan perform?

A. I&M performed better than the third party administered programs by achieving 90% of their goal compared to Energizing Indiana achieving 81%, as shown in <u>Table 14</u>. However, on average, the Company only met 86% of its total gross kWh goal for 2014,[93] making it still eligible for a performance incentive of 15% of all program costs.

Table 14. I&M 2014 Energy Efficiency Program Performance

Administrator	**% of kWh Goal**
Core Plus	
Appliance Recycling	127%
Online Energy Check-Up	75%
Home Energy Reporting Program	84%
Peak Reduction	N/A
RE Res Demo	23%
RE Com Demo	78%
Home Weatherization	41%
Residential New Construction	41%
Energy Efficient Products	41%
C&I Incentives	91%
C&I Audit	94%
C&I Small Business Direct Install	102%
C&I Retro-Commissioning Lite	103%
C&I HVAC Optimizer	20%
Res EECO	98%
Com EECO	98%
Subtotal	**90%**
Core Programs	
Home Energy Assessment	100%
Low Income Weatherization	100%
Residential Lighting	100%
Energy Efficient Schools Kits	93%
Energy Efficient Schools Audits	561%
C&I Rebate	68%
Subtotal	**81%**
Portfolio Total	**86%**

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[93] I&M Discovery Request Response to CAC 4-01; I&M DSM/EE Program Scorecard EMV December (Exhibit NM-4).

Q. How is I&M's 2015 performance on meeting its energy efficiency goals?

A. Its 2015 performance appears to be going much worse than 2014. As of October 2015, the Company had only achieved 44% of its energy efficiency gross kWh goal, and had spent 52% of its budget.[94]

Q. What is I&M's current performance incentive?

A. I&M's current performance incentive was approved as part of a settlement agreement in Cause No. 44486.[95] Currently, I&M calculates its shared savings incentive based on the net benefits calculated using the Utility Cost Test. The Company first calculates 90% of the net benefits, and then is eligible to earn 15% of the benefits. The incentive is capped at 15% of the sector (residential, commercial and industrial) program costs. In the past, I&M was subject to a threshold of achieving at least 50% of its energy efficiency goal before becoming eligible for shared savings, but it does not appear that it has a threshold any longer. The EECO program and any program that does not achieve a UCT score of 1.0 (in this application, the Residential Peak Program and the Income Qualified Weatherproofing) are not eligible for the shared savings incentive.

Q. Is their proposal for performance incentives reasonable?

A. No, it is not reasonable primarily because it is an incentive that is not based on achieving any level of savings. If I&M saves one kilowatt-hour, it is eligible for a "performance" incentive. As illustrated by I&M's 2014 energy efficiency achievements, the Commission should establish a performance incentive that is

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[94] I&M DSM/EE Program Scorecard October 2015 (Exhibit NM-3).
[95] Cause No 44486, Order of the Commission, approved December 03, 2014.

contingent upon a much higher performance, especially considering I&M's poor 2015 performance as reported so far.

Requiring a threshold, or a level of performance, to earn an incentive is national best practice.[96] There are currently twelve states that have a shared net benefits performance incentive, and of these twelve states, six of them require the utility to achieve 70% of the energy savings goal to be eligible to receive the incentive (Arkansas, Arizona, Colorado, Missouri, Oklahoma and Texas). Of the remaining six, two require 50% of the energy savings goal (Georgia and Minnesota), and four did not require an energy savings goal be met (North Carolina, South Carolina and Kentucky) or provide information (Ohio). [97]

Given that I&M is setting its own energy efficiency goals, I recommend that if the Commission approves a shared net benefit performance incentive, the Commission require that I&M meet 100% of its goal as a threshold for a performance incentive.

Q. Are performance incentives an effective tool to increase energy efficiency adoption?

A. Yes. Performance incentives are part of the three-legged stool that supports ratepayer funded energy efficiency: cost recovery, decoupling or a lost revenue adjustment mechanism, and a performance incentive.

Q. What do you propose I&M use as the basis for their incentive?

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[96] ACEEE, Performance Incentive Review, 2015, page 7 (Exhibit NM-14).
[97] *Id.*

A. I recommend that I&M use multiple performance metrics to define the performance incentive, and cap the maximum amount of the incentive through at financial incentive cap.

Q. What is a reasonable percentage of benefits that I&M should receive in a performance incentive?

A. I&M is proposing to save ~0.77% of prior year retail sales each year in 2016. There are currently 15 states that are achieving energy efficiency savings upwards of one percent, and the leader is achieving more than three percent. Based on ACEEE's State Scorecard, this level of efficiency would put I&M at about 19th, if it were a state. This level of performance should not receive such a high shared net benefit performance incentive.

Of the twelve states that currently have a shared net benefit performance incentive, six of them have an incentive of 10% of the net benefits or less. The other six have varying levels of performance incentives for achieving savings goals. For example, in Colorado, utilities may receive 15% of net benefits if they achieve 150% of their energy savings goal. Oklahoma allows 15% if the utility achieves 80% of their energy savings goals. Duke Energy Carolinas and Duke Energy Progress utilities receive 11.5% – 11.75% of the NPV of the net benefits of the UCT as an incentive for energy efficiency impacts, and there is no minimum savings required.

Table 15. Overview of Net Benefit Performance Incentives and Energy Efficiency Savings[98]

State	**Net benefit performance incentive level**	**Threshold requirement**	**State savings as a percent of sales**
Arkansas	10%	80% of energy goal	0.53%
Arizona	6-8%	85% of goal	1.73%
Colorado	1% at 80% of goal Max 15% at 150% of goal	80% of goal	0.77%
Georgia	8.5%	50% of goal	0.23%
Kentucky	10-15%	None	0.37%
Minnesota	Up to 7 cents per first year kWh saved	At least 0.4% savings, or half of last five year average savings	1.22%
Missouri	4-6%	70% of goal	0.52%
North Carolina	11.5 -11.75%	None	0.64%
Ohio	No data	No data	0.89%
Oklahoma	15%	80% of goal	0.30%
South Carolina	6 – 11.75%	None	0.53%
Texas	Max 10%	100% of goal	0.20%

As I discussed above, performance incentives are a critical tool in energy efficiency policy. However, as show in Table 15, the performance incentive does not need to be extremely rich to motivate utilities to act, and in fact, the richest incentives shown in Table 15, have the lowest statewide energy efficiency savings.[99]

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[98] ACEEE, Performance Incentive Review, 2015 (Exhibit NM-14).; Gilleo, Annie et al. The 2014 State Energy Efficiency Scorecard. October 2014.

[99] Other policies besides performance incentives drive utility energy efficiency savings as well. Several of the states with the highest energy efficiency impacts also have state energy efficiency resource standards or comparable policies.

Based on this information, a lower net benefit percentage is more appropriate for I&M. I suggest a tiered performance incentive, with a cap on the total incentive level.

Q. Should I&M receive a performance incentive if the lost revenue adjustment mechanism is not revised?

A. No, it would be my recommendation that in the absence of: (1) requiring the utility to show that they have “lost” revenues; and (2) shortening the lost revenue recovery period to the shorter of 36 months or the life of the measure, or requiring the utility to return to the Commission for a rate case every three years, I&M should not receive a performance incentive. However, if the lost revenue period is shortened to 36 months or the life of the measure, whichever is shorter, the Commission should allow a performance incentive.

Q. Is I&M proposing to earn a performance incentive on its Residential Peak Reduction Program?

A. No. I&M is not proposing to recover performance incentives for four of its programs: Income Qualified Weatherproofing, Residential Peak Reduction, Residential EECO and C&I EECO.[100]

Q. You mentioned crafting a performance incentive based on multiple performance metrics. Can you expand on that idea?

A. Yes. Based on recent research from the American Council for an Energy Efficiency Economy, a performance incentive that considers multiple factors costs

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[100] I&M Witness Walter Testimony, Attachment JCW-6.

the least as a percent of energy efficiency program costs and results in the highest energy efficiency impacts.

I recommend that I&M's performance incentive be based off of the Michigan Public Service Commission's use of an Financial Incentive Cap[101] and six quantifiable Performance Metrics to determine the amount of the utility's performance incentive, as shown in Table 16. The Financial Incentive Cap determines the total maximum amount of incentive available to the utility each year.

Table 16. Consumers Energy Company 2016-2017 Incentive Mechanism[102]

Performance Metric	Description	Performance Requirements		Percentage of Financial Incentive Cap	
		Minimum	Maximum	Minimum	Maximum[103]
Lifetime Energy Savings	Lifetime MWh savings for exceeding 1.0% annual reduction	100.1% of lifetime	115% of lifetime	53%	80%
Low Income Programs	Energy savings from income qualified programs	100.1% of plan	115% of plan	4.40%	13.33%
Multi-Measure Residential	Increase number of residential participants who install three or more measures	16% increase in # of participants from 2015 and 2016	20% increase in # of participants from 2015 and 2016	2.20%	6.67%
Multi Measure	Increase number of	16% increase	20% increase	2.20%	6.67%

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[101] The formula for Consumers Energy's maximum financial incentive is: if the portfolio UCT score is more than 1.6, the incentive is [(0.15/(UCT-1))*net benefits]; if the portfolio UCT score is less than 1.6, the incentive is [(0.25/UCT-1))*net benefits]. This total is multiplied by the respective Percentage Financial Incentive Cap in Table 16 for each of the metrics once the utility meets the Performance Requirements.

[102] Michigan Public Service Commission, Order Approving Settlement Agreement, Case No. U-1771. December 22, 2015. Available at http://efile.mpsc.state.mi.us/efile/docs/17771/0031.pdf.

[103] Financial incentive based on sliding scale between minimum and maximum caps. The actual percentage would be proportional to the Company's achievement in a particular metric. Total financial incentive is not to exceed 100% of the financial incentive cap.

C&I	business participants who install three or more measures	in # of participants from 2015 and 2016	in # of participants from 2015 and 2016		
Energy Star Benchmarking for Businesses	Provides business with benchmarking of building energy characteristics with ENERGY STAR portfolio manager	16% increase in # of participants from 2015 and 2016	20% increase in # of participants from 2015 and 2016	2.20%	6.67%
Business Energy Assessments	Energy Assessments for Small & Medium sized business customers	16% increase in # of participants from 2015 and 2016	20% increase in # of participants from 2015 and 2016	2.20%	6.67%

First, the Financial Incentive Cap is determined based on the formula in footnote 94, and then the Performance Metrics in Table 16 are used to determine the incentive Consumers Energy is eligible for each year. I recommend I&M's Financial Incentive Cap be lower than Consumers Energy's because I&M is achieving less savings, and is not being required to meet a statutory efficiency goal, but instead is suggesting their own goal. Similar to Consumers Energy, I suggest that if the overall portfolio UCT is lower, a higher Financial Incentive Cap is appropriate to encourage the utility to pursue all cost-effective efficiency, not just the most cost-effective efficiency.

Using a lower Financial Incentive Cap (10% instead of 15% in the formula in footnote 94), and I&M's forecasted UCT of 2.69 for its portfolio, I&M's Financial Incentive Cap would be $1.8M in 2016. This amount is very similar to what the Company is requesting in this application. However, unlike what I&M is proposing, under the Performance Metrics incentive I am suggesting, the Company would have to achieve 100% of their energy savings goal to be eligible for a significant portion of the incentive. Table 17 displays the outcome if I&M achieves 100.1% of their energy savings goal and if they achieve less than 100% of their energy savings goal.

Table 17. Proposed I&M Financial Incentive

Scenario 1: 100.1% of Energy Savings goal, meeting all other Performance Metrics at minimum level		
Performance Metric	% of Financial Incentive Cap	Incentive ($)
Lifetime Energy Savings	53%	$975,015
Low Income	4.4%	$80,944
Multi-Measure Residential	2.2%	$40,472
Multi Measure C&I	2.2%	$40,472
Energy Star Benchmarking for Businesses	2.2%	$40,472
Business Energy Assessments	2.2%	$40,472
Total	66.2%	$1,217,848
Scenario 2: Less than 100% of Energy Savings goal, meeting all other Performance Metrics at minimum level		
Lifetime Energy Savings	0%	$0
Low Income	4.4%	$80,944
Multi-Measure Residential	2.2%	$40,472
Multi Measure C&I	2.2%	$40,472
Energy Star Benchmarking for Businesses	2.2%	$40,472
Business Energy Assessments	2.2%	$40,472
Total	13.2%	$242,834

While using six discreet Performance Metrics to determine each utility's performance incentive may seem overly complex, it could actually simplify the process in Indiana because each utility would be held to the same standard. Currently, each IOU electric DSM plan that I have reviewed has different performance incentives, as shown in Table 18 below, which is arguably at least equally complex and administratively burdensome to the IURC staff and stakeholders.

Table 18. NIPSCO, DEI and Vectren Proposed Performance Incentives Differ Significantly

	Description of Performance Incentive	**Authority**
Duke Energy Indiana	12% of actual program costs depending on performance; capped at 12% of 115% of budget.	Existing mechanism approved in Cause 43955 DSM 2
NIPSCO	None	Cause No. 44634, December 30, 2015 Order
Vectren	-4 to 10% of actual program costs depending on performance; capped at 10% of budget	Cause No. 43427 (original); Cause No. 44495 (current)
I&M	15% of 90% of UCT benefits, capped at 15% of program costs. No threshold for incentive.	Cause No. 44486, December 03, 2014 Order

Q. Is the issue of performance incentives in front of the Commission elsewhere?

A. Yes, performance incentives are part of the SEA 412 IRP/EE rulemaking, IURC RM # 15-06. As part of this effort, I strongly recommend that a workshop be held to discuss a cohesive state policy on performance incentives and calculation of lost revenues, as these areas seem to have the most diverse methodologies among Indiana utilities. In this workshop, I strongly recommend that the Commission and stakeholders consider the costs and benefits of designing a performance incentive that has multiple criteria, as well as identify appropriate criteria for a three-year EE cycle that will motivate the utility to pursue Indiana's EE policy goals.

Q. Please summarize your performance incentive recommendations.

A. My recommendations regarding I&M's proposed performance incentives are: (1) performance incentives are a critical part of energy efficiency policy, but they should only be provided for performance; (2) if the Commission chooses to permit a performance incentive, it should require that I&M meet 100 percent of its goal before allowing the Company to earn an incentive, and use multiple performance metrics to determine I&M's performance incentive; and (3) I&M should not be permitted to earn a performance incentive unless the lost revenue recovery is limited to 36 months or the life of the measure, whichever is shorter.

VII. I&M'S PLAN IS NOT REASONABLE OR IN THE PUBLIC INTEREST: I&M'S MOST RECENT TRM AND EVALUATION, MEASUREMENT AND VERIFICATION HAVE NOT BEEN INCORPORATED INTO THE 2016-2017 GOALS.

Q. What is the most recent EM&V that I&M has conducted?

A. I&M completed Core and Core Plus Evaluation, Measurement and Verification in 2014, both of which were released in May 2015. I&M stated that they used evaluated deemed savings provided by their EM&V vendor for 2014 programs in the design of their 2016 programs.[104]

Q. What is I&M's proposed evaluation budget in relation to its overall budget for 2016 (excluding lost revenues and performance incentives)?

A. I&M's forecasted EM&V cost is five percent of program budget,[105] although that ranges from 3-10% by program. I&M did not present their forecasted EM&V data in one exhibit, but rather it was spread across several exhibits, so it is compiled in Table 19 below.

Table 19. I&M proposed 2016 Program and EM&V Costs

	Total Program Cost[106]	**EM&V Costs[107]**	**EM&V as % of Total of Program Costs**
Home Energy Products Lighting	$1,370,369	$50,000	4%
Home Energy Products Products	$325,942	$15,000	5%
Income Qualified Weatherproofing	$567,971	$ 55,000	10%
Schools Energy Education	$632,031	$25,000	4%
Home Appliance Recycling	$562,346	$35,000	6%
Home New Construction	$412,652	$35,000	8%
Home Weatherproofing	$574,442	$ 513,943	10%
Home Energy Online Checkup	$571,486	$40,000	7%
Home Energy Reports	$973,599	$35,000	5%
Residential Peak Reduction	$689,632	$35,000	5%

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[104] I&M Witness Walter Testimony, page 44, lines 14-18.

[105] I&M Witness Walter Testimony, Attachment JCW-3, 2016 Program Tables.

[106] I&M Witness Walter Testimony, Attachment JCW-2, 2016 Plan. Excluding lost revenue and performance incentive.

[107] I&M Witness Walter Testimony, Attachment JCW-3; EECO costs are found in I&M Response to CAC 01-02, "WP 2016 EECO kWh Forecast" tab (Exhibit NM-15).

Home Comfort & Efficiency Pilot	$211,765	$20,000	9%
Work Prescriptive Rebate	$1,778,328	$97,547	5%
Work Custom Rebate	$3,442,741	$100,000	3%
Work Direct Install	$444,071	$40,000	9%
Small Business Efficiency Pilot	$196,320	$7,000	4%
EECO	$1,038,790	$75,000	5%
Total	$14,697,485	$719,547	5%

Similarly, I&M did not file its past year program budgets and EM&V in a coherent format. In fact, there appear to be very different data for the same year in the same spreadsheet supplied to CAC as shown in Table 20. For example for I&M's 2014 data, in one tab, the sum of costs labeled as "EM&V" totals over $600,000 and in another tab the sum of a cost labeled as "evaluation and related" is $56,624 and in a third tab, $47,980. Data for 2015 is equally confusing. Perhaps there is a simple explanation for these inconsistencies; however, I&M should strive for more consistent and clear reporting.

Table 20. Inconsistencies in I&M Program and EM&V Costs

	Total Program Cost	EM&V Costs	EM&V as % of Total of Program Costs
2014[108]	$15,228,870	$654,898	4%
2014[109]	$15,228,870	$47,980	0%
2014[110]	$15,221,059	$56,624	0%

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[108] I&M Discovery Request Response to CAC 01-02; "2014 Final Spend" Tab (Exhibit NM-16).

[109] I&M Discovery Request Response to CAC 01-02; "Attach JCW-7 2014 Final Perf." tab (Exhibit NM-17).

[110] I&M Discovery Request Response to CAC 01-02; "2014 Final Verified Savings" tab (Exhibit NM-18).

2015[111]	$13,877,733	$696,655	5%
2015[112]	$17,328,387	None provided	N/A
2015[113]	$17,035,271	None provided	N/A
2016	$14,697,485	$719,547	5%

Q. Is there anything else you wish to inform the Commission regarding EM&V?

A. The Commission should be aware that the Indiana-specific, ratepayer-funded Technical Resource Manual (also known as Technical Reference Manual) was updated this past summer.[114] The maintenance of documents such as these is crucial to having a solid baseline for which to conduct EM&V in Indiana, especially with the recently enacted federal Clean Power Plan.

Q. What are your EM&V recommendations?

A. I recommend that I&M refine their EM&V filings in future applications, and strongly suggest that the Company file their EM&V costs in one exhibit, for all programs.

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[111] I&M Discovery Request Response to CAC 01-02; "EM&V Cost Per Program (Exhibit NM-19).

[112] I&M Discovery Request Response to CAC 01-02; "2015 Plan." (Exhibit NM-20).

[113] I&M DSM EE Program Scorecard October 2015 (Exhibit NM-3).

[114] Indiana Technical Resource Manual 2.2 (Exhibit NM-21).

IX. CONCLUSION AND RECOMMENDATIONS.

Q. Please summarize your recommendations.

A. I recommend that the Commission reject I&M's plan in this Cause because it cannot meet the requirements of the ARP statute, Ind. Code § 8-1-8.5-9, or Ind. Code § 8-1-8.5-10(c) or (h) and furthermore, because even if it were reasonable under these sections, it does not include reasonable financial incentives or lost revenues.

In order to rectify these issues and present a plan that the Commission could and should approve, I&M would have to:

1. Present a DSM plan that is consistent with an IRP that reasonably balances energy resources through comparable consideration of both supply and demand-side resources.
2. Pursue all reasonably achievable savings by increasing the goals for those programs unaffected by opt-out customers to levels consistent with Action Plan, and spending entire DSM budget.
3. Modify new construction and low income programs, re-evaluate if the Neighborhood Energy and Moderate Income are appropriate programs to offer, and provide an explanation if the Company finds they are not appropriate, offer a program for multifamily homes, new manufactured homes, direct install for schools, and non-residential self-direct programs, and modify its opt-out letter to include details on the benefits of EE.
4. Require I&M's Oversight Board guidance return to the pre-Settlement oversight requirements.

5. Demonstrate that it is experiencing lost revenues and then limit lost revenue recovery to 36 months or the life of the measure, whichever is shorter.
6. Include a performance incentive that is based on multiple performance metrics and subject to financial cap. A performance incentive should only be proposed if lost revenue recovery is limited to 36 months or the life of the measure, whichever is shorter.
7. File clear EM&V in all future DSM proceedings.

Q. Does this conclude your testimony?

A. Yes.

VERIFICATION

I, Natalie A. Mims, affirm under penalties of perjury that the foregoing representations are true and correct to the best of my knowledge, information and belief.

Natalie Mims

January 13, 2016

Natalie A. Mims

Date

Exhibit NM-1

Resume of Natalie A. Mims

NATALIE A. MIMS

1035 Santa Barbara St, Suite 9
Santa Barbara, CA 93101
808-987-0389
mimsconsultllc@gmail.com

RELEVANT WORK EXPERIENCE

MIMS CONSULTING, LLC
Principal, April 2015 - current

SOUTHERN ALLIANCE FOR CLEAN ENERGY
Energy Efficiency Director, January 2013 - current
Earlier position: Energy Policy Manager, October 2010– December 2012

- Testifies as expert witness before the Public Service Commissions on energy efficiency cost recovery, program plans and financial incentive mechanisms in Georgia, North Carolina and South Carolina
- Responsible for ongoing energy efficiency portfolio and program level quantitative and qualitative research and analysis of major utilities in the Southeast
- Track and participate in energy efficiency regulatory proceedings. Current regulatory proceedings include IRP, cost-recovery filings, energy efficiency program pilots and existing program modifications
- Responsible for reviewing and writing comments and/or testimony for all major energy efficiency regulatory proceedings for utilities in Tennessee, North and South Carolina, Georgia and Florida
- Responsible for managing energy efficiency staff and establishing and implementing efficiency strategy for the SACE
- Assists in development/fundraising to ensure energy efficiency work funded in upcoming years
- Lead participant for SACE at TVA, Duke Energy and Georgia Power energy efficiency working groups

ROCKY MOUNTAIN INSTITUTE
Senior Consultant, July 2009 – October 2010
Earlier positions: Intern, Fellow, Analyst, and Consultant October 2004- July 2009

- Project manager for nine-person team creating energy efficiency component of national analysis to eliminate US fossil fuel consumption by 2050
- Project manager for company-wide energy efficiency strategy and development
- Lead on energy efficiency analysis for major southeastern IOU low-carbon strategy
- Lead author on published national analysis on electric productivity
- Member of senior leadership of Energy and Resources Team at the organization. Contributed to team strategy, resource planning and staffing for 12-20 person team and hiring as well as organizational professional development strategy
- Contributed to writing Hawaii Energy Strategy 2007 and planning Hawaii Biofuels Summit Contributed to RMI filings in Energy Efficiency docket before Hawaii Public Utility Commission
- Participated in Hawaii Energy Policy Forum Energy Efficiency working group
- Significant contributor to consulting and research projects including: national and state energy policies, utility revenue adjustment mechanisms, utility regulatory structures, private sector investment in energy efficiency, corporate carbon management strategy, renewable energy market assessments, large and small scale sustainable development projects, Hawaii agricultural sustainability barriers and solutions

PUBLICATIONS

- Legislative Options to Improve Transportation Efficiency. November 2005, RMI.
- Feebates: A Legislative Option to Encourage Continuous Improvements to Automobile Efficiency. February 2008, RMI.

- Plug-In Hybrid Electric Vehicles and Environmentally Beneficial Load Building: Implications on California's Revenue Adjustment Mechanism, Presented at Association of Energy Service Professionals Conference, January 2008.
- Industrial Electric Productivity: Myths, Barriers, & Solutions. Presented at ACEEE Industrial Summer Study, July 2008.
- Assessing the Electric Productivity Gap and the U.S. Efficiency Opportunity. Presented at IEPEC, August 2009.

EDUCATION

MASTER OF ENVIRONMENTAL LAW & POLICY
Vermont Law School, South Royalton, Vermont
August 2004

- Relevant coursework includes: Environmental Justice, Environmental Law, Land Use, Water Law, Federal Natural Resource Law, Comparative Methods of Dispute Resolution, Environmental Law Principles, Extinction: The Endangered Species Act, Legal Research & Writing, Ecology
- Activities: Solutions Conference 2004

B.A. ENGLISH & B.A POLITICAL SCIENCE
The Pennsylvania State University, State College, Pennsylvania
May 2002

- Honors: Blue & White Scholarship; Dean's List five semesters; National Collegiate Honor Scholar
- Relevant coursework includes: Economics, Social & Developmental Psychology
- Activities: Shaver's Creek Outdoor School Camp Counselor, May 2001

COMMUNITY SERVICE

SECRETARY, SANTA BARBARA COUNTY SURF CLUB

BOARD MEMBER, VERMONT LAW SCHOOL ALUMNI ASSOCIATION

Exhibit NM-2

I&M Discovery Request Response to CAC Set 1, Q6
Updated Action Plan

Updated Action Plan for Electric Demand Side Management (DSM) Programs:

Final Report

Prepared for:
Indiana Michigan Power Company
Fort Wayne, Indiana

Prepared by:
H. Gil Peach & Associates LLC
Jai J. Mitchell Analytics
Forefront Economics Inc.

with contributions from:

H. Gil Peach
John Mitchell
Mark E. Thompson
Howard Reichmuth

March 14, 2013

Vision Statement

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- To go further, to find better ways

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H. GIL PEACH & ASSOCIATES EIN: 93-323715

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Suggested Citation: Peach, H., Mitchell, J., & Thompson, M., *Updated Action Plan for Electric Demand Side Management (DSM) Programs: Final Report; Prepared for Indiana Michigan Power Company*. Beaverton, Oregon: H. Gil Peach & Associates, March 2013.

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Updated Action Plan for Electric Demand Side Management (DSM) Programs:

Final Report

Portfolio Level Overview

This document presents a three-year demand side management (DSM) program action plan for residential and non-residential electric customers in the Indiana portion of the Indiana Michigan Power Company service area, referred to in this report as I&M-Indiana (I&M). This report was prepared by H. Gil Peach & Associates, Jai J. Mitchell Analytics and Forefront Economics Inc with consultation and review by the I&M DSM staff and the Oversight Board. The design and cost effectiveness of electric DSM programs are addressed in this report. In this first section the focus is on the program portfolio.

The overall portfolio parameters are summarized in Tables 1 and 2. The portfolio Total Resource Cost Test (TRC) is 2.3 with a weighted life of 12.4 years (Table 1). The profile of portfolio costs and benefits is shown in Table 2.

Table 1: Portfolio TRC and Life.

Portfolio TRC	2.3
Weighted life (Years)	12.4

Table 2: Portfolio Benefit and Cost Profile.

Portfolio Level	Dollars (Thousands)
Net Benefits	$ 379,852
Net Costs	$ 160,017
Umbrella DSM Program Costs	$ 3,396
Net Present Value	$ 216,439
Annual Net Benefits	$ 24,633

The overall portfolio table values can also be shown with specific program bundles according to sector or status within the statewide effort. The specific program bundle breakouts are shown below.

Table 3: Breakout Benefit/Cost Analysis

	C&I	Residential	Core	Core Plus
Net Benefits	$ 234,955	$ 144,897	$ 143,505	$ 236,347
Net Costs	$ 63,631	$ 93,386	$ 62,540	$ 97,476
Umbrella DSM Program Costs	$ 1,228	$ 2,168	$ 1,263	$ 2,132
Net Present Value	$ 170,096	$ 46,343	$ 79,701	$ 136,738

Within the Overall Portfolio:

- The Overall Commercial & Industrial TRC is 3.5
- The Overall Residential TRC is 1.5
- The CORE TRC is 2.2
- The CORE Plus TRC is 2.4

Special Budget Items at the Portfolio Level

The portfolio budget contains certain portfolio level expenses (budget lines) that are not assigned to specific program budgets (or included in the program level Total Resource Cost calculations) but operate at the overall portfolio level (Table 4).[1]

Table 4: Annual Portfolio Level DSM Expenses.

Line No.	Budget Line Item	Amount ($)
1	**Information technology and systems**	$ 150,000
2	**Staff development & memberships**	$ 120,000
3	**New Program Development**	$ 210,000
4	**General energy efficiency management and collaboration**	$ 140,000
5	**Codes work**	$ 100,000
6	**MPS and Action Plan**	$ 100,000
7	**DSM Marketing and Customer Awareness**	$ 300,000
8	**Evaluation and Related**	$ 140,000
	Total	$ 1,260,000

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[1] The special portfolio level budget items are included in the calculation of the overall portfolio level TRC.

These line items either apply across all programs (regardless of the specific inclusion or exclusion of individual programs), or provide start-up funding for an area that is not ready to be formulated as a program in this program cycle (codes work). The first item supports the tracking system and other computer systems. The second supports staff development, participation in industry conferences and membership organizations and training. The third is a pool to draw on each year to support new program development (NPD). This permits drawing upon resources of AEP that are outside I&M's DSM staff. The fourth is funding for one staff member outside the actual program level budgets to support a "point position" for participation in statewide meetings and common efforts. The fifth item is to permit work on codes, which will require development over the new program cycle. We could not put this activity in as a specific DSM program because we could not figure a way to assign savings at this stage: it needs to be tested as an ongoing pilot for three to five years and part of the pilot will be developing a mutually agreed link between codes work and energy savings results with regulators.[2] The sixth item is to fund the next full scale potential study and program action plan and/or to provide supplementary support in this area moving forward. The seventh, "DSM Marketing and Customer Awareness" is a general marketing and communications budget separate from the line items in the individual program budgets. The eighth line item covers an in-house position for evaluation and related functions separate from the individual program budgets.

The extra first year costs in the individual program budgets have been deleted and instead there is an annual cost adder for each program budget.

Staffing

The recommended staffing level if all programs are implemented is 10 positions. Two of these are covered (Line Items 4 and 8) in the Overall Portfolio budget. The other 8 are in the individual program budgets.

Summary of Program Level TRCs

The individual programs with their Total Resource Cost (TRC) results are as follows (the portfolio level budget items have been loaded on the portfolio TRC but not on the individual program TRCs):

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[2] Codes work for Indiana will have been specially developed for Indiana. Guidance from other states can found in the presentations at the MEEA Midwest Regional Codes Conference (http://www.mwalliance.org/policy/midwest-regional-energy-codes-conference). Codes work is carried in various states but varies considerably depending on specific codes legislation, existing staffing and training for codes enforcement, whether code enforcement is a state or county responsibility and the degree to which the energy-efficiency parts of codes are enforced.

- **Demand Programs:** C&I Peak Reduction (2.7); Residential Peak Reduction (1.5);
- **R&D:** Renewables & Demonstrations (0.3);
- **Commercial & Industrial Programs:** C&I Custom (10.9); C&I Rebates (2.8); C&I Retrocommissioning Lite (5.0); C&I HVAC and Refrigeration Optimization (1.2); C&I Audit (1.3); Energy Efficient Schools – Audit (0.4)
- **Residential Audit Programs:** Residential On-Site Audit (1.9); Residential On-Line Audit (1.0);
- **Weatherization Programs:** Residential Weatherization – Regular Income (1.5); Residential Moderate Income Qualified Weatherization (1.5); Residential Low Income Qualified Weatherization (0.6) – because we added money for Health and Safety items that belong in this program type; Residential Neighborhoods (1.6);
- **Other Residential:** Residential EE Products (1.5); Residential Home Reports (0.8) – due to the one year measure life and the PJM numbers; Energy Efficient Schools - Education (1.8); Residential New Construction (1.5); Residential Appliance Recycle (1.3); Residential Lighting (2.2)
- **Codes:** Not TRC tested – to be developed as a pilot over 3-5 years, and then converted to a program. Specific cost categories and estimation of costs will need to be developed as part of the project.

The Programs

The programs are outlined individually in this section of the report. Each program is briefly discussed in terms of:

- Rationale
- Participation & Measures
- Marketing Plan
- Program Tracking
- Budget Assumptions

The program descriptions are planning projections that can be considered initial program designs. The real program designs will be more complex and will evolve from I&M internal planning, the Oversight Board and work with program vendors on final design. Also, the operative design for each program implemented will be emergent from actual practice. Planning requires a certain linearity of thinking for use in making projections to future years. In contrast, in the direct experience of implementation each program is its own unique totality and will encounter realities that require interaction and adjustment. For this practical reason, we advocate the model of the "free administrator," [3] so that each program manager is seen as implementing a program objective but is free (with I&M and OSB review) to modify the program as it moves forward to achieve goals. The program is progressively modified to make it more relevant, efficient and effective. Just as the Technical Resource Manual (TRM) is meant to be a "living document," the programs here are understood to initial designs for "living programs" which will require improvements as they venture out into full implementation in the material world. The nature of these improvements will only be discoverable in the action of implementation.

This plan advocates 21 programs plus new program development in the codes area. The programs cover the Residential and Commercial & Industrial areas, and include both Core and Core Plus programs.[4] Planned program percentage savings are shown in Figure 1 and Table 5.

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[3] The "free administrator" is Donald Campbell's "experimental administrator": "*Experimental administrators* have justified the reform on the basis of the importance of the problem, not the certainty of their answer, and are committed to going on to other potential solutions if the first tried fails." Campbell, Donald T., "Reforms as Experiments," Pp. 7 1-100 in E.L. Streuening and M. Guttentag (eds.), *Handbook of Evaluation Research (Vol. 1)*. Beverly Hills, California: Sage, 1975. In Campbell's perspective a program is a "reform."

[4] In Indiana, Core programs are run statewide by a single program vendor; Core Plus programs are run by individual utilities. For both Core and Core Plus programs, the Oversight Board (OSB) plays a role in the final shaping of the programs and in the selection of program vendors along with the utilities.

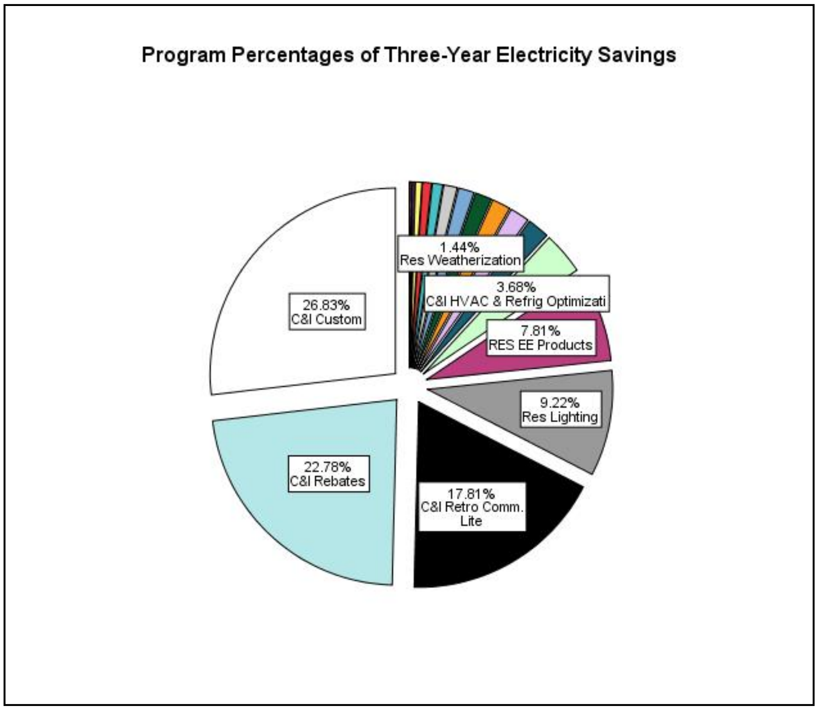

Figure 1: Planned Three-Year Savings (Percentages).

Table 5: Program Savings as Percentage of 3-Year kWh Savings.

Program	3-Year Cumulative kWh	% of Portfolio
C&I Custom	315,288,244	26.83%
C&I Rebates	267,731,772	22.78%
C&I Retro Comm. Lite	209,288,916	17.81%
Res Lighting	108,324,256	9.22%
RES EE Products	91,727,316	7.81%
C&I HVAC & Refrig Optimization	43,273,440	3.68%
Residential Home Report	22,552,050	1.92%
Res Appliance Recycle	19,811,715	1.69%
Moderate Income	18,925,036	1.61%
Res Weatherization	16,969,815	1.44%
Res On-Site Audit	16,257,330	1.38%
Income Qualified Weatherization	13,722,360	1.17%
Energy Efficient Schools - Education	10,385,244	0.88%
C&I Audit	9,056,691	0.77%
Residential Neighborhoods	6,498,701	0.55%
Res Online Audit	2,688,696	0.23%
Res New Construction	1,980,118	0.17%
Enegy Efficient Schools - Schools	614,080	0.05%
Renewables & Demonstration	107,370	0.01%
Portfolio	1,175,203,150	100.00%

Program 1: Commercial and Industrial Peak Reduction (CORE PLUS)

This program involves providing an AC cycling peak reduction measure to a wider market of small and medium-sized commercial customers as a load reduction program focused on air conditioners. It is not assumed that the program is functioning within a "smart grid" and while we recommend consideration of two-way meters for immediacy of certain verification, we assume a one-way signal with the use of meters with memory that may be queried on-site.

Rationale

Load (kW) constraints are one of the most costly events a utility encounters. During peak times when demand escalates and there is a problem with meeting demand with additional generation supply (either physically or at reasonable cost), the cost per kW to the company can escalate exponentially. For this reason, in these situations load control is essential to control costs and insure service.

Participation and Measures

Measures are shown below, followed by participation projections.

Table 6: Measures – C & I Peak Reduction

Measures
Load Control – AC Cycling

Table 7: Participation and Savings -- C&I Peak Reduction

Commercial and Industrial Peak Reduction				
Potential participants				10,290
Per participant savings (kWh):				0
Per participant savings (kW):				9.5
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	515	5.0%	0	4,910
2015	617	6.0%	0	5,882
2016	720	7.0%	0	6,864
Average	617	6.0%	0	5,885

Marketing Plans

The Marketing and Promotional Plan should include mention of the program in any communications with appropriate customers regarding energy efficiency program options and on the Company website. Additional promotion may include bill inserts and recognition window stickers for participating businesses. Customers with account representatives should be contacted through the account representatives. However, since utilities typically have fewer staff (and staff have many more responsibilities) than in the past, it may be that the most effective marketing will be through the selected program delivery agent.

The small and medium sized commercial class is not expected to be easy to enlist. Generally, these customers will be concerned about the effects of the cycling on clients (sales) and staff. It is expected that this program may cause a temperature fluctuation of about 2 degrees. If this can be communicated or demonstrated it may ease fears about effects on customers or production. The small commercial class is usually not assigned account representatives, so this will be a limiting factor in communications. The issue of owner-occupied versus tenant-occupied space will also be a challenge in promoting participation in this program. The marketing and promotion effort will give priority to owner-occupied facilities.

Program Tracking Considerations

Direct load control is data intensive and load management data is precise. When load events are called either for capacity shortages or economic emergencies, the systems self-validate. Care needs to be taken to insure the collection of data elements sufficient to show the baseline condition at the time an event is called and the response to the call as a kW effect. The duration of each event for evaluation purposes should also last long enough to show the affected units back on line to demonstrate there are no unexpected rebound effects.

Budget Assumptions

The anticipated cost to I&M for offering the medium/small commercial AC cycling component to customers involves budgets for a monthly participant incentive and payment when events are responded to. Cost to the participants is to accept the temporary load control when incidents are called.

Table 8: Estimated Three-Year Program Budget - C&I Peak Reduction

C&I Peak Reduction	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Program Costs						
Implementation & Other Annual Cost		$50,000	$50,000	$50,000	$150,000	2%
DSM Staffing		$104,794	$108,462	$112,256	$325,511	4%
Monitoring & Evaluation		$40,000	$40,000	$40,000	$120,000	2%
Variable Program Costs						
Annual Incentives	$80	$41,200	$90,560	$148,160	$279,920	4%
Delivery & Other	$3,626	$1,867,390	$2,237,242	$2,610,720	$6,715,352	88%
Total Budget		$2,103,384	$2,526,264	$2,961,136	$7,590,783	100%

Program 2: Residential Peak Reduction (CORE PLUS)

A load control program is a dispatch program. In a dispatch program, a switch can be engaged to send a signal which directly reduces load. Direct load control is an important approach to peak reduction because it offers low cost to the company and is dispatchable.

Rationale

Load (KW) constraints are one of the most costly events a utility encounters. During peak times when demand escalates and there is a problem with meeting demand with additional generation supply (either physically or at reasonable cost), the cost per kW to the company can escalate exponentially. For this reason, in these situations load control is essential to control costs and insure service.

Participation and Measures

Measures are shown below.

Table 9: Measures – Residential Peak Reduction

Measures
DLC – Residential AC

Projected participation by year is shown in the table below.

Table 10: Estimated Participation and Savings - Residential Peak Reduction

Residential Peak Reduction				
Potential participants				234,850
Per participant savings (kWh):				0
Per participant savings (kW):				0.9
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	11,743	5.0%	-	10,686
2015	14,091	6.0%	-	12,823
2016	16,440	7.0%	-	14,960
Average	14,091	6.0%	-	12,823

Marketing Plans

Marketing should take advantage of current concerns for mitigating climate problems by emphasizing a green marketing theme and can include the following elements:

- Proposed marketing efforts are to include mention of the program in any communications with customers regarding energy efficiency program options such as bill inserts, recognition window stickers for participating homes, media coverage of how to manage electric bills, customer service representatives, and promotion using the I&M website.

- Residential communications for the program can reach out to customers with high bill complaints and to customers with payment problems as well as to general promotion to customers concerned with keeping costs low and interested in mitigating global warming.

Program Tracking Considerations

Direct load control is data intensive and load management data is precise. When load events are called either for capacity shortages or as tests, the systems self-validate. Care needs to be taken to insure the collection of data elements sufficient to show the baseline condition at the time an event is called and the response to the call as a kW effect. The duration of each event for evaluation purposes should also last long enough to show the affected units back on line to demonstrate there are no unexpected effects.

Detailed Budget Plans

An estimated three-year budget for this program is provided below. Cost to the participants is to accept the temporary load control when incidents are called.

Table 11: Estimated Three-Year Program Budget – Residential Peak Reduction

Res Peak Reduction	**Cost/ Participant**	**2014**	**2015**	**2016**	**3-Yr Total**	**Percent of Total**
Fixed Program Costs						
Implementation & Other Annual Cost		$30,000	$30,000	$30,000	$90,000	0%
DSM Staffing		$104,794	$108,462	$112,256	$325,511	2%
Program Monitoring & Evaluation		$100,000	$100,000	$100,000	$300,000	1%
Variable Program Costs						
Incentives	$40	$469,720	$1,033,360	$1,690,960	$3,194,040	14%
Delivery & Other	$460	$5,401,780	$6,481,860	$7,562,400	$19,446,040	83%
Total Budget		$6,106,294	$7,753,682	$9,495,616	$23,355,591	100%

Program 3. Renewables and Demonstrations (CORE PLUS)

This program contains five program elements: Solar photovoltaic, solar hot water, ground source heat pumps, LED streetlights, and the “Go Deep” project. This program is open to new technologies as they become feasible. Each of these program elements is currently borderline cost-effective. Together, the set is not cost-effective. However, this program in included as a recommended program for three reasons. First, it is a source for a small number of technology demonstration projects that can be used for promoting interest in energy efficiency. This can include a small number of solar demonstration projects at schools, a ground source heat pump demonstration and sponsoring a few homes for the “Go Deep” project. In addition, LED streetlights are now fully available and will likely become a recommended program measure in future years.

Since most people are interested in "Green" programs, these examples will fit with and encourage this interest. Second, each of the demonstrations is at the edge of current technology in its area. This will keep key company staff current in solar, ground source, and "Go Deep" technologies. Third, each of these has sufficient scale possibilities that make them sufficiently powerful to address climate change and, at the same time, running these demonstrations will place the company in with companies in a leadership role in developing these technologies.

Rationale

Each of these program elements push technology beyond current cost-effective limits, but, at the same time, present coherent pathways towards the future of energy efficiency applications. The “Go Deep” project is based on a German model using a “passive house” strategy. The goal is to reduce energy use by eighty percent in existing homes. The principles of this approach include tight super-insulated homes with a thick building envelope and high performance windows and doors. According to the organizer of the “Go Deep” project, Linda Wigington, “Our housing is facing a crisis of obsolescence, and we have a lion share of existing houses that need to be dealt with to reduce energy in the near term.” In this approach structure and appliances are parts of the solution as is “how a family lives in a house.” “Go Deep” is a national project in which individual utilities sponsor a small number of homes in the 1,000 home pilot. Early results suggest that attaining the savings goal is possible, and the focus is on system replacements and increasing efficiencies.

Participation and Measures

Measures are shown below.

Table 12: Measures and Incentives – Renewables and Demonstrations

Measure/Program Element	Measure Number	Incentive Amount
Solar PV	Demo	100%
Solar Hot Water	Demo	100%
Ground Source Heat Pump	Demo	100%
Go Deep	Demo	100%
LED Streetlights	Demo	100%

Because this is a promotional and R&D program there will be only a very small number of projects each year.

Table 13: Estimated Participation and Savings - Renewables and Demonstrations

Renewables & Demonstration				
Potential participants				10,000
Per participant savings (kWh):				3,579
Per participant savings (kW):				1.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	5	0.1%	17,895	6
2015	5	0.1%	17,895	6
2016	5	0.1%	17,895	6
Average	5	0.1%	17,895	6

Marketing Plans

These projects will be used to create interest in energy efficiency through public demonstration projects and to provide referrals to the other programs.

Program Tracking Considerations

Since these are demonstration programs data collection will focus on technical documentation of each project.

Detailed Budget Plans

An estimated three-year budget for this program is provided below.

Table 14: Estimated Three-Year Program Budget - Renewables and Demonstrations

Renewables & Demonstrations	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Program Costs						
Implementation & Other Annual Cost		$25,000	$25,000	$25,000	$75,000	12%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	17%
Program Monitoring & Evaluation		$75,000	$75,000	$75,000	$225,000	36%
Variable Program Costs						
Incentives (paid annually to participants)	$7,590	$37,950	$37,950	$37,950	$113,850	18%
Delivery & Other	$7,000	$35,000	$35,000	$35,000	$105,000	17%
Total Budget		$207,881	$209,104	$210,369	$627,354	100%

Program 4. Commercial and Industrial Rebates (CORE)

This program targets non-residential customers eligible for prescriptive measures. These will include commercial, industrial, and institutional customers. For-profit, non-profit and public agencies (such as schools) will be included.

Rationale

Rebates are straightforward reimbursements of a portion of customer cost of specific rebated energy efficiency items. Many customers have concerns about the high first cost associated with some of the larger energy efficiency investments (e.g. HVAC systems or energy management systems). The incentives proposed will help remove that barrier.

Participation and Measures

Representative measures are shown in the table below. Measures may be added or deleted from the prescriptive list as information is gained during program planning and administration.

Table 15: Measures and Incentives – C&I Rebates

Measures	Measure Number	Incentive
Window Film	C-7	50%
Efficient Package Refrigeration	C-9	50%
Electronically Commutated Motors	C-10	50%
Premium Motors	C-11	50%
Single Application VFD	C-13	50%
Energy Star Transformers	C-14	50%
New Efficient Lighting Equipment	C-17	50%
Retrofit Efficient Lighting Equipment	C-18	50%
LED Exit Signs	C-19	50%
LED Traffic Lights	C-20	50%
Low Flow Fixtures	C-23	50%
Vending Miser and Vending Machine Timers	C-14b	50%

An offering of energy efficient products is a traditional role that customers expect from utilities. And, we know that customers tend to trust utilities above other entities in this specialized area. We expect this program to easily communicate to customers and to have substantial participation from the first year. It is important to note that unlike most other programs, participants may return repeatedly to this program to purchase additional products. Projected participation by year is shown in the table below.

Table 16: Estimated Participation and Savings - C&I Rebates

C&I Rebates				
Potential Participants				42,400
Per participant Savings (kWh):				25,564
Per Participant Savings (kW):				4.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	1,696	4.0%	43,356,544	6,879
2015	1,781	4.2%	45,529,484	7,224
2016	1,823	4.3%	46,603,172	7,394
Average	1,767	4.2%	5,163,067	7,166

Marketing Plans

This program will need to be continually advertised during its operations. We recommend some general advertising in the form of brochures and mailings targeted to potential program participants. I&M should work directly with business associations and contact some customers through account representatives.

Program Tracking Considerations

The program manager should insure that the vendor managing this program has an excellent tracking system and provision should be made to gather in-service date and technical data about equipment being replaced as well as the energy savings measures that will replace old equipment.

Detailed Budget Plans

An estimated three-year budget for the Commercial and Institutional Rebate Program is provided below. Costs to participating customers include the remainder of equipment and installation costs.

Table 17: Estimated Three-Year Program Budget – C&I Rebates

C&I Rebates	Cost per Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$50,000	$50,000	$50,000	$150,000	1%
DSM Staffing		$104,794	$108,462	$112,256	$325,511	1%
Monitoring & Evaluation		$120,000	$120,000	$120,000	$360,000	1%
Variable Costs						
Annual Incentives	$4,520	$7,665,920	$8,050,120	$8,239,960	$23,956,000	94%
Delivery & Other	$130	$220,480	$231,530	$236,990	$689,000	3%
Total Budget		$8,161,194	$8,560,112	$8,759,206	$25,480,511	100%

Program 5. Energy Efficient Schools – Audit (CORE)

The program is available to public and private schools in the service territory. The school energy use analysis and audit component of the Energy Efficient Schools Program will provide building walkthrough energy audits for school buildings. All K-12 schools that are greater than 10 years old will be eligible for an energy audit. Information on the age of buildings will be self-reported by the school districts on the audit application. The objective of the school audits is to educate school officials on the benefits of energy efficiency and the savings associated with the installation of recommended energy saving measures and operational improvements to their schools.

Rationale

The state education system is a critical activity with limited resources. The effort to increase efficiency in schools will lead to the use of resources towards a more rational allocation. Additionally, the implementation of energy efficient measures will lead to increased quality of lighting and comfort within the learning environment. There is significant potential energy savings within the education system.

Participation and Measures

Measures are shown in the table below, and may be added or subtracted during the program based on experience.

Table 18: Measures and Incentives – Residential Energy Efficient Schools - Audit

Measures – Kit Items	Measure Number	Incentive
Efficient Residential Lighting	R-11	100%
Lighting Controls	C-18	100%
LED Exit Signs	C-19	100%
Vending Machine Timers	C-31	100%
7-Plug Smart Strips	RC-1	100%

Table 19: Estimated Participation and Savings – Energy Efficient Schools – Audit

Energy Efficient Schools - Audit				
Potential Participants				320
Per participant Savings (kWh):				7,676
Per Participant Savings (kW):				2.0
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	12	3.6%	92,112	24
2015	14	4.5%	107,464	28
2016	16	5.0%	122,816	32
Average	14	4.4%	107,464	28

Marketing Plans

The school audit program will be one of two programs that will be rolled out to the school districts, using a number of marketing channels including the Special Education Planning Districts (SEDs) located throughout the state. The use of the SEDs facilities will assist the fulfillment of the program goals while addressing equitable distribution. In addition to the SEDs, program marketing, outreach and recruitment will occur through state-level organizations such as the Indiana Association of School Business Officials, and via direct outreach to the school districts themselves.

Marketing and outreach activity will be conducted initially over the phone with the Director of each Special Education District (SED) and/or the individual school districts.

Program Tracking

The program vendor will be required to perform detailed program tracking.

Budget Assumptions

An estimated three-year budget for this program is provided below. There are no costs to participating customers.

Table 20: Estimated Three-Year Program Budget – Energy Efficient Schools – Audit

Energy Efficient Schools - Schools	Cost per Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$10,000	$10,000	$10,000	$30,000	7%
DSM Staffing		$25,875	$26,781	$27,718	$80,373	19%
Monitoring & Evaluation		$75,000	$75,000	$75,000	$225,000	52%
Variable Costs						
Incentives	$1,717	$20,606	$24,041	$27,475	$72,122	17%
Delivery & Other	$600	$7,200	$8,400	$9,600	$25,200	6%
Total Budget		$138,681	$144,221	$149,793	$432,696	100%

Program 6. Commercial and Industrial Retro-Commissioning Lite (CORE PLUS)

This program targets commercial and institutional customers with a usage profile that indicates a possible high value from retro-commissioning. Although direct requests may also be received, typically the program begins off-site with a scan of billing records using EZ Sim or a similar tool. This screening process will select a pool of buildings for which it looks like retro-commissioning is highly likely to produce substantial energy savings. Building commissioning is a process that is associated with new buildings; a quality assurance process that is followed to facilitate new buildings performing as designed. Retro-commissioning applies a similar process to existing buildings. The goal is insure that a building operates efficiently and effectively. The focus of this pilot program is in insuring efficient operation, rather than on upgrading equipment. The program conducts a low-cost “tuning” of electricity related building systems. The tuning typically involves control systems such as energy management systems that may be improperly programmed, or controls that are out of calibration. When problems are identified and demonstrated, they may have major economic effects. When this type of problem exists, retro-commissioning resolves such problems at low cost.

There is single measure, retro-commissioning. This project will also feed participants towards the Commercial & Industrial Rebates Program and the Commercial & Industrial Custom Program.

Rationale

Most buildings have never been commissioned, so the commissioning of an existing building may be able to identify and correct high priority operating deficiencies and verify proper operations. The focus will typically be on energy-using equipment, lighting, and controls. Further, this program is designated as “retro-commissioning lite,” since it will involve engagements of about $4,000 per building[5], rather than the $10,000 to $52,000 associated with

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[5] This is per building; an individual project may have more than one building.

full retro-commissioning.[6] The objective will be to find the best buildings for the program. These will be buildings with significant energy problems that can be easily detected and easily fixed. Energy savings will be documented by engineering calculations and evaluated using EZ Sim. The persistence of energy savings will also be tested.

Participation and Measures

Measures are listed below.

Table 21: Measures and Incentives – C&I Retro-Commissioning Lite

Measure	Measure Number	Incentive Amount
Retro Commissioning Engagement	C-3	$750

Table 22: Estimated Participation and Savings – C&I Retro-Commissioning Lite

C&I Retro Commissioning Lite				
Potential Participants				42,400
Per participant Savings (kWh):				26,253
Per Participant Savings (kW):				4.3
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	1,060	2.5%	27,828,180	4,583
2015	1,442	3.4%	37,856,826	6,234
2016	1,908	4.5%	50,090,724	8,249
Average	1,470	3.5%	38,591,910	6,355

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[6] See Haasl &Terry Sharp, A Practical Guide for Commissioning Existing Buildings. Washington, DC: Office of Building Technology, State and Community Programs, US Department of Energy. Prepared by Portland Energy Conservation, Inc. and Oak Ridge National Laboratory, April 1999.

Marketing Plans

We recommend some general advertising within the business community, primarily in the form of brochures and mailings targeted to potential program participants; also coordination with business associations.

Program Tracking Considerations

The program manager should collect, at a minimum, information about all customer electrical equipment, hours of operation, etc. The major concern will be for complete and accurate documentation of "before" and "after" energy use and demand impacts. In addition, a way to monitor the duration of energy savings and demand reduction should also be included.

Detailed Budget Plans

An estimated three-year budget for this program is provided below. Costs to participating customers include the remainder of equipment costs. Note that the delivery cost shows as zero. This is due to bundling delivery cost into the $1,500 per site (see incentive of $750 under variable costs) and the $50,000 per year for implementation and other annual costs.

Table 23: Estimated Three-Year Program Budget – C&I Retro-Commissioning Lite

C&I Retro Comm. Lite	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$50,000	$50,000	$50,000	$150,000	4%
DSM Staffing		$69,863	$72,308	$74,837	$217,007	5%
Monitoring & Evaluation		$120,000	$120,000	$120,000	$360,000	9%
Variable Costs						
Incentives	$750	$795,000	$1,081,500	$1,431,000	$3,307,500	82%
Delivery & Other	$0	$0	$0	$0	$0	0%
Total Budget		$1,034,863	$1,323,808	$1,675,837	$4,034,507	100%

This program also serves as a feeder program for the prescriptive program (Program 5, C&I Rebates).

Program 7. Commercial and Industrial HVAC and Refrigeration Optimization (CORE PLUS)

This program was designed on the premise that much commercial, industrial, and institutional Heating Ventilation and Cooling is not operating as planned. A typical assignment envisioned in this program is to do on-site testing of HVAC units, and review their operation as an integrated building system. For example, out of twelve rooftop units, it is likely that two will be operating out of specification due to improper installation, subsequent damage to units, or problems with controls. In the case of a large school, built in sections over time, it would not be unusual to find adjacent units, some cooling and some heating, and other units damaged while most units are performing as designed.

Rationale

Most buildings have never had a focused look at the working of the HVAC systems. This program will deploy HVAC specialists to test units and make recommendations for their efficient operation as a building system. This will primarily involve repair of units and control adjustments, but may also involve recommendations for modification to air circulation within buildings.

Participation and Measures

Measures are listed below.

Table 24: Measures and Incentives – C&I HVAC and Refrigeration Optimization

Measure	Measure Number	Incentive Amounts
Small HVAC Optimization	C-2	50%
Grocery Refrigeration Tune-Ups and Improvements	C-29	50%
Refrigeration Casework Improvements	C-30	50%

Participation is indicated in the table below.

Table 25: Estimated Participation and Savings – C&I HVAC and Refrigeration Optimization

C&I HVAC & Refrigeration Optimization				
Potential Participants				25,100
Per participant Savings (kWh):				7,155
Per Participant Savings (kW):				1.2
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	853	3.4%	6,103,215	1,056
2015	1,054	4.2%	7,541,370	1,305
2016	1,381	5.5%	9,881,055	1,710
Average	1,096	4.4%	7,841,880	1,357

Marketing Plans

It is likely that company representatives can help develop lists of buildings that will be likely candidates for this program. In addition, there should be coordination with business associations. The budget below provides for some general advertising at business events, as well as brochures and premiums.

Program Tracking Considerations

This is an applied technical program that will be dependent on the quality and completeness of technical drawings and brief technical explanation provided by the program staff. Evaluation will rely on this information and may also involve spot metering and (where applicable) billing analysis.

Detailed Budget Plans

An estimated three-year budget for this program is provided below. Costs to participating customers include the remainder of costs (for repairs to HVAC equipment and remodeling to permit better airflow within buildings).

Table 26: Estimated Three-Year Program Budget – C&I HVAC and Refrigeration Optimization

C&I HVAC & Refrig Optimization	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$50,000	$50,000	$50,000	$150,000	4.4%
DSM Staffing		$69,863	$72,308	$74,837	$217,007	6.4%
Monitoring & Evaluation		$100,000	$100,000	$100,000	$300,000	8.8%
Variable Costs						
Incentives	$830	$707,990	$874,820	$1,146,230	$2,729,040	80.4%
Delivery & Other	$0	$0	$0	$0	$0	0%
Total Budget		$927,853	$1,097,128	$1,371,067	$3,396,047	100%

This program also serves as a feeder program for the prescriptive program (Program 5, C&I Rebates).

Program 8. Commercial and Industrial Audit (CORE PLUS)

This program is targeted to small commercial/retail establishments, food service facilities and grocery store/supermarkets. It consists of refrigeration casework improvements, improvements to refrigeration setpoints to reduce load, restaurant commissioning audits (designed to optimize controls and limit energy losses in food service facilities) and a commercial LED bulb change out. The program will also serve as a feeder to Program 5, C&I Rebates.

Rationale

There are consistent energy savings to be obtained from food service facilities (primarily restaurants) and the refrigeration end-use in grocery stores and supermarkets. There are four DSM measures in this program, listed in the table below.

Participation and Measures

Measures are listed below.

Table 27: Measures and Incentives – C&I Audit

Measure	Measure Number	Incentive Amount
Small Commercial LED Change out	C-21	100%
Restaurant and Grocery Audit	C-28	100%
Grocery Refrigeration Tune-Up and Improvements	C-29	50%
Refrigeration Casework Improvements	C-30	50%

Participation is indicated in the table below.

Table 28: Estimated Participation and Savings – C&I Audit

C&I Audit				
Potential Participants				2,470
Per participant Savings (kWh):				15,973
Per Participant Savings (kW):				2.3
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	86	3.5%	1,373,678	194
2015	99	4.0%	1,581,372	224
2016	111	4.5%	1,773,003	251
Average	99	4.0%	1,182,002	167

Marketing Plans

It is likely that company representatives can develop lists of buildings that will be likely candidates for this program. In addition, there should be coordination with business associations. There are two audit paths for measure implementation within this program. The LED change out measure is to be managed as an independent feature and a "feeder" to the efficiency audit measure. In this case a local lighting supplier is hired as the ESCO for this measure with pre-approved rates for material and labor based solely on a per-bulb basis. As teams of installers contact potential businesses an agreement to include a C&I audit for grocery/supermarket and food service facilities will be required to receive the 100% incented LED bulb offering. During a normal C&I measure audit, in absence of the LED bulb contact, the offering of the LED change out will be made in addition to those measures and programs made available through the audit process.

Program Tracking Considerations

This is an applied technical program that will be dependent on the quality and completeness of technical drawings and brief technical explanation provided by the program staff developed on-site for each project.

Detailed Budget Plans

An estimated three-year budget for this program is provided below.

Table 29: Estimated Three-Year Program Budget – C&I Audit

C&I Audit	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$50,000	$50,000	$50,000	$150,000	15%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	11%
Monitoring & Evaluation		$45,000	$45,000	$45,000	$135,000	13%
Variable Costs						
Incentive	$1,970	$169,420	$195,030	$218,670	$583,120	57%
Delivery & Other	$130	$11,180	$12,870	$14,430	$38,480	4%
Total Budget		$310,531	$339,054	$365,519	$1,015,104	100%

This program also serves as a feeder program for the prescriptive program (Program 5, C&I Rebates).

Program 9. Commercial and Industrial Custom (CORE PLUS)

This program targets only commercial, industrial and institutional accounts. The program is a totally custom program, designed to develop exceptionally productive energy savings opportunities in cooperation with the customer. Each project will be specially designed. The incentive is projected to be fifty percent of incremental cost. It is expected that projects will need to be carried out in narrow time windows as dictated by conditions specific to the customer's operations and that evaluation will consist primarily of short term instrumentation and spot metering. For the first nine months of each program year, no project may be allocated more than ten percent of the measures budget allocated for this program. The hurdle rate for projects under this program will be set to insure only the most cost-effective projects are selected so as to insure cost recovery.

Rationale

Some commercial and institutional customers will offer special opportunities for energy savings, either brought to I&M by the customer (or the customer's ESCO), or as identified by company account representatives and engineers. By providing a fifty percent "buy down," customer projects will be likely to move forward. Experience will show whether a fifty percent buy down is enough to attract projects. If this percentage proves too low (based on response to the program) the percentage buy down will be raised. Experience with similar projects in the Northeast has led utilities to offer 90 percent to 75 percent buy downs in this program sector. The hurdle rate (payment for savings) for the program will be set to insure I&M only acquires cost-effective projects.

Participation and Measures

Measures are shown below.

Table 30: Measures and Incentives – C&I Custom

Measures	Measure Number	Incentive
Customer Specified (Electric)	NA	Cost share of study to develop project proposal and 50% of energy efficiency improvements
Energy Champion (Large Industrial)	NA	
Integrated Building Design	C-8	

Table 31: Estimated Participation and Savings - C&I Custom

C&I Custom				
Potential Participants				4,000
Per participant Savings (kWh):				870,962
Per Participant Savings (kW):				143.3
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	54	1.4%	47,031,948	7,738
2015	64	1.6%	55,741,586	9,171
2016	72	1.8%	62,709,264	10,318
Average	63	.6%	55,160,927	9,076

Because of the custom nature of the project, there will not be a large number of participants in any one year. Each participant, in this type of program, is special which makes tailoring to specific customers unique. In encouraging participation, it is important to recognize that standard baselines such as current practice for an industry or least cost alternative do not work for custom settings. Recognizing the unique baseline for each site, which will depend on the business operating procedures and on interactive equipment as much or more than on market factors should help in recruitment of participants

Marketing Plans

An example of this type of program is NSTAR Electric's Compressed Air Leak Detection and Remediation Program (www.compressedairchallenge.org and www.nstaronline.com/business/energy_efficiency). Also see Pacific Power's Energy FinAnswer and Energy FinAnswer Express programs, the WPPI, SDG&E and Mid-American Large Bid Programs and the Xcel Energy Large Industrial Process Improvement Program. It is expected that these will be high return projects in terms of savings achieved. The program approach is to "get out of the box" of conventional utility DSM programs to embrace programs that large customers may pursue for reasons of overall industrial efficiency. While both gas and electric energy will need to be analyzed, the Company would fund portions of these projects that produce electrical demand reductions and energy savings.

Program Tracking Considerations

Data requirements will vary with the specifications for each project. In some cases, utility billing meter information is capable of the level of detail required to assess program impacts. In other cases, spot metering or other types of assessment may be required. In any case, the program manager should collect, at a minimum, information about all customer electrical equipment, hours of operation, etc. It is expected that evaluations will primarily take the form of short term instrumentation and spot metering with engineering review. Since these are custom projects, it will be particularly important in insure provision is made to assess the kWh and/or kW condition that constitutes the baseline, and then measure the change due to the DSM improvements.

Detailed Budget Plans

An estimated three-year budget for this program is provided below. Costs to participating customers include the remainder of energy study cost to develop project proposals, provision for staff involvement in developing and monitoring the project, and the remainder of equipment costs.

Table 32: Estimated Three-Year Program Budget – C&I Custom

C&I Custom	**Cost per Participant**	**2014**	**2015**	**2016**	**3-Yr Total**	**Percent of Total**
Fixed Costs						
Implementation & Other Annual Cost		$30,000	$30,000	$30,000	$90,000	2%
DSM Staffing		$69,863	$72,308	$74,837	$217,007	4%
Monitoring & Evaluation		$120,000	$120,000	$120,000	$360,000	7%
Variable Costs						
Incentives	$21,360	$1,153,440	$1,367,040	$1,537,920	$4,058,400	79%
Delivery & Other	$2,000	$108,000	$128,000	$144,000	$380,000	7%
Total Budget		$1,481,303	$1,717,348	$1,906,757	$5,105,407	100%

Program 10. Residential Home Energy Audit (CORE)

This program targets single-family and multi-family homes for a series of low-cost direct installed measures. Onsite walkthroughs are performed and recommendations are given for targeted weatherization retrofits that are needed and guidance is given to help the customer achieve greater savings in the home. The program delivery agent is responsible for the outreach and performance of the program and deemed savings are determined on a per site basis.

Rationale

The On-Site Audit with direct install program element will provide households with a walk-through examination of their home by a trained auditor. The auditor will convey energy saving tips during the walk-through, and attempt to be comprehensive in their assessment of opportunities. The recommendations of the auditor are expected to be standard measures associated with whole house weatherization, such as ceiling insulation, wall insulation, air sealing, etc. At the same time, during the walk-through audit, the auditor will install the measures at no cost to the customer.

Participation and Measures

Measures are listed below.

Table 33: Measures and Incentives – Residential Home Energy Audit

Measure	Measure Number	Incentive Amounts
Efficient Residential Lighting	R-11	100% of incremental cost
Low Flow Fixtures	R-12	100% of incremental cost
WH Tank/Pipe Wrap and Temp Setpoint	R-13	100% of incremental cost

Projected participation is shown in the table below.

Table 34: Estimated Participation and Savings – Residential Home Energy Audit

Residential Home Energy Audit				
Potential Participants				389,500
Per participant Savings (kWh):				465
Per Participant Savings (kW):				0.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	6,201	1.6%	2,883,465	741
2015	5,453	1.4%	2,535,645	652
2016	5,453	1.4%	2,535,645	652
Average	5,702	1.5%	2,651,585	681

Marketing Plan

Marketing and customer communications will be orchestrated through the CORE program's contractor and the Utilities. Working together the groups will orchestrate a messaging campaign that will develop a target list of potential customers and ensure that customers understand the program benefits. The development of scheduled site visits will be orchestrated using a variety of outreach platforms including, direct mail, internet, email, call center and via neighborhood canvassing. All enrollment methods will provide detailed information to the customer regarding the scope of program operations.

Program Tracking Considerations

The CORE program contractor will be required to maintain a program tracking database.

Detailed Budget Plans

An estimated three-year budget for this program is provided below. This program is provided at no cost to the customer. Due to the cost reimbursement mechanism established for gas treated homes, costs associated with measures that produce gas savings but no electric savings are not included. Gas savings are not included in the model.

Table 35: Estimated Three-Year Program Budget – Residential Home Energy Audit

Res On-Site Audit	**Cost per Participant**	**2014**	**2015**	**2016**	**3-Yr Total**	**Percent of Total**
Fixed Costs						
Implementation & Other Annual Cost		$10,000	$10,000	$10,000	$30,000	2%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	6%
Monitoring & Evaluation		$30,000	$30,000	$30,000	$90,000	5%
Variable Costs						
Incentive	$37	$230,057	$202,306	$202,306	$634,670	37%
Delivery & Other	$50	$310,050	$272,650	$272,650	$855,350	50%
Total Budget		$615,038	$551,110	$552,375	$1,718,523	100%

Program 11. Residential Lighting (CORE)

The Residential Lighting program is focused on providing wholesale incentives to buy down or mark down the incremental cost of CFLs, LEDs, and other efficient lighting fixture and control systems.

The promotion will provide discounts to utility customers toward the purchase of CFLs, LEDs, and other ENERGY STAR qualified lighting efficiency products.

Rationale

The Residential Lighting program elements both improve the product mix in favor of energy efficient technologies for the service territory by promoting the purchase and stocking of efficient replacement units. Energy Star has overcome all of the defects of the earlier local or regional promotional programs through a single national program structured to periodically advance program standards and regulate minimum efficiencies. At the same time, it is structured to work with regional marketing initiatives and local promotion.

Participation and Measures

Measures are shown in the table below.

Table 36: Measures and Incentives - Residential Lighting

Measures/Program Element	Measure Number	Incentive Amount
Efficient Residential Lighting	R-11	66%

Projected participation by year is shown in the table below.

Table 37: Estimated Participation and Savings - Residential Lighting

Residential Lighting				
Potential Participants (yearly)				389,500
Per participant Savings (kWh):				274
Per Participant Savings (kW):				0.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	60,373	15.5%	16,542,202	3,816
2015	70,110	18.0%	19,210,140	4,432
2016	74,005	19.0%	20,277,370	4,678
Average	68,163	17.5%	18,676,571	4,309

Marketing Plans

The program delivery agent will perform regular store visits to actively engage customers in Indiana with messages about the cost savings and environmental benefits of energy efficient lighting products. Promotional lighting program labeling and signage will be placed in retail locations that promote the participant products and provide customers with cost and efficiency value information. Activities within retail events may include a booth, educational materials and hands-on activities.

Program Tracking Considerations

Data collection and documentation for program purposes and monthly/annual reporting will be included as features of the vendor program.

Detailed Budget Plans

An estimated three-year budget for this program is provided below.

Table 38: Estimated Three-Year Program Budget – Residential Lighting

Residential Lighting	Cost per Participant	2014	2015	2016	3-Yr Total	Percent of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	0.4%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	0.8%
Monitoring & Evaluation		$50,000	$50,000	$50,000	$150,000	1.1%
Variable Costs						
Incentives	$63	$3,803,499	$4,416,930	$4,662,315	$12,882,744	90.6%
Delivery & Other	$5	$301,865	$350,550	$370,025	$1,022,440	7.2%
Total Budget		$4,210,295	$4,873,634	$5,139,759	$14,223,688	100%

Program 12. Energy Efficient Schools – Education (CORE)

The program is available to public and private schools in the service territory for students in grades 5 and 6. The goal is to educate students about energy use and to produce cost effective electric and natural gas savings by influencing students and their families to focus on conservation and efficient use of electricity. Each eligible student will receive a kit of low-cost efficiency measures and educational materials.

Rationale

Education programs have in the past largely been seen as a part of the public service role of utilities and have generally emphasized information about the science of electricity and safety around power lines or when using electricity. The current program emphasizes the problem of assessing opportunities to make a home more energy efficient, joined with an opportunity to install kit items.

Education programs are important even without immediate energy savings because the substantial payoff for these programs is in the knowledge gained by the students and the potential influence it will have in their ability to make smart energy choices over the life course. The assessed savings for this program come from the kit measures installed.

Participation and Measures

Measures are shown in the table below, and may be added or subtracted during the program based on experience.

Table 39: Measures and Incentives – Residential Energy Efficient Schools - Education

Measures – Kit Items	Measure Number	Incentive
Efficient Residential Lighting	R-11	100%
Low Flow Fixtures	R-12	100%

Table 40: Estimated Participation and Savings – Energy Efficient Schools - Education

Energy Efficient Schools - Education				
Potential Participants				5,729
Per participant Savings (kWh):				318
Per Participant Savings (kW):				0.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	5,443	95.0%	1,730,874	446
2015	5,443	95.0%	1,730,874	446
2016	5,443	95.0%	1,730,874	446
Average	5,443	95.0%	1,730,874	446

Marketing Plans

This program is unusual because its success depends on considerable ongoing effort to work with school organizations at several levels in order to insure institutional support and to promote enthusiasm for the program among teachers and students.

Program Tracking

The program requires detailed reporting on school, classroom and student participation rates, allocation of kits, and documentation of kit items installed. All data requirements should be part of the program database maintained by the program vendor.

Budget Assumptions

An estimated three-year budget for this program is provided below. There are no costs to participating customers. Due to the cost reimbursement mechanism established for gas treated homes, costs associated with measures that produce gas savings but no electric savings are not included. Gas savings are not included in the model.

Table 41: Estimated Three-Year Program Budget – Energy Efficient Schools – Education

Energy Efficient Schools - Education	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	5.2%
DSM Staffing		$25,875	$26,781	$27,718	$80,373	7.0%
Monitoring & Evaluation		$75,000	$75,000	$75,000	$225,000	19.6%
Variable Costs						
Incentives	$23	$124,645	$124,645	$124,645	$373,934	32.6%
Delivery & Other	$25	$136,075	$136,075	$136,075	$408,225	35.6%
Total Budget		$381,595	$382,500	$383,437	$1,147,532	100%

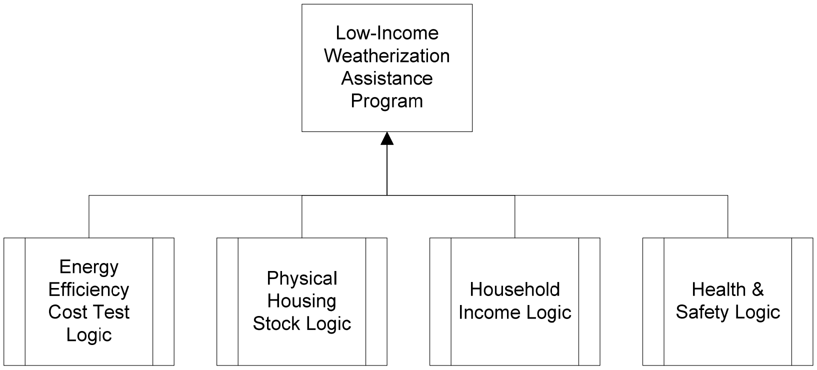
Program 13. Income Qualified Weatherization (CORE)

This program will serve income qualified residential customers. The program element is the Residential Low Income Program which will serve customers up to an including 200 percent of the Federal Poverty Level. The program is oriented toward single-family detached homes. .

Rationale

Low-income programs are different from traditional DSM programs. They are a special case in that they attempt to cover four objectives:

1. Like other DSM programs, a core objective is to provide energy savings (DSM savings).
2. Unlike other DSM programs, a second core objective is to provide repairs necessary to install energy savings improvements in a part of the housing stock that is often old and substandard in comparison to middle and upper income housing.
3. Provide DSM service to customers who otherwise could not obtain DSM improvements due to cost.
4. Due to problems with low-income housing stock, address health and safety concerns.



For these reasons, the prevailing practice in the area of low-income programs is not to focus solely on the “California tests” traditionally used in DSM program review.[7] Instead,

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[7] For low-income programs, program cost-effectiveness is a lesser issue, although still an important objective. Because of their particular focus on the special needs of disadvantaged households, low-income energy efficiency programs are generally not held to the same cost-effectiveness criteria as utility energy-efficiency “resource” programs (i.e., while test results are calculated for consideration as one factor, they are not judged with a strict “total resource cost” test, or TRC). More typically, the focus is on the magnitude of utility bill savings to participating customers, rather than the utility system avoided energy supply costs. Also, low-income programs often include

commissions have been adopting different tests for low-income programs. For example, the DC Commission uses an "Expanded All Ratepayers Test" (incorporating several "non-energy benefits" for low-income programs if the Benefit Cost ratio on the initial TRC test is 0.8 or above). The California commission uses a "Modified Participant Test" and a Utility Cost Test (including "non-energy benefits") for screening measures for low-income programs. A measure is accepted into the program if it passes either test. Thus, the Total Resource Cost (TRC) test result for the Southern California Edison Low-Income Energy Management Assistance Program was 0.63 for 2004 and 0.61 for 2005. Similarly, the TRC for Pacific Gas & Electric's Low-Income Energy Partners Program was 0.41 for 2004.[8]

Unlike most of the DSM programs in this report, the Income Qualified Weatherization Program will also serve homes heated with natural gas up to the limit of reimbursement by gas companies. Due to the cost reimbursement mechanism established for gas treated homes, costs associated with measures that produce gas savings but no electric savings are not included. Gas savings (therms) are also not included in the spreadsheet models.

Participation and Measures

The types of weatherization measures to be offered are shown in the table below. This program is free to qualifying participants each year until funds are exhausted.

Table 42: Measures – Residential Income Qualified Weatherization

Measure	Measure Number
Ceiling Insulation/Attic Insulation	R-2
Refrigerator Charge and Duct Tune-Up	R-4
House Sealing Using Blower Door	R-5
Efficient Residential Lighting	R-11
Low Flow Fixtures	R-12
Tank Wrap, Pipe Wrap and Water Temp Setpoint	R-13

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broader "non-energy benefits" (NEBs) such as lowered credit and collection costs and avoided bad debt for the utility, and improved health and safety for customers. See: Kushler, Martin, Dan York & Patti Witte, "Meeting Essential Needs: The Results of a National Search for Exemplary Utility-Funded Low-Income Energy Efficiency Programs." Washington, DC: American Council for an Energy-Efficient Economy, Report Number U053, September 2005.

[8] For differences in the treatment of TRC with respect to low-income programs in several jurisdictions, please see: https://dl.dropbox.com/u/12011114/The%20TRC%20and%20Low-Income.pdf

Table 43: Canvassing Measures – Residential Income Qualified Weatherization

Measure	Measure Number
7-Plug Smart Strips	RC-1
Compact Fluorescent Light	RC-2

Table 44: Estimated Participation and Savings - Residential Income Qualified Weatherization

Income Qualified Weatherization				
Potential Participants				135,500
Per participant Savings (kWh):				1,730
Per Participant Savings (kW):				0.6
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	1,322	1.0%	2,287,060	810
2015	1,322	1.0%	2,287,060	810
2016	1,322	1.0%	2,287,060	810
Average	1,322	1.0%	2,287,060	810

Marketing Plans

Marketing will be performed as a combined effort between the utility and the program delivery agent. Identified communities will receive program information and canvassing dates during which time each home will be approached for weatherization services on a door-to-door basis.

Program Tracking Considerations

Data collection and documentation for program purposes and annual reporting will require a tracking system. The selected delivery contractor will be requested to carry out most of the data entry for this system.

Detailed Budget Plans

An estimated three-year budget for this program is provided below. Costs to participating customers will be customer’s time and permitting access to the home for improvements.

Table 45: Estimated Three-Year Program Budget – Residential Income Qualified Weatherization

Income Qualified Weatherization	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	0.6%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	1.1%
Program Monitoring & Evaluation		$120,000	$120,000	$120,000	$360,000	3.7%
Variable Costs						
Incentives	$574	$759,452	$759,452	$759,452	$2,278,356	23.4%
Delivery & Other	$1,750	$2,313,500	$2,313,500	$2,313,500	$6,940,500	71.2%
Total Budget		$3,247,883	$3,249,106	$3,250,371	$9,747,360	100%

Program 14. Residential Weatherization (CORE PLUS)

This program provides a home weatherization inspection audit, blower-door leak test and recommendations to the homeowner for incented weatherization measures. This program targets electrically heated homes that have incomes above the qualification criteria for the moderate and income qualified weatherization program. The program is designed to ensure the retrofit installation of major weatherization measures in households.

Rationale

The program is designed to promote whole-house or near whole-house weatherization for families above moderate incomes.

Participation and Measures

Measures are shown in the table below, and may be added or subtracted during the program based on experience.

Table 46: Measures and Incentives – Residential Weatherization

Measure	Measure Number	Incentive Amounts
Wall Insulation	R-1	40%
Ceiling Insulation	R-2	40%
Programmable Thermostats	R-3	40%
Refrigerator Charge and Duct Repair	R-4	40%
House Sealing Using Blower Door	R-5	40%
Low Flow Fixtures	R-12	40%
HW Tank/Pipe Wrap and Temperature Setpoint	R-13	40%

Projected participation is shown in the table below.

Table 47: Estimated Participation and Savings - Residential Weatherization

Residential Weatherization				
Potential Participants				56,724
Per participant Savings (kWh):				2,085
Per Participant Savings (kW):				0.9
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	1,333	2.4%	2,779,305	985
2015	1,361	2.4%	2,837,685	1,005
2016	1,418	2.5%	2,956,530	1,047
Average	1,371	2.4%	2,857,840	1,012

Marketing Plans

I&M will need to actively market this program in customer communications, such as bill stuffers and radio or television spot advertisements. Employees can also make customers aware of this program if they contact the company about energy efficiency or a need to lower bills.

Program Tracking Considerations

Data collection and documentation for program purposes and annual reporting will require a tracking system. The selected delivery contractor will be requested to carry out most of the data entry for this system. All data requirements should be part of the program database.

Detailed Budget Plans

An estimated three-year budget for this program is provided below.

Table 48: Estimated Three-Year Program Budget – Residential Weatherization

Res Weatherization	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	1%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	2%
Monitoring & Evaluation		$100,000	$100,000	$100,000	$300,000	6%
Variable Costs						
Incentives (paid annually to participants)	$419	$557,994	$569,715	$593,575	$1,721,283	33%
Delivery & Other	$750	$999,750	$1,020,750	$1,063,500	$3,084,000	58%
Total Budget		$1,712,675	$1,746,618	$1,814,493	$5,273,787	100%

Program 15. Moderate Income Weatherization (CORE PLUS)

This program provides a home weatherization inspection audit and blower-door leak tests and recommendations to the homeowner for incented weatherization measures. This program targets electrically heated homes that have incomes above the qualification criteria for the Core Income Qualified Weatherization program but below 300% FPL. The program is designed to ensure the retrofit installation of major weatherization measures in households.

Rationale

The program is designed to promote whole-house or near whole-house weatherization for families of moderate income. The program designed incentive is lower than the Core Income Qualified Weatherization program but more than the Core Plus Residential Weatherization Program. Some health and safety repair costs are included in the implementation budget.

Participation and Measures

Measures are shown in the table below, and may be added or subtracted during the program based on experience.

Table 49: Measures and Incentives – Moderate Income Weatherization

Measure	Measure Number	Incentive Amounts
Wall Insulation	R-1	50%
Ceiling Insulation	R-2	50%
Programmable Thermostats	R-3	50%
Refrigerator Charge and Duct Repair	R-4	50%
House Sealing Using Blower Door	R-5	50%
Residential Efficient Lighting	R-11	100%
Low Flow Fixtures	R-12	50%
HW Tank/Pipe Wrap and Temperature Setpoint	R-13	50%

Projected participation is shown in the table below.

Table 50: Estimated Participation and Savings – Moderate Income Weatherization

Moderate Income Weatherization				
Potential Participants				17,650
Per participant Savings (kWh):				4,124
Per Participant Savings (kW):				1.5
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	706	4.0%	2,911,544	1,031
2015	794	4.5%	3,274,456	1,160
2016	883	5.0%	3,641,492	1,290
Average	794	4.5%	3.275,831	1,160

Marketing Plans

I&M will need to actively market this program in customer communications, such as bill stuffers and radio or television spot advertisements. Employees can also make customers aware of this program if they contact the company about energy efficiency or a need to lower bills.

Program Tracking Considerations

Data collection and documentation for program purposes and annual reporting will require a tracking system. The selected delivery contractor will be requested to carry out most of the data entry for this system. All data requirements should be part of the program database.

Detailed Budget Plans

An estimated three-year budget for this program is provided below.

Table 51: Estimated Three-Year Program Budget – Moderate Income Weatherization

Moderate Income	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	1%
DSM Staffing		$25,875	$26,781	$27,718	$80,373	1%
Monitoring & Evaluation		$100,000	$100,000	$100,000	$300,000	5%
Variable Costs						
Incentives	$756	$533,612	$600,125	$667,393	$1,801,131	28%
Delivery & Other	$1,750	$1,235,500	$1,389,500	$1,545,250	$4,170,250	65%
Total Budget		$1,914,987	$2,136,406	$2,360,361	$6,411,754	100%

Program 16. Residential Energy Efficient Products (CORE PLUS)

This program will provide rebates to I&M customers toward the purchase energy efficient appliances including ductless heat pumps, heat pump water heater, and selected consumer electronics. Cool roof materials will also be included.

The dollar amount for the appliance incentive for this promotion is lower than might be expected based on industry experience in prior years. This is due in part to recent changes in the Energy Star program and the overall success of the Energy Star strategy as demonstrated by the gradual increase in energy efficiency of base case (non-Energy Star) equivalent products. Refrigerators may be included based on analysis as new Energy Star refrigerator standards go into effect. Currently some DSM administrators, such as the Energy Trust of Oregon, offer refrigerator rebates only on Consortium for Energy Efficiency (CEE) Tier 3 refrigerators. Rebates for energy efficient appliances should be set using Consortium for Energy Efficiency tiers.

Rationale

Energy efficient appliances and other residential products improve the product mix in favor of energy efficient technologies for the service territory by promoting the purchase and stocking of efficient replacement units. Appliance promotions are best developed on a national level with participation by utilities and governments. Energy Star has overcome all of the defects of the earlier local or regional promotional programs through a single national program structured to periodically advance program standards and regulate minimum efficiencies. At the same time, it is structured to work with regional marketing initiatives and local promotion.[9]

Participation and Measures

Representative measures are shown in the table below.

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[9] For an example of the history of the residential clothes washer initiative, see Shel Feldman Management Consulting, Research into Action incorporated, and Xenergy incorporated, *The Residential Clothes Washer Initiative, A Case Study of the Contributions of a Collaborative Effort to Transform the Market*, prepared for the Consortium for Energy Efficiency, June 2001.

Table 52: Measures and Incentives – Residential Energy Efficient Products

Measures	Measure Number	Incentive
Cool Roofs	R-7	50%
Electric Heat to SEER 16 Heat Pump	R-8	50%
Energy Star Clothes Washer	R-10	50%
Heat Pump Water Heater	R-14	50%
Ductless Heat Pump	R-15	50%

Table 53: Estimated Participation and Savings – Residential Energy Efficient Products

RES EE Products				
Potential Participants (yearly)				389,500
Per participant Savings (kWh):				801
Per Participant Savings (kW):				0.2
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	19,086	4.9%	15,287,886	3,542
2015	19,086	4.9%	15,287,886	3,542
2016	19,086	4.9%	15,287,886	3,542
Average	19,086	4.9%	15,287,886	3,542

Because of normal consumption trends, a large numbers of customers are expected to participate in this program from the beginning. Note that for this program customers may repeat in different years. The offer of energy efficient products is a long established role for utilities. Also, customers tend to trust utilities for information on energy efficiency. Communication with customers regarding offerings in this program is expected to proceed with ease.

Marketing Plans

Proposed marketing efforts focus on coordinated advertising with selected retail outlets, general media ads and bill stuffers. This type of program is best implemented using program implementation vendors. The program elements exist in nationally available programs for utilities to implement, and selection of a regional vendor will provide added value in the form of detailed program and technology knowledge and relationships. A basic assumption in the development of this program is that it is not so much the size of the rebate so much as the existence of a rebate and the skill in developing engaging promotions and long-term relationships with the appliance industry and dealers that will help move the more energy-efficient products.[10]

The basic marketing goals for the appliance program elements come from the Consortium for Energy Efficiency and Top Ten™ and are provided below:[11]

- Consumers understand and value the benefits from energy-efficient features.
- Retail sales force is knowledgeable about Energy Star and considers it a meaningful distinction for making a sale.
- Rebate stickers are on appliances on retail sales floors.
- Manufacturers market and promote energy-efficient products and/or features.
- Energy efficiency, defined by Energy Star performance levels, becomes a standard feature or is available across all manufacturers' product lines.
- Energy Star represents the most energy efficient quality products available, but generally now serve as the base and the rebated appliance is typically a Tier 3 Consortium for Energy Efficiency retail appliance or a Top Ten™ level Energy Star appliance. *Though we refer to the efficient alternative as Energy Star, we really mean Consortium for Energy Efficiency Tier 3 or Top Ten™ appliances.*

In this program, I&M will be an active participant in the US Energy Star campaign. Through this participation, it is expected that the company will move more Energy Star products into retail stores, help make energy efficient lighting more affordable to its customers, and provide a continuing and responsible guidance and energy efficiency education message to customers.

Incentives may be implemented by coupons, in-store markdowns, or upstream manufacturer buy-downs. A coupon approach is more suitable for a service territory because it gives the program administrator direct control over where coupons are available and for which sales outlets.

Program Tracking

Data collection and documentation for program purposes and monthly/annual reporting will be included as features of the vendor program "package." Data estimation of the baseline market and market potential for the specific Energy Star appliances promoted should be refined as a part of the vendor services and developed for each product type.

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[10] A review of rebates offered across the US suggests that most utilities are offering rebates from this kind of marketing and promotional perspective rather than from a direct resource acquisition perspective. See the Database of State Incentives for Renewables & Efficiency, (DSIRE), maintained by the North Carolina Solar Center for the Interstate Renewable Energy Council (IREC) funded by the U.S. Department of Energy (DSIRE) at http://www.dsireusa.org/.

[11] CEE's National Residential Home Appliance Market Transformation Strategic Plan, December 2000 (http://www.docstoc.com/docs/78624721/Home-Appliance-Market).

Budget Assumptions

An estimated three-year budget for this program is provided below. The cost to participating customers is the customer's share of the cost (cost of product after the rebate).

Table 54: Estimated Three-Year Program Budget – Residential Energy Efficient Products

RES EE Products	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$10,000	$10,000	$10,000	$30,000	0.2%
DSM Staffing		$25,875	$26,781	$27,718	$80,373	0.5%
Monitoring & Evaluation		$75,000	$75,000	$75,000	$225,000	1.5%
Variable Costs						
Incentives	$254	$4,845,267	$4,845,267	$4,845,267	$14,535,802	95.9%
Delivery & Other	$5	$95,430	$95,430	$95,430	$286,290	1.9%
Total Budget		$5,051,572	$5,052,478	$5,053,415	$15,157,465	100%

Program 17. Residential Online Audits (CORE PLUS)

This program provides an online tool available for all residences within the I&M service territory. Individuals are invited to participate by modeling their residence's equipment and typical household operations. Guidance is then given to the participant on potential energy efficiency activities or measures that might be useful in helping them to achieve greater efficiency within their home. Based on the survey results, a kit of low-cost measures is mailed to the participants for self-installation.

Rationale

The program is open to all residential customers at no charge to provide easy access to energy efficiency recommendations tailored to the home. Since it is conducted by Internet, it can fit in a customer's schedule, and provides an opportunity for all customers to participate. The program elements are an entry-level degree of customer engagement, providing a way for customers to begin to get direct information on what they can do to make their home more energy efficient.

All homes will receive low-cost lighting measures for self-installation. Homes that identify as electrically heated will also receive water conservation measures.

Participation and Measures

Measures are shown below.

Table 55: Measures and Incentives – Residential Online Audit

Measures	Measure Number	Incentive Amounts
CFLs	R-11	100%
Low Flow Fixtures	R-12	100%

Projected participation by year is shown in the table below.

Table 56: Estimated Participation and Savings – Residential Online Audit

Residential Online Audit				
Potential Participants				389,500
Per participant Savings (kWh):				321
Per Participant Savings (kW):				0.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	1,169	0.3%	375,249	97
2015	1,558	0.4%	500,118	129
2016	1,753	0.5%	562,713	145
Average	1,493	0.4%	479,360	123

Marketing Plans

The program will be marketed to residential households through normal customer communications and as a feature on the company website.

Program Tracking Considerations

Website activities should be utilized to populate a tracking database with comprehensive list of all recommendations made to participants. Savings assessments will be determined based on follow-up surveys and tracking of measures contained within the savings kits. This program will be used as a feeder to other programs.

Detailed Budget Plans

An estimated three-year budget for this program is provided below.

Table 57: Estimated Three-Year Program Budget – Residential Online Audit

Res Online Audit	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Program Costs						
Implementation & Other Annual Cost		$10,000	$10,000	$10,000	$30,000	5%
DSM Staffing		$69,863	$72,308	$74,837	$217,007	38%
Monitoring & Evaluation		$35,000	$35,000	$35,000	$105,000	19%
Variable Costs						
Incentives	$23	$26,887	$35,834	$40,319	$103,040	18%
Delivery & Other	$25	$29,225	$38,950	$43,825	$112,000	20%
Total Budget		$170,975	$192,092	$203,981	$567,047	100%

Program 18. Residential Appliance Recycling (CORE PLUS)

The recycling program improves the in-service technology mix for the service territory by removing energy hog appliances and deleting them from existence in an environmentally friendly way. Appliance recycling is available primarily through two national program vendors, both of which bring the necessary environmentally sound technologies and procedures to the program.

This program targets households with second refrigerators or freezers. The program will provide free refrigerator and/or freezer pick up. Once I&M receives verification that the refrigerator has been recycled, the customer will receive a $40 incentive.

Rationale

This program targets residential customers with second refrigerators or freezers, preferably those older than 1993. The program is designed to take these inefficient older refrigerators off the market entirely, and to do so in an environmentally-sustainable manner. I&M will pay a $40 incentive to each customer to help persuade them to get rid of the second refrigerator or freezer, and will also cover the cost associated with removing the refrigerator or freezer and recycling its components.

Participation and Measures

Measures are shown below.

Table 58: Measures and Incentives – Residential Appliance Recycling

Measure	Measure Number	Incentive Amount
Eliminate Old Appliances	R-9	$40

Projected participation is reported in the following table.

Table 59: Estimated Participation and Savings – Residential Appliance Recycling

Res Appliance Recycle				
Potential Participants				119,000
Per participant Savings (kWh):				1,009
Per Participant Savings (kW):				0.2
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	1,785	1.5%	1,801,065	378
2015	3,570	3.0%	3,602,130	755
2016	7,140	6.0%	7,204,260	1,511
Average	4,165	3.5%	4,202,485	881

Marketing Plans

This program will be marketed directly to consumers through bill inserts, direct mailing materials, and through refrigerator distributors. The program will need to mail information to customers on a regular schedule (twice a year basis, or more frequently as needed to produce the desired participation rates), and through point-of-purchase information at trade ally facilities.

Program Tracking Considerations

The program vendor will be required to supply a detailed database sufficient to demonstrate the age and condition of units picked up and also to demonstrate that the units are properly destroyed and recycled. In addition, the database should be sufficient to supply data necessary for program evaluation. Generally tracking for this program type begins with a photo of the refrigerator nameplate or attachment of an ID code sticker on pick-up, and tight tracking capability is required through disassembly to insure beyond question that there is never even a slight diversion of working units to the secondary market.

Detailed Budget Plans

An estimated three-year budget for this program is provided below. There are no costs to participating customers.

Table 60: Estimated Three-Year Program Budget – Residential Appliance Recycling

Res Appliance Recycle	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	2%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	4%
Monitoring & Evaluation		$90,000	$90,000	$90,000	$270,000	10%
Variable Costs						
Incentives	$40	$71,400	$142,800	$285,600	$499,800	19%
Delivery & Other	$140	$249,900	$499,800	$999,600	$1,749,300	65%
Total Budget		$466,231	$788,754	$1,432,619	$2,687,604	100%

Program 19. Residential New Construction (CORE PLUS)

This is a “beyond Energy Star” strategy for new residential construction. A second program element, Energy Star manufactured homes would have been included except that the relatively small stock and yearly increment of manufactured homes in I&M's Indiana service territory are too small to support a program.

Recent changes in Energy Star and the general success of Energy Star in improving the performance of baseline (Non Energy Star) new homes have negatively affected the cost-effectiveness of the standard Energy Star program. In the Energy Star program, there are many builder pathways (called Building Options Packages) to enable manufacturers to meet Energy Star criteria. Many Energy Star builders, in order to be sure of meeting the Energy Star criterion, now build beyond it. From a utility perspective, supporting "beyond Energy Star" homes is the only viable option to insure cost-effectiveness of this program element.

Two other certifications have been introduced into the home performance market. These are LEED and Passivehaus. The basic concept of the program is the “high performance” home. All such homes will be Energy Star Plus and some will also be LEED and Passivehaus certified. I&M should provide all three tracks. The ultimate goal is the “net zero ready” home, which, with the addition of Solar PV from the renewable energy program will become net zero or even slightly revenue positive for the household, selling net energy back to the utility. This end goal will not be met by most homes in the program, but they can all be oriented towards this track.

Passive solar design and orientation reduce a home's heating and cooling costs and makes the home more comfortable. Better lighting and better internal temperature control are to be included. The incremental cost of $3,000 per home plus a $500 inspection fee in the illustrative measure package represents a generalized measure package.

Rationale

The basic philosophy for the program should incorporate net-zero concepts. These include an expected measure life for the new house of 150 years and a net-zero plan. The plan for each house will provide elements of energy savings in the original construction plus a set of steps which may be taken later to move towards net-zero. The key feature of the plan is to order elements so no work impedes the future steps. PV, since it is not a DSM measure is not included in this program but the goal is a house that is solar ready. A basic concept is the development of the customers as a repeat customer for additional increments or energy efficiency packages throughout the life of the structure.

Participation and Measures

Measures are shown below.

Table 61: Measures and Incentives – Residential New Construction

Measures	Measure Number	Incentive Amounts
Energy Star New Home (Building Options Package)	R-6	$1,500
Lighting and Appliance Bonus when 10 energy efficient fixtures and 3 labeled Energy Star appliances are included (or equivalent upgrade)		
Inspection Service Fee		$500

Projected participation by year is shown in the table below.

Table 62: Estimated Participation and Savings - Residential New Construction

Res New Construction				
Potential Participants				375
Per participant Savings (kWh):				4,222
Per Participant Savings (kW):				1.4
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	56	15.0%	236,432	77
2015	94	25.0%	396,868	130
2016	113	30.0%	477,086	156
Average	88	23.3%	370,129	121

Marketing Plans

The financial incentive is provided directly to homebuilders to help offset the additional cost to build an Energy Star home. This gives the incentive a multiplier of between two and three. This program element is a vendor-delivered program requiring an experienced Energy Star program vendor. The program vendor provides all of the detailed knowledge and relationships to put the program in place with a restricted set of measures to reach savings levels significantly beyond Energy Star using a set of builder options packages. While the customer has higher first cost, the customer pays less for energy over the life of the home and on a life cycle basis comes out well ahead financially. The program vendor will also provide the established channels to national builders, establish relationships with local builders, and will come supplied with all manner of promotional materials.

The key, according to the Texas Energy Star program, is in promoting the value of the brand to builders who would like to differentiate their product. Marketing methods include:

1. Newspaper and real estate guide ads
2. Signage
3. Marketing materials
4. Builder and subcontractor training and ongoing technical assistance
5. Training in the advantages of Energy Star homes for all the builders, sales staff, realtors, and the lending community.
6. Seminars and literature targeted at consumers. This is a valuable addition to a marketing effort because consumers can create a market pull.

Key points to include in a beyond Energy Star program element are:[12]

1. Establish a single stable multi-year approach. This will give stability to builders and allow the program to grow more readily.
2. Establish a single, simple, and high program standard of efficiency. This is important because it lets builders know where they stand and what is expected.
3. Establish good relationships with area builders and developers.
4. Ensure that staff professionalism, delivery systems, equipment, marketing materials and quality assurance are all of high quality.
5. Maintain strict adherence to specifications based on sound building science and economics to maintain program credibility and consistency.
6. Establish a process for certifying and documenting homes built to requirements.[13]
7. Develop a solid infrastructure of experienced, well-known and respected organizations.

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[12] Drawn from Vermont Energy Star Program, managed by Efficiency Vermont.

[13] Texas Energy Star Program.

8. Develop targeted incentives that are well coordinated with marketing and other service-related materials.
9. Coordinate with health and safety standards and codes for residential construction.
10. Provide ongoing technical training for builders and subcontractors.
11. Promote builders buy-in into the program by getting them financially invested in the program through advertising, building requirements, and training so they will support all aspects of the program.[14]
12. New construction is an excellent area to review for strategic combination of gas and electric energy efficiency measures.

Program Tracking Considerations

As Energy Star homes, Energy Star Plus homes are certified by HERS raters, and I&M will need to work with the HERS raters and the program vendor to establish a workable data tracking system. There are several models for this system, for example the "Dashboard" system developed by Paragon Consulting Services.

Detailed Budget Plan

An estimated three-year budget for this program is provided below. Costs to participating customers include the customer's outlay for any remaining incremental cost of the Energy Star Plus home.

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[14] Texas Energy Star Program.

Table 63: Estimated Three-Year Program Budget – Residential New Construction

Res New Construction	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$10,000	$10,000	$10,000	$30,000	3.7%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	13.3%
Monitoring & Evaluation		$50,000	$50,000	$50,000	$150,000	18.4%
Variable Costs						
Incentives	$1,500	$84,000	$141,000	$169,500	$394,500	48.4%
Delivery & Other	$500	$28,000	$47,000	$56,500	$131,500	16.2%
Total Budget		$206,931	$284,154	$323,419	$814,504	100%

Program 20. Residential Neighborhoods (CORE PLUS)

This program is targeted primarily to households at or below 150 percent of poverty. The program involves identification of a specific neighborhood with approximately 60 percent low-income customers which is approached through local leaders and an organized effort to secure community participation.

The program provides a set of low-cost/no-cost energy saving homes in the neighborhood. This service will be provided to all homes, including low-income and non low-income homes. Gas customers are provided with energy efficient lights (CFLs, LEDs and/or halogens). Electrically heated homes will receive lighting measures, low-flow fixtures and some portion will receive infiltration reduction treatment. Though administered through a program delivery vendor, the program requires staff involvement in community meetings and events.

The program concentrates services in a neighborhood blitz and with local recognition to minimize cost. It then moves on to another neighborhood. By concentrating on lower income neighborhoods and rural communities, the program serves mainly low-income customers. However, in keeping with the community approach all homes in the neighborhood are offered service.

Participation and Measures

Measures are shown in the table below.

Table 64: Measures and Incentives – Residential Neighborhoods

Measures	Measure Number	Incentive
House Sealing using Blower Door	R-5	100%
Efficient Residential Lighting	R-11	100%
Low Flow Fixtures	R-12	100%
Tank Wrap, Pipe Wrap & Water Temp Setpoint	R-13	100%

Participation is expected to begin with the selection of one or two neighborhoods, and then be expanded to additional neighborhoods. Projected participation by year is shown in the table below.

Table 65: Estimated Participation and Savings – Residential Neighborhoods

Residential Neighborhoods				
Potential Participants				210,300
Per participant Savings (kWh):				583
Per Participant Savings (kW):				0.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	1,262	0.6%	735,746	189
2015	2,103	1.0%	1,226,043	315
2016	3,155	1.5%	1,839,365	472
Average	2,173	1.0%	1,267,053	325

Marketing Plans

Marketing is approached through community social relations in a neighborhood application with the support of community leaders. Generally, a community meeting or community dinner will be included. Application will be in a house by house blitz.

Program Tracking

Data collection and documentation for program purposes and annual reporting will require a tracking system so that measures installed can be tracked by relevant household classification variables.

Budget Assumptions

The budget for this program will be refined with experience. In several ways, this is a social marketing program rather than a traditional marketing program in that it is community based. This means there will be overhead for working with local officials and community leaders and for community events such as a dinner.

Table 66: Estimated Three-Year Program Budget – Residential Neighborhoods

Residential Neighborhoods	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	4%
DSM Staffing		$36,225	$37,493	$38,805	$112,522	7%
Monitoring & Evaluation		$75,000	$75,000	$75,000	$225,000	13%
Variable Costs						
Incentives	$147	$185,893	$309,772	$464,732	$960,396	57%
Delivery & Other	$50	$63,100	$105,150	$157,750	$326,000	19%
Total Budget		$380,218	$547,415	$756,286	$1,683,918	100%

Program 21. Residential Home Reports (CORE PLUS)

The Home Energy Comparison Report is a periodic comparative usage report that compares customers' energy use relative to similar residences in the same geographical area and which also gives customers specific energy savings recommendations to encourage energy saving behavior. The reports are typically mailed quarterly but the pattern may be altered by the program manager. The recommendations may be accompanied by coupons and links to other Company programs and to a website that promotes energy efficiency opportunities. The program has been tested as a pilot in South Carolina, where it was limited to individually metered, owner-occupied single family homes. The pilot showed approximately 2 percent overall energy savings for the pilot participants as compared to a control group of non-participants. According to the evaluation study, customers who reduced energy use tended to live in homes that had higher energy consumption and customers who increased energy use tended to live in homes with lower energy consumption compared with average homes. Based on pilot results, expansion to a full scale program will use information on homes that lowered use and homes that increased use for targeting and for testing messaging content to improve program performance.

Rationale

Customer Reports programs have emerged since 2007 and are being introduced by several utilities and other DSM administrators. They are often referred to as "behavioral" programs since the program theory is that careful messaging will influence energy savings behavior and because the first generation of these pilot programs studied only the messages and the net energy savings with respect to the control group. Only much more recently have the physical mechanisms causing energy savings been a subject of program research. Behavior, for example, may be as simple as changing energy use habits and patterns. Or it may be the purchase of an energy efficient appliance. It could be participation in one of the Company's other DSM programs. This program differs from all other DSM programs because it is not designed to provide meaningful savings to individual households. An average savings of 2 percent is well within the range of normal year to year variation in household energy use ("noise"), and the pattern of reduction for high use homes coupled with increase for low use homes is the typical pattern of regression to the mean. However, if the 2 percent savings can be shown to hold up over time as a contrast between a treatment group and a control group (with both groups determined by random assignment under control of a third-party evaluator rather than the Company or a program vendor or implementer) the result is meaningful and sizable at the system level on a one-year savings basis.

Participation and Measures

There is one measure, the Customer Report. However, the reports may be delivered with different frequencies, and messaging may be tested to achieve best results.

Table 67: Measures – Residential Home Reports

Measures – Kit Items	Measure Number
Residential Home Report	R-16

Table 68: Estimated Participation and Savings – Residential Home Reports

Potential Participants				194,750
Per participant Savings (kWh):				193
Per Participant Savings (kW):				0.05
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	38,950	20.0%	7,517,350	1,930
2015	38,950	20.0%	7,517,350	1,930
2016	38,950	20.0%	7,517,350	1,930
Average	38,950	20.0%	7,517,350	1,930

The knowledge base for messaging is similar to that for corporate communications and traditional marketing and promotion programs.

This program type is unique in that it presents no dollar cost that is apparent to customers and participation is assigned by the utility (with provision for opt-out) as a part of the program design. As this program matures, different groups of customers may be targeted for participation.

Marketing Plans

Since the program content is marketing and promotion/corporate communications there is not a special marketing plan other than the actual Customer Reports. Instead, the program manager will determine which customers should be included and which excluded from the program (targeting). Then the total group eligible for the program will be split using random assignment conducted by the third party independent evaluator. This will provide a treatment group and a control group. The treatment group will receive the messaging; the control group will not. Possibly the program manager will decide to form more than one treatment and/or control group. In that case, the key feature is always random assignment from a pool of eligible customers to the various groups. Also, frequency of reports may be quarterly or varied.

Program Tracking

Data collection and documentation for program purposes and annual reporting will require a tracking system. This will require careful tracking of group members, attrition, and of messages and frequency. In addition, an effort will be conducted to determine the physical causes of energy savings and customer costs.

Budget Assumptions

Costs to participating customers will be customer's time and any incremental costs due to selection of energy-efficient appliances or home improvements. Company costs will be limited to the communications, the tracking system, and determining the actual customer costs. An estimated three-year budget for this program is provided below.

Table 69: Estimated Three-Year Program Budget – Residential Home Energy Reports

Residential Home Report	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	4%
DSM Staffing		$25,875	$26,781	$27,718	$80,373	5%
Monitoring & Evaluation		$40,000	$40,000	$40,000	$120,000	7%
Variable Costs						
Incentives	$0	$0	$0	$0	$0	0%
Delivery & Other	$12	$467,400	$467,400	$467,400	$1,402,200	84%
Total Budget		$553,275	$554,181	$555,118	$1,662,573	100%

The Measures

The first question about measures is whether there should be a Measures section in a Program Action Plan now that there is a fully completed Indiana Technical Resource Manual (TRM). An alternative would be to simply reference all measures to the TRM. But each team developing Program Action Plans brings its own experience and this experience will color to some degree how certain measures are understood in the ex ante planning process. Where there are differences of perspective, the planning process for Program Action Plans is one of the key places where discussions of possible changes to the TRM will arise.

The purpose of this section is to provide documentation of the assumptions used to screen the Energy Efficiency Measures (EEMs) identified for consideration in this report. Our assumptions are based on references cited throughout this section as well as the direct experience of our team with technologies in the field and actual DSM program evaluations. While not all of the field and DSM program experience can be cited in published works, published references are used to establish a reasonable range of assumptions. The point estimate used within that range is based on our professional opinion. For the most part, since the Indiana TRM now exists, measure characteristics have been conformed to the Indiana TRM.

The mapping of EEMs to Residential DSM programs is shown in the table below by the value listed in each cell. The value represents the percentage of participants installing the measure. Cells with no value mean the measure is not included in the program.

Measure Maps

The mapping of EEMs to DSM programs is shown in the following tables. Measures are listed down the side of each table; programs are listed across the top. The Residential table is shown first, followed by the Commercial & Industrial table.

The values represented in each table are the percentage of participants installing each measure. Cells with no value mean the measure is not included in the program.

Table 70: Residential Measure Map.

RESIDENTIAL PROGRAMS: MEASURE MAPPING

Residential Program No.			10	11	12	13	14	15
End-Uses	**EEM Description**	**EEM Ref #**	**Residential Home Energy Audit**	**Residential Lighting**	**Energy Efficient Schools - Education**	**Income Qualified Weatherization**	**Residential Weatherization**	**Moderate Income Weatherization**
Residential Space Conditioning	**Wall Insulation (R3-R11)**	**R-1**					0.30	0.20
	Ceiling Insulation (R6-R30)	**R-2**				0.21	0.45	0.85
	Programmable Thermostats	**R-3**					0.20	
	Refrig Charge/Duct Tune-Up	**R-4**				0.35	0.10	0.35
	House Sealing Using Blower Door	**R-5**				1.00	0.90	1.00
	Energy Star Construction	**R-6**						
	Cool Roofs	**R-7**						
	Elec Heat to SEER 16 H Pump	**R-8**						
Load Management	**Eliminate Old Appliances**	**R-9**						
Residential Appliances	**Energy Star Clothes Washers**	**R-10**						
Residential Lighting	**Efficient Residential Lighting**	**R-11**	1.00	1.00	1.00	1.00		1.00
Water Heating	**Low Flow Fixtures**	**R-12**	0.25		0.25	0.25	0.15	0.85
	Tank Wrap, Pipe Wrap and Water Temp Setpoint	**R-13**	0.15			0.45	0.10	0.45
	Heat Pump Water Heaters	**R-14**						
Miscellaneous Technologies	**Ductless Heat Pump**	**R-15**						
	Customer Report	**R-16**						
	Smart Plug	**RC-1**				1.00		

Note: Values in the table represent the percentage of participants receiving the measure.

RESIDENTIAL PROGRAMS: MEASURE MAPPING

Residential Program No.			16	17	18	19	20	21
End-Uses	EEM Description	EEM Ref #	Residential EE Products	Residential Online Audits	Residential Appliance Recycling	Residential New Construction	Residential Neighborhoods	Residential Home Reports
Residential Space Conditioning	Wall Insulation (R3-R11)	R-1						
	Ceiling Insulation (R6-R30)	R-2						
	Programmable Thermostats	R-3						
	Refrig Charge/Duct Tune-Up	R-4						
	House Sealing Using Blower Door	R-5					0.15	
	Energy Star Construction	R-6				1.00		
	Cool Roofs	R-7	0.04					
	Elec Heat to SEER 16 H Pump	R-8	0.04					
Load Management	Eliminate Old Appliances	R-9			1.00			
Residential Appliances	Energy Star Clothes Washers	R-10	0.20					
Residential Lighting	Efficient Residential Lighting	R-11		1.00			1.00	
Water Heating	Low Flow Fixtures	R-12		0.25			0.90	
	Tank Wrap, Pipe Wrap and Water Temp Setpoint	R-13					0.12	
	Heat Pump Water Heaters	R-14	0.05					
Miscellaneous Technologies	Ductless Heat Pump	R-15	0.08					
	Customer Report	R-16						1.00
	Smart Plug	RC-1						

Note: Values in the table represent the percentage of participants receiving the measure.

Table 71: Commercial & Industrial Measure Map.

COMMERCIAL & INDUSTRIAL PROGRAMS: MEASURE MAPPING

Commercial & Industrial Program No.			4	5	6	7	8	9
End-Uses	**EEM Description**	**EEM Ref #**	**C&I Rebates**	**Energy Efficient Schools - Audit**	**Retro-Commissioning Lite**	**HVAC and Refrigeration Optimization**	**C&I Audit**	**C&I Custom**
Customer-Sited Generation	**Combined Heat and Power, CHP**	**C-1**						*
C&I Space Conditioning	**Small HVAC Optimization and Repair**	**C-2**				0.90		*
	Retro-Commissioning Engagement	**C-3**			1.00			*
	Low-e Windows 1500 ft2	**C-4**						*
	Premium New HVAC Equipment	**C-5**						*
	Large HVAC Optimization and Repair	**C-6**						*
	Window Film	**C-7**	0.05					*
	Integrated Building Design	**C-8**						*
Design	**Efficient Package Refrigeration**	**C-9**	0.10					*
Motors and Drives	**Electronically Commutated Motors**	**C-10**	0.10					*
	Premium Motors	**C-11**	0.10					*
	Motor Controls and Motor Applications Tune-Up	**C-12**						*
	Single Application VFD	**C-13**	0.15					*
Power Distribution	**Energy Star Transformers**	**C-14**	0.02					*
	Efficient AC/DC Power	**C-15**						*
Lighting	**LED Outdoor Lighting**	**C-16**						*
	New Efficient Lighting Equipment	**C-17**	0.10					*
	Retrofit Efficient Lighting Equipment	**C-18**	0.90	1.00				*
	LED Exit Signs	**C-19**	0.05	1.00				*
	LED Traffic Lights (10)	**C-20**	0.05					*

COMMERCIAL & INDUSTRIAL PROGRAMS: MEASURE MAPPING

Commercial & Industrial Program No.			4	5	6	7	8	9
End-Uses	**EEM Description**	**EEM Ref #**	**C&I Rebates**	**Energy Efficient Schools - Audit**	**Retro-Commissioning Lite**	**HVAC and Refrigeration Optimization**	**C&I Audit**	**C&I Custom**
	Small Commercial LED Change out	**C-21**					0.85	*
	Perimeter Daylighting	**C-22**						*
Water Heating	**Low Flow Fixtures**	**C-23**	0.01					*
	Solar Water Heaters	**C-24**						*
	HP Water Heaters	**C-25**						*
Cooking and Laundry	**HE Food Prep and Holding**	**C-26**						*
	Energy Star Commercial Clothes Washer	**C-27**						*
	Restaurant & Grocery Audit	**C-28**					1.00	*
Other	**Grocery Refrigeration Tune-Up and Improvements**	**C-29**				0.05	0.25	*
	Refrigeration Casework Improvements	**C-30**				0.10	0.20	*
	VendingMiser® and Vending Machine Timers	**C-31**	0.05	0.05				*
	Network Computer Power Management	**C-32**						*
	Solar Electric	**C-33**						*
	Smart Strips	**RC-1**		1.00				*

Note1: Values in the table represent the percentage of participants receiving the measure.
Note2: The asterisk in the column for Program 9 (C&I Custom) indicates the measures that may appear in this program.

Residential Measures

Wall Insulation (R-1)

This measure involves increasing wall insulation from R-3 and adding insulation to the R-11 level. This measure saves both heating and cooling energy. In the case of gas heated residences, the electric savings are for cooling only and are much less than the heating savings. Therefore the cost effective application of this measure is for electrically heated residences only.

Measure Applicability

This measure is considered applicable to a portion of the 24 percent of residential customers that heat with electricity. Of these customers, about 5 percent have heat pumps and live in more recent stock that is probably insulated. Of the remaining 17 percent, we will assume that half are poorly insulated and could benefit from this measure. Overall the applicability is taken as 8 percent of the residential sector.

Incremental Cost

This measure contemplates adding wall insulation to a 2x4 stud wall where there is none. We assume a cost of $1.25 per square foot of wall area. DEER uses a value of $1.32 per square foot of wall area. The DEER values are based on going from an R-0 to an R-13; the equipment costs are given as $0.15 for equipment and $1.17 for labor resulting in the overall cost of $1.32. Our estimate is more conservative. The total installed cost for the home modeled is $1,400.

Average Annual Expected Savings

Savings from this measure are strongly dependent on the efficiency of the electric heat source. The stock to which this measure is applied consists primarily of electric furnaces. Therefore the simulations assume the displacement of resistance heat. Building simulations show savings of 1885 kWh to 2600 kWh/yr for electric-heated residences and less than 400 kWh/yr for gas-heated residences. For this analysis the annual savings will be taken as 2,100 kWh/yr for electric-heated residences and 400 kWh/yr for gas-heated residences.

Expected Useful Life

This analysis uses an effective useful life of 25 years, the DEER uses 20 years.

Ceiling Insulation R6-R30 (R-2)

This measure involves increasing ceiling insulation from R-6 to the R-30 level. This measure saves both heating and cooling energy. In the case of gas heated residences, the electric savings are for cooling only and are much less than the heating savings. So the cost effective application of this measure is to electric heated residences only.

Measure Applicability

This measure is considered applicable to a portion of the 24 percent of residential customers that heat with electricity. Of these customers about 5 percent have heat pumps and live in more recent stock that is probably insulated. Of the remaining 17 percent we will assume that half are poorly insulated enough to benefit from this measure. Overall the applicability is taken as 8 percent of the residential sector.

Incremental Cost

We assume a cost of $0.75/square foot of wall area and 1000 square feet of wall space for a total cost of $750. DEER uses a value of $0.757/square foot of wall area. This job includes the cost of providing for adequate attic venting.

Average Annual Expected Savings

Savings from this measure are strongly dependent on the efficiency of the electric heat source. The stock to which this measure is applied consists primarily of electric furnaces. Therefore the simulations assume the displacement of resistance heat. Building simulations from I&M specific weather data show savings of 1,500 kWh to 2,700 kWh/yr for electric heated residences and less than 400 kWh/yr for gas-heated residences. For this analysis, the annual savings is assumed to be 1,500 kWh/yr for electric-heated residences and 300 kWh/yr for gas-heated residences.

Expected Useful Life

This analysis uses an effective useful life of 25 years.

Programmable Thermostats (R-3)

Programmable thermostats save energy by lowering the average daily temperature of the inside of a building. Most of the energy savings is heating energy because that heating thermal load is much larger than the cooling load, but some energy savings in cooling energy will also be realized. Programmable thermostats are commonly sold for self installation. But the installation has the following four important issues that need to be considered.

1. Some thermostats are line voltage thermostats, and there is some shock hazard to the unaware.
2. The first step in programming a thermostat is the system specification. Here the installer tells the thermostat what kind of a system it is controlling. The system type is selected from a list of about 30-50 different system types. This is a non-obvious choice.
3. For system controls there are standard colored wires, but often hookups use non-standard wire. For the mechanically inclined this process is okay but for others it is daunting.
4. Then, after it is installed successfully there is the issue of controlling it to get satisfactory results. Sometimes this needs a guiding hand.

The US DOE is phasing out programmable thermostats from the Energy Star program. Evaluation studies have found insufficient savings to warrant the Energy Star designation. Proper installation and operation appear to be at the root of the lack of energy savings. We have chosen to leave these devices in our mix of EEMs and feel that with proper installation and setup the technology is sound. Our incremental cost includes the cost of installation over and above the off-the-shelf cost of programmable thermostats. Even with proper installation, there is an ongoing need for a design that is more user-friendly and easier to operate.

Measure Applicability

The I&M Appliance study shows 23 percent of the respondents reported the use of a programmable thermostat. Also the Appliance Study reports 23 percent have electric heating in the form of resistance heat or heat pumps. It is not clear if the reported programmable thermostats were all on electric heating situations. For this analysis 20 percent of treated homes are taken as good candidates for a new programmable thermostat.

Incremental Cost

Programmable thermostats cost retail in the range of $50-$100. A utility program may be able to purchase in bulk. It may be necessary to have a range of options which include at least line voltage and low voltage. For these purposes we take $70 as the melded cost of the thermostats.[15] It is assumed here that thermostats will be installed as part of a site visit in a broader program with $25 allocated for installation labor. In total the installed cost will be taken as $120 per thermostat.[16] Some sites with line voltage thermostats may require more than one thermostat.

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[15] DEER lists the incremental cost as $56.3, and the installed cost as $73.33 per unit.

[16] DEER lists the incremental cost as $73.33 of which $56.37 is equipment cost and $16.96 in labor. This analysis uses $50 for the labor cost which accounts for some of the difference in the costs.

Average Annual Expected Savings

Thermostat savings are best realized when the set back interval is of the order of 8 hours or longer, and the amount of savings depends on the number of degrees the thermostat is set back. The rule of thumb is one percent heating savings for every degree the thermostat is set back for at least 8 hours. For this estimate a five degree thermostat set back is assumed, leading to heating savings in the average electrically heated home of 500 kWh/yr.

Expected Useful Life

In principle, these thermostats can last for in excess of 20 years, but the backup batteries have a finite life and the programming can be changed or confused. In this case, the effective lifetime will be taken as 10 years.[17]

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[17] DEER list the EUL as 12 years.

Refrigeration Charge and Duct Tune-Up (R-4)

This measure is designed to save electric energy by increasing the operating efficiency of the refrigerant system by insuring that it is properly charged. It is common in residential cooling or heat pump systems to have an incorrect amount of refrigerant charge because these systems are usually charged on site during installation. This measure also leads to significant savings from finding and sealing duct leaks which increases the system distribution efficiency.[18]

Measure Applicability

This measure is applicable to most of the residential stock. Notably even new installations can benefit from this measure.

Incremental Cost

The incremental cost of this measure pays for a visit by a specially trained HVAC technician. For this analysis this cost is taken as $350.

Average Annual Expected Savings

The average annual expected savings from this measure depends on the size of the residence. Based on I&M specific simulations we find savings of 1,200 kWh/yr for a heat pump (electrically heated residence) and 300 kWh/yr on a gas heated residence with AC only.

Expected Useful Life

This is essentially a tune-up measure and is considered here to have a useful life of 5 years.

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[18] While these measures are theoretically handled by different trades, in practice they are implemented by a specially trained HVAC technician. This combination is efficient from a cooling system perspective and also typically cost-effective.

House Sealing Using Blower Door (R-5)

This measure applies to residential electrically heated properties. It involves using blower door technology to pressurize the home. Once the house is pressurized, the air leaks are identified and sealed with appropriate materials to decrease heat loss from the building envelope.

Measure Applicability

This measure is applicable to most of the residential stock.

Incremental Cost

The incremental cost of sending a technician to a home and performing a Blower Door test and sealing the identified leaks is assumed here to be $500. By comparison, the C&RD database lists $0.16 per 0.1 air change per square foot which translates to $500 per house with 0.2 air changes per square foot.

Average Annual Expected Savings

An electrically heated home will achieve 1,000 kWh in annual savings according to our modeling, and a gas home will save 200 kWh annually.

Expected Useful Life

The life of the savings for this measure depends on the quality of the materials used especially for the gaskets for the windows and doors. An expected useful life of 15 years is assumed by the Indiana TRM.

Energy Star Construction (R-6)

An Energy Star qualified new home is required to be 15 percent more efficient than a similar home that meets the 2004 International Energy Conservation Code, IECC. The mechanism for estimating Energy Star compliance is through the use of a Home Energy Rating System (HERS) score calculated from a brief estimate of annual energy use. The savings proceed principally from heating, cooling, lighting and water heating savings.

Measure Applicability

This measure is applicable to all new residential construction. But for the purposes of this study the measure is restricted to new residential all electric construction, estimated here to be 40 percent of new construction.

Incremental Cost

The incremental cost for this measure consists of the increased cost of building components such as insulation, windows, lighting and appliances. This cost is site specific, and there is some choice in selecting the package of measures. An initial cost effectiveness screening of this measure showed that the maximum cost effective cost is $3,000. This requires composing a package of only the most cost effective measures. Therefore this package includes the strongly cost effective measures of flow efficient showerheads and inspection and checkout of heat pumps that are not commonly part of the Energy Star package (but should be). Based on the choice of the most cost effective measures, the cost used for this study is $3,000.

Average Annual Expected Savings

The savings from this measure are variable depending on the particular site treatment chosen, but estimates for this region are in the range of 3,000-4,500 kWh/yr. For this study, the savings is assumed to be 4,223 kWh/yr.

Expected Useful Life

This measure has a useful life comparable to that of new construction and for this study the life will be taken as 25 years.

Package Detail New Residential Energy Star Plus

Program planning for an assumed package of energy star plus treatments has used a model of a prototypical all electric participant. Using this model the full package of measures is examined to estimate the energy savings for the individual measures in the package.

The energy star new residential achieves energy savings principally through improvements to the building shell and reductions in interior appliance energy use.

As perspective consider an all electric single storey residence of about 1,900 square feet. This residence is heated and cooled by a SEER 13 heat pump which is the current standard.

The Energy Star package consists of three common sense building steps. First the thermal conductivity of the envelope is reduced by small coordinated improvements to the building shell, better glazing, selective increase to insulation levels, and by attention to air sealing and framing details. Then the performance of the heating cooling systems is improved by duct insulation and testing. Finally, the internal energy use is reduced by using efficient lighting, appliances, and showerheads. None of these improvements is extreme, but taken together these small improvements can result in an approximate 20 percent reduction in annual energy use. This is the core of the Energy Star Plus savings.

Another 5 percent reduction in energy use is possible if the residence is oriented to use solar gain to offset winter heating. And a further 5+ percent reduction in energy use can be achieved through the use of a SEER 15 rated heat pump. Another 10 percent savings is possible through the use of solar hot water heating, and another 10 percent reduction is possible by applying a modest solar PV array. These further reductions are all beyond the core Energy Star package, and only the first, the solar site orientation is cost effective currently. The further enhancements from a more efficient heat pump and other solar applications are quite reliable and effective, but beyond the current cost effectiveness horizon.

In practice each building is unique, and slightly different packages of improvements to shell and appliances are selected based on specific circumstances, but the savings will break down approximately as in Table 72. In this example the annual energy use for an all electric residence has been reduced from about 19,400 kWh/yr to about 15,600 kWh/yr, about a 20 percent reduction by core energy star measures alone and another 5 percent through solar site orientation.

Table 72. Energy Star Plus Residential Savings Example

Efficiency Category	Annual Savings, kWh/yr	How Achieved
Shell Improvements	1,600	20% reduction in thermal loss, shell and infiltration
Hot Water Improvements	700	2.0 gpm showerhead
Duct Improvements	585	Insulation and leak testing
Efficient Appliances	945	Efficient light, washer, dishwasher, an average 20% reduction in internal loads
Solar Site Orientation	1,050	Enhanced south glazing

The Energy Star Plus package consists of the efficiency measures noted in Table 73.

Table 73. Energy Star Plus Savings Measures

Shell insulation
Duct insulation and leak testing
Three energy star appliances including efficient lighting and an energy star clothes washer
A 2.0 gpm rated shower head(s) and faucet aerators
Whole house air sealing details

In the case of a residence with gas heat and hot water heating, the efficient appliance and cooling savings are the same with the shell and hot water improvements resulting in gas savings.

Cool Roofs (R-7)

This measure is intended to save cooling energy by reducing the temperature in the attic through attic ventilation and through the use of optically reflective roofs. Recent improvements in roofing have led to roofing in attractive architectural colors that can reflect solar gain almost as well as white or reflective roofs. This reflection of solar gain along with adequate attic ventilation can lower attic temperatures significantly thereby reducing heat gain to the home and also improving the distribution efficiency of any ductwork or distribution fans that are located in the attic space. Attic cooling lowers the thermal gain to the residence below, and it also improves the distribution efficiency of any attic duct work. At least half the cooling savings attributable to this measure proceed from the improved distribution efficiency, and therefore this measure is intended for application where there are attic ducts or distribution fans. This is essentially a site built measure including the installation of roof vents and the installation of several hundred square feet of reflective material to the inside of the roof rafters.

Measure Applicability

This measure is considered applicable to all new roofing applications. It is especially effective for central air conditioning applications with distribution ductwork in the attic. According to the appliance survey 92 percent of residences have central AC, and of these 15 percent are assumed to have attic ductwork. Overall the applicability is taken as 92 percent of the residential sector.

Incremental Cost

The incremental cost for this measure is taken to be the incremental cost of the Energy Star Qualified roofing which is reported to be currently $0.23/square foot, but which is expected eventually to be zero. All other roofing costs and required ventilation are assumed to be unchanged by this measure. For this study we will take the incremental cost to be an average of $0.10/ square foot over the five year planning period. For the average residence, $340.

Average Annual Expected Savings

The savings from this measure proceed from lowered cooling energy by reducing ceiling heat gain. According to DOE, ceiling heat gain accounts for 15-25 percent of the residential cooling load. The radiant barrier has been observed to reduce ceiling heat gain by 16-42 percent. The cool attic strategy also improves cooling distribution efficiency if the cooling ducts or fan unit is in the attic. For this study we will take the average annual savings to be 560 kWh/yr. Savings larger than these will be found in the extreme cases with poorly insulated air conditioning distribution located in the attic spaces.

Expected Useful Life

This measure consists of reasonably durable material installed in an attic. The useful life is assumed to be 12 years.

Resistance Electric Heat to SEER 16 Heat Pump (R-8)

This measure is designed save heating energy and cooling energy by replacing an existing central air conditioner/electric furnace by a modern heat pump. Most of the savings proceed from replacing resistance heating by a heat pump at more than twice the thermal efficiency. This measure has significant savings, but also significant costs because it involves replacing the whole heating and cooling system, not including ducts.

Measure Applicability

This measure is applicable to about 17 percent of the residential sector that heats with an electric (resistance) furnace.

Incremental Cost

This measure requires replacing the whole heating/cooling system not including ducts. The cost of such a replacement is quite site specific, but can be expected to be a first cost of $10,000 or more. There are two contexts for such a replacement: 1) early retirement in-order to achieve large heating savings, and 2) where the central AC needs to be replaced anyway, the most prudent thing would be to replace with a heat pump because of its significant heating savings. The upgrade to a heat pump can be expected to cost about $5,500-$6,500 more than the AC replacement alone. For this analysis we assume $10,000 as the incremental cost.

Average Annual Expected Savings

The average annual expected savings from this measure depends on the size of the residence. Based on I&M specific simulations we find savings in the range of 8,000 kWh/yr for a single family residence and 6,470 kWh/yr in the multifamily application.

Expected Useful Life

The physical life of this measure is about 20 years, but for the purposes of this analysis we will take 15 years as the useful life of this measure to reflect the application of this measure in an early retirement context.

Eliminate Old Appliances (R-9)

This measure involves creating electric energy savings by collecting and dismantling underused older refrigerators and freezers. Ideally only operating or operable appliances would be eligible for removal.

Measure Applicability

This measure is applicable to the approximately 28 percent of the residential sector that have more than one refrigerator or freezer. Of these only 50 percent are assumed to have an interest in the program. For this study the applicability will be taken as 14 percent of the residential sector.

Incremental Cost

The incremental cost of this measure will be taken as the cost of acquiring and recycling the unit. For this study that cost will be assumed to be $165.

Average Annual Expected Savings

Savings from this measure are dependent on the age of the refrigerator and the location where it is used. Savings estimates for this measure also need to include the zero effects of including operable but not operating refrigerators. Reported savings estimates vary widely from an astonishing 1,900 kWh/yr for C&RD to 413 kWh/yr observed in the Connecticut Appliance Turn-In program. For this program, the savings will be assumed to take the middle road, 1,150 kWh/yr.

Expected Useful Life

The useful life of this measure is the length of time the removed refrigerator would have continued to be used absent the program. There is no reliable research on this and for this program the useful life will be taken as 5 years.

Energy Star Clothes Washers (R-10)

This measure involves obtaining an Energy Star clothes washer which is a more efficient clothes washer than a standard clothes washer. This measure has significant water and detergent savings in addition to the electric savings. According to the Environmental Protection Agency, horizontal-axis washing machines can use about 40 percent less water and 50 percent less energy than conventional washers, cause less wear and tear on clothes, and can accommodate large items that won't fit in a top-loader. A typical top-loading washer uses about 40 gallons of water per full load. In contrast, a full-size horizontal axis clothes washer uses between 20 and 25 gallons.

Measure Applicability

This program applies only to customers who have electric water heaters, electric dryers, and who have no high efficiency clothes washer. This applies to 40 percent of I&M customers.

Incremental Cost

The incremental cost for clothes washers vary significantly depending on the features. The value used in this analysis is $400; DEER uses a value of $565.82 and the C&RD lists a value of $245.26. Due to the wide variety of costs for Energy Star clothes washers $400 is a good mid-range value for the purposes of this analysis.

Average Annual Expected Savings

The kWh savings from a clothes washer depend to a significant extent on the source of the water heating and dryer’s energy source. If the water heater is a gas water heater the kWh savings are insignificant but if the source is an electric water heater the savings can be substantial. Savings also depend on whether the clothes washer has a built in heat source which some do have. This analysis used 400 kWh. DEER lists 199 kWh and C&RD lists a range from 54 kWh to 509 kWh depending on the model chosen. Savings will be assumed to be 400 kWh because the program will be limited to customers with electric water heat and electric dryers.

Expected Useful Life

The expected useful life used in the analysis is 18 years; however, both DEER and C&RD use 14 years.

Efficient Residential Lighting (R-11)

This measure consists of substituting compact fluorescent lighting for incandescent lighting. At each socket treated, such a substitution will reduce lighting power by about 80 percent. A full application of this measure consists of converting all the most used lighting fixtures from incandescent to compact fluorescent. Housing audits taken over the last 10 years show that an average house has about 25-45 lighting sockets with an aggregate connected incandescent lighting load of about 2,700 watts. But of this load, only about 10-15 sockets are used for about an average of 5 hours/day, the rest are infrequently used. So it is the ten-fifteen most frequently used sockets that are the primary targets for a whole house lighting conversion. A satisfactory conversion of these most important sockets may require recourse to a variety of bulb styles, powers, and even adapters (such as lamp harps) to facilitate accommodating the CFL to these ten best locations.

Measure Applicability

This measure is applicable in 100 percent of residential sector, but to allow for some existing use of compact fluorescents this study will use 95 percent as the applicability factor for this measure.

Incremental Cost

The cost for this technology continues to decrease, and there are various sales or promotions where the cost may be as low as $1.50/bulb. But for the purpose of this program planning we will use the Indiana TRM value of $3.00/average bulb to cover the costs of compact fluorescent bulbs, and $14.00/bulb for 10.5 watt LED bulbs. Full application of this measure, assuming treatment as directed within program guidelines vary with the number and types of bulbs installed per household.

Average Annual Expected Savings

Expected savings are dictated by the Indiana TRM. For CFL bulb applications the typical per bulb annual savings for a direct install measure is taken to be 41 kWh per year. A typical LED bulb installation produces a savings of 32 kWh per year.

Expected Useful Life

Compact fluorescent bulbs have a life time of 10,000 hours, about 7-10 times as long as the incandescent bulbs they replace. Assuming the average compact fluorescent bulb is used 2,000 hours/yr (5-plus hours/day) gives a conservative estimate of useful life of 5 years. LED bulbs have a deemed lifetime of 15 years per the Indiana TRM.

Special Note

The United States (along with many other countries, including China and Australia) is phasing out inefficient bulbs. The US law (Clean Energy Act of 2007) holds that certain light bulbs must be 25% to 35% more efficient by 2012 to 2014. Certain bulbs are excluded (those lower than 40 Watts and those over 150 Watts, also specialty lights, appliance lamps, “rough service” bulbs, three-way bulbs, colored lamps, and plant lights). This means that traditional 60 Watt and 100 Watt incandescent bulbs will gradually become unavailable unless the underground economy expands to meet preferences of customers who do not desire to make the change. Also, from 2012 through 2014, government pro-CFL promotions, along with promotions by big box stores, advocacy by environmental groups, and climate change organizations, as well as some religious organizations will encourage reliance on CFLs and LEDs. From a "reason analysis" perspective, it is likely that people will increasingly say they would have purchased CFLs in the absence of a utility program, or that the percentage of influence of the utility program on their decisions to purchase CFLS will be radically declining. At the same time, just because a law has been put into place does not mean that it is enforceable (for example, some states have progressive building standards, but they are not reflected in current practice). Currently (in 2013) 60 Watt and 100 Watt bulbs are available in any quantity via the Internet.

The time will come for utilities to withdraw from the CFL area, at least for 60 Watt and 100 Watt bulbs. However, we recommend that CFL programs be continued until it is clear that there is general public acceptance of CFLs, through 2017. We suggest that I&M discuss with the Commission a temporary modification of the TRC test for CFLs to emphasize *gross* energy savings rather than *net* energy savings (the focus here is on removing the "free rider" label from customers who are jointly influenced). This negotiation is necessary due to the joint influence on purchasing decisions which is complex.

What has become clear in socket studies is that there is a huge number of sockets without CFLs or LEDs; also that households tend to purchase only some CFLs and moving household beyond a certain number of sockets does not create free riders (for those additional CFLs) even if the household already has some CFLs. If the Commission is unable to agree to move towards gross savings for 60 Watt and 100 Watt CFLS, I&M should evaluate the financial risk and terminate the CFL effort earlier.

Low Flow Fixtures (R-12)

This technology consists of a new showerhead rated at 2.0 gallons per minute (gpm) at 80 pounds per square inch (psi) and a swivel aerator for the kitchen faucet and fixed aerators for the lavatory faucets. The current US standard for showerheads is 2.5 gpm. Measurements of the existing shower flows in building stock show a range of 2.75 gpm to 3.75 gpm with frequent individual cases in excess of 5 gpm. Evaluations have shown that programs that replace with 2.0 gpm heads have greater savings than programs that replace with the standard 2.5 gpm shower heads. Program shower heads should be 2.0 gpm at 80 psi and with a lifetime scaling and clogging warranty. It is important also to be cautious about the use of “pressure compensating” showerheads. These are more prone to clogging and can lead to unintentional increases in flow rate in low pressure situations such as well water systems or older systems with occluded piping. Customer acceptability is an important component in a showerhead program. Customers will remove new low flow showerheads if the quality of the showering experience declines with the new showerhead. Therefore it is important to research and test the showerhead chosen for the program carefully. In addition, the old showerhead must be removed from the premises to decrease the likelihood of having it reinstalled.

Measure Applicability

This measure is applicable to the 40 percent of the residential sector that heat water with electricity.

Incremental Cost

Low flow fixture costs vary widely, and depend on whether the fixtures are purchased retail or in bulk. The costs for a bulk purchase for a showerhead and three aerators also have a wide range, about $8.00-$15.00/set. The most important feature of these fixtures is the long-term acceptability and durability because these factors have a direct impact on the lifetime savings. With a long enough lifetime, this is such a cost effective measure that all prices in the range are quite cost effective. Because the cost of the showerhead varies significantly and quality is so important for this program, it is essential to test, choose and pay the price for a high quality showerhead. This measure is so cost effective that even with a more expensive showerhead the program will still remain cost effective and a quality showerhead will ensure measure persistence. The per-unit-installed cost will be taken as $25/residence.[19]

Average Annual Expected Savings

Field monitoring studies can demonstrate the flow savings, but ultimately the overall savings will be a combination of flow savings and the duration of use. The flow of the showerhead used has a significant impact on savings. This program is designed around a 2.0 gpm showerhead as compared to a 2.5 gpm showerhead. Therefore the savings will be more than the 120–133 kWh per unit listed in DEER. In addition the climate is different and the inlet water temperature is lower so the savings in this I&M program will be greater. Several studies have measured final savings in terms of electric input to the tank, but usually these studies have included savings from comprehensive treatments including other measures such as tank and pipe insulation, kitchen and bath lavatory aerators, tank thermostat set back, and leaky diverter replacement. Savings can vary from program to program depending strongly on the choice of showerhead. Savings can also diminish with “take back” in the event that the new showering experience

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[19] The DEER Database lists measure costs as $22.946 per unit and $37.946 installed cost

is longer than the original. Actual savings observed in the comprehensive cases include these take back effects, and are in the range of 650 kWh/yr to 950 kWh/yr. The savings from a showerhead and aerator change alone are taken as 500 kWh/yr.

Tank Wrap, Pipe Wrap, and Water Temperature Setpoint (R-13)

This technology consists of adding insulation around the water heater, checking and resetting the tank thermostat, and replacing leaky shower flow diverters. These measures are principally tank-centric, and can be self installed or by a site visit if the package is part of a broader program. Resetting the tank thermostat is also a safety issue because it can reduce scalding and burns due to too high a set temperature.

Measure Applicability

The applicability for measures of this type is discussed under low flow fixtures. In I&M service territory electric water heat accounts for about 40 percent of water heating, 2/3 of that 40 percent would be eligible for this measure because in some cases the tank cannot be accessed to install a blanket or one has already been installed. As a result the applicability is taken as 25 percent.

Incremental Cost

The cost of this treatment breaks down as $30 for materials and $20 for installation labor. For these purposes the measure cost is taken as $50 because these measures will typically be part of a larger program.

Average Annual Expected Savings

The dwelling savings for these measures is discussed under low flow fixtures. Based on prior experience and evaluation work on other programs it is estimated that the savings would be about 1 kWh per day.[20] For this program we have used the conservative value of 200 kWh/yr savings.

Expected Useful Life

The lifetime of these measures is potentially quite long. For practical purposes the lifetime will be considered limited by the expected lifetime of the hot water tank, 10 years.[21]

Expected Useful Life

The life time of this equipment is the key to its cost effectiveness. If an adequate, even pleasant, shower can be provided through lifetime warranted equipment, then the practical lifetime of the equipment is the length of time until the equipment is replaced in the course of renovation. For these purposes that lifetime is taken as 10 years.[22] Normally showerheads will last longer but with renovations and changes in ownership a 10 year EUL is a good planning number.

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[20] Khawaja S. PhD, and Reichmuth, H. PE., 1997. Impact Evaluation of PacifiCorp's Ebcons Multifamily Program. Pacificorp.

[21] DEER says 15 years for pipe insulation, 9 years for faucet aerators, and 15 years for an efficient water heater so 10 years is conservative. The C&RD lists 10 years for a water heater with a minimum warranty of 10 years.

[22] DEER Database, 2005

Heat Pump Water Heaters (R-14)

Water heating is one of the largest energy uses in the home. In the case of electrically heated water, the annual water heating energy is about 4800 kWh/yr. The heat pump water heater is essentially a small heat pump drawing heat from the air by cooling and de-humidifying it and injecting this heat into a storage tank. Physically, this measure consists of a small self contained heat pump and a water storage tank and associated pumps and controls.

Measure Applicability

This measure is applicable to the 40 percent of the residential sector with electric water heat. Of these, 50 percent are assumed to have a suitable location for the unit. Overall measure applicability is assumed to be 20 percent of the residential sector.

Incremental Cost

The incremental cost of this measure consists of the cost of the heat pump water heater, water storage tank and installation plumbing and general construction labor. The site orientation of such a unit is important; it should never be sited in an attic and freezing situations should also be avoided. Therefore, some special site adaptation and plumbing may be necessary. For this study we will take $2,500 as the cost; others report lower costs but we do not think these take adequate account of special site costs.

Average Annual Expected Savings

For this study it is assumed that the heat pump water heater will perform with a coefficient of performance of 2, leading to annual savings of 2,000 kWh/yr.

Expected Useful Life

The useful life of this measure is assumed to be that of a similar appliance, a window air conditioner: 18 years.

Ductless Heat Pump (R-15)

This measure applies to residential electrically heated homes. Ductless heat pumps have two parts, an indoor and an outdoor unit. The outdoor unit can connect to multiple indoor units via a cable and refrigerant lines. The outdoor unit is placed outside at ground level and is connected to the indoor units via a small hole. The indoor units are wall mounted in centrally located rooms within the home and distribute the heated or cooled air throughout the space. Because of its design no ducts are required which eliminates fan energy and heat and cooling losses through the duct work.

Measure Applicability

This measure is applicable to most of the residential stock that uses electric resistance heat.

Incremental Cost

Incremental cost is expected to decline as the market becomes more familiar with this space heating technology.

Average Annual Expected Savings

Savings from installing a ductless heat pump depend on home size, usage, thermal integrity of the home, and temperature set point.

Expected Useful Life

Heat pump technology has been available for some time and its operating characteristics are well understood. The ductless heat pump is a new application of a tried and true technology; as a result the measure life of a heat pump is applied to the ductless heat pump in all applications.

Customer Reports (R-16)

Customer Reports is a behavioral measure. It saves energy by focusing customer attention on comparison to one's neighbor as a benchmark. In a generic approach to customer reports, participant households receive periodic reports illustrating their energy use performance in comparison to neighbors in similar homes.

Measure Applicability

All residential customers are technically eligible, however marking and promotion will be to random selected customers in the upper half of the yearly energy usage distribution.

Incremental Cost

The incremental cost is quite low since the form of the measure is simply a report received quarterly or with some other chosen frequency.

Average Annual Expected Savings

Some customer reports programs include resultant energy savings from change in energy use behaviors (reducing waste while preserving amenity), appliance purchases and recruitment into traditional energy efficiency programs as a result of the customer reports. For this measure/program we include only behavioral savings. The initial savings assumption used in program planning (as a one-year percentage of annual kWh usage) has been reported by prior programs. However, for treatments that continue over multiple years the decay of attention should be considered. We have assumed long range annual savings in the order of two-thirds of what might be expected in the first year of treatment.

Expected Useful Life

Until there is at least a decade of experience with scaled up customer reports programs and studies of decay following the last report received, the measure life is taken as one year. However, for a program of duration of more than one year the calculation assumes a decay effect after one year and that amount of savings is assumed to be stable for each year customer reports are received.

Smart Plug (RC-1)

This measure consists of a power strip with load sensing capability. When the primary load is turned off, the secondary loads connected to the power strip are automatically powered down. This measure is typically used in home office spaces where support equipment (printers, projectors, etc.) may be left on after the connected computer is turned off.

Measure Applicability

This measure is applicable to residential home office space and some entertainment center applications.

Incremental Cost

The incremental cost for this measure is determined to be the cost of purchase of the smart plug.

Average Annual Expected Savings

Savings associated with this measure are based on home-energy use surveys, with typical household electronics usages and reasonable assumptions of secondary equipment usage patterns. It should be noted that the household loading due to electronics is increasing steadily and projected savings from this measure will likely increase over time.

Expected Useful Life

This measure will have a medium-term useful life.

Commercial Measures

Combined Heat and Power (C-1)

This measure is a form of site generation with the waste heat applied to large steady thermal loads, usually at an industrial scale. The economics favorable to this measure usually involve a high thermal load factor. Electricity generated by CHP applied to an existing gas thermal load has a unique efficiency opportunity in terms of fuel use and in terms of carbon offset because the fuel use associated with the generated electricity is only the marginal increase in gas use. The CHP resource is strongly favored from the perspective of carbon calculations. System sizes range from about 100 kW to MW scale in electrical output.

Measure Applicability

This measure is applicable in a large scale industrial context.

Incremental Cost

This cost for measure is very site specific, of the order of $500-$1500/kW electric. This measure also has significant annual maintenance costs.

Average Annual Expected Savings

The savings from this measure consist of the net electrical output of the CHP plant. For example, a single moderately-sized plant of 250 kW would have an output of the order of 2 million kWh/yr.

Expected Useful Life

This measure has an expected useful life typical of appliances, of 15 to 20 years.

Small HVAC Optimization and Repair (C-2)

This measure applies to packaged rooftop units. These units are the predominant means of conditioning for small-to-medium scale commercial buildings. The savings proceed from improved compressor performance, better run time control, and fresh air cooling. These rooftop units are a homogenous pool of equipment that has been identified as underperforming. Typically, the refrigerant charge is out of specification, the economizers perform poorly if at all, and the airflow is too low for proper operation. Many utilities (e.g., SCE, PG&E, National Grid) are offering programs employing a structured diagnosis and repair protocol. Often these programs use trade named processes such as Proctor Engineering “check me”, or PECI “aircare plus” etc. Candidates for this measure are rooftop units found in a wide range of sizes with output capacities of from 4 to 50 tons with the most predominant capacity being 5 tons.

Measure Applicability

This measure is applicable in 70 percent of the commercial sector.

Incremental Cost

The cost for this technology includes site visits and diagnostics with simple repairs performed immediately without need for a second site visit. The costs will naturally vary with the specifics of the repair. Planning estimates for this diverse mix of treatments, made by the Northwest Power and Conservation Council (NWPCC), use $0.20/first year kWh savings.

Average Annual Expected Savings

Savings vary from unit to unit, but in the cases where there have been significant corrections to the refrigerant charge or to economizer operation savings on the order of 2,500 kWh/unit have been observed. At a particular site there will typically be several treated units.

Expected Useful Life

There are inherent limitations to the lifetime of the treatment provided by this measure. The improvements may be superseded by operational changes, and the remaining lifetime of the treated unit may be limited.

Retro Commissioning Engagement (C-3)

Commissioning is a systematic step-by-step process of identifying and correcting problems and ensuring system functionality. Commissioning seeks first to verify that the system design intent is properly executed, and it goes further by comparing actual building energy performance to appropriate bench marks to validate building performance as a whole. The best candidates for this measure are buildings larger than about 100,000 square feet. While commissioning in general can become quite complex, often the greatest savings proceed from a simple review of building operations to assure that the building is not being unnecessarily used during non-occupied times. New Commissioning (C-3) should be done as part of the construction contract, and most contractors will claim that this is normal business. But the performance of even new buildings is often erratic for a year or two while unnoticed problems come to light. This new commissioning is a detailed process of initial calibration and control sequence testing or verification. The initial process is usually not done well, but even so, the initial commissioning is inherently limited because usually it takes about a year of building operation to see how the building actually operates as a whole. By contrast, Retro-Commissioning (C-4) seeks to tune a building that is already operating and has a track record of a year or two at least. The Retro-Commissioning process starts with an analysis of the utility bills for all fuels, which to a trained eye will show the larger general operational problems which are then followed up with a limited scope site visit. Retro-Commissioning is usually necessary even for buildings that have been initially commissioned. There will be the occasional building which after years of operation will have its controls so mixed up that it will need a comprehensive new commissioning (C-3). In practice the New Commissioning is the larger more complicated job, while Retro-Commissioning is more superficial and focused on finding and fixing major problems only by applying low-cost/no-cost controls changes.

Measure Applicability

In this analysis New Commissioning is assumed to take place on 100 percent of new commercial stock as a matter of proper business. Retro-Commissioning is applicable in 75 percent of the existing commercial sector, and after a few years, to all of the new commercial buildings.

Incremental Cost

The cost for this technology is quite site specific, based on NWPCC estimates new commissioning costs about $0.37/kWh/yr, which for a typical large commercial building of 100,000 square feet would be about $37,000. For this study we are assuming a brief version of retrofit commissioning. Retro-Commissioning, or “commissioning lite”, that prescreens buildings on the basis of billing data and follows it with a site visit. In this analysis, all program-related commissioning is the Retro Commissioning and the New Commissioning is assumed to be part of the construction process.

Average Annual Expected Savings

Savings from this measure can vary widely. For Retro Commissioning, it is assumed here that the building electric energy use can be reduced by on average 20 percent. A significant portion of the energy savings due to both of these measures is associated with the heating fuel, usually gas. In estimates of program cost effectiveness for electric utilities, gas savings are usually not valued which can underrate the overall cost effectiveness of this measure.

Expected Useful Life

There are inherent limitations to the lifetime of the treatment provided by this measure. The improvements may be superseded by operational changes, and the remaining lifetime of the treated unit may be limited.

Low-E Windows (C-4)

This measure saves energy by reducing the thermal losses and gains through windows. This measure assumes that the efficient window has a heat loss rate of 0.35 BTU/deg F hr, representing the performance of a quality, double glazed argon filled low-e window. The original window is assumed to have a heat loss rate of 0.75 BTU/deg F hr, representing the average losses from a mix of single and double glazed windows.

Measure Applicability

This measure is applicable in 100 percent of new commercial buildings and 30 percent of existing commercial stock.

Incremental Cost

The incremental cost for this technology depends strongly on the context of use. If the efficient windows are used in a replacement context, then the full cost of $20/sqft is applicable. If the efficient windows are used as an upgrade in new construction then an incremental cost of only $3/sqft is used.

Average Annual Expected Savings

It is assumed here that the average site installation will contain 1,500 square feet of high efficiency window replacements.

Expected Useful Life

This is a very long-lived measure that will generally last the life of the building. For the purpose of this study, a periodic change-out due to breakage and the potential for future technological innovations leading to window replacement were assumed.

Premium New HVAC Equipment (C-5)

Premium new HVAC equipment employs more efficient motors/pumps and larger heat exchangers and pipes to lower operating energy requirements. Premium equipment is often designated with an Energy Star rating or by the Consortium of Energy Efficiency (CEE) as Tier I or Tier II, or it may not have an official rating, but it does deliver slightly improved performance and is usually sold as such. Premium HVAC equipment is a very broad category including efficient variable speed fans, and efficient chillers, efficient ice makers, and efficient packaged roof top units. It should be noted that rooftop units serve more than half of the commercial space, and they have therefore been the subject of an ongoing efficiency improvement campaign by CEE and the industry.

Measure Applicability

This measure is applicable in 100 percent of new commercial construction.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. Based on NWPCC estimates, the premium upgrade costs about $0.46/kWh/yr.

Average Annual Expected Savings

Savings attributable to this measure are generally fairly small because they represent only an incremental improvement in performance on equipment that is already required to be reasonably efficient. It is assumed here that the savings in new construction will be 3 percent of total energy use.

Expected Useful Life

The premium upgrades can be expected to last the life of the equipment.

Large HVAC Optimization and Repair (C-6)

This measure refers to restoring large HVAC equipment to its nominal operating performance. This measure needs to be distinguished from commissioning which is used to refine the controls of large HVAC which generally leads to large savings. By contrast this measure applies to the operation of the equipment and includes chiller and condensing tower cleaning, filter maintenance and tune-up etc. It also includes the optimization of economizer operation by verifying that the enthalpy sensors and economizer controls are functioning properly.

Measure Applicability

This measure is applicable in commercial sector buildings with large HVAC systems.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. Based on NWPCC estimates, the premium upgrade costs about $0.34/kWh/yr.

Average Annual Expected Savings

Savings attributable to this measure are generally fairly small because they claim only the savings due to restoring equipment to its original operation. For this study these savings are assumed to be 3 percent of building energy use.

Expected Useful Life

There are inherent limitations to the lifetime of the treatment provided by this measure. The improvements may be superseded by operational changes, and the remaining lifetime of the treated unit may be limited.

Window Film (C-7)

Window films are thin layers of polyester, metallic and adhesive coatings that allow some light to pass through but greatly reduce the amount of solar radiation passing through the window. These films provide some barrier to heat loss through the window. It is a highly cost-effective measure with wide application.

Measure Applicability

This measure is applicable in 90% of the commercial sector. While all buildings would benefit from the installation of this measure, buildings with 25% or greater of total outside wall area containing windows, single pane windows and south/south-west facing windows will receive greater benefit from this measure.

Incremental Cost

Energy Star lists the incremental cost of window film ranging from $1.35 to $3.00 per square foot of film.

Average Annual Expected Savings

During the cooling season 60% of a building’s heat load is generated by solar heating though windows. During the heating season, up to 25% of a buildings heat loss is through window conduction. Window films greatly reduce these energy loads. For typical building installation, annual energy savings are assumed to be 4 kWh/yr per square foot installed.

Expected Useful Life

This measure is assumed to have a relatively short useful life.

Integrated Building Design (C-8)

This measure applies to new construction where careful design and specific engineering can get beyond the rules of thumb, leading to the use of smaller equipment more carefully matched to load. Integrated design refers to an approach commonly used to design energy efficient new commercial buildings. Essentially, the design process lowers building loads, and then carefully matches HVAC equipment to the lowered load. In practice the most significant characteristic of efficient new commercial buildings is significantly reduced lighting loads and often reduced plug loads. The other important characteristic is enhanced building shell performance through improved insulation and solar shading, and enhanced daylighting. Taken together these improvements result in significantly altered lighting, heating, and cooling loads. Typically, the cooling loads will be significantly reduced, while the changes to the heating loads are more complex. The reduced internal gain from lighting etc will actually increase the gross heating loads, which the shell improvements may reduce somewhat through insulation or emphasized solar gain.

The altered heating and cooling loads will usually not conform to established equipment sizing rules of thumb, which generally result in oversized equipment. A primary objective in integrated design is to down size or eliminate the HVAC equipment leading to more efficient operation, and often leading to installation cost savings. It is notable that the shell improvements will usually result in more stable and comfortable interior wall and glazing surface temperatures that permit alternative and reduced means of heating and cooling distribution which can lead in turn to reduced fan or pump energy, leading to significantly more efficient heating and cooling distribution strategies. This reduction in distribution can also result in reduced installation costs. The integrated design process usually employs building modeling, but as more efficient new commercial building experience develops, a few basic strategies are emerging which can be used without recourse to costly building modeling. (see: New Buildings Institute, Core Performance Guide).

Measure Applicability

This measure is applicable in 100 percent of new commercial construction, but in national chain or franchise designs, the integrated design may already have been done at the corporate level, or getting to a level of integrated design may require interaction at the corporate design level that may not be possible at the local level.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. The incremental costs of efficient new commercial buildings developed through integrated design are quite building specific, and may range widely from about $3.50/square foot to negative incremental cost. But in general, the incremental cost will be the net of some increased costs for various building elements (such as lighting, external shading elements, insulation, more efficient equipment, more sophisticated controls, etc), and some decreased costs resulting from reduced equipment sizes and simplified distribution strategies. There are examples of highly efficient new commercial buildings that have negative incremental costs, but a good rule of thumb is to assume that the incremental cost will be of the order of $1.75/square foot, or about $0.35/first year kWh saved.

The particular incremental cost for a real building could be quite complex to estimate. Therefore in order to minimize overhead, utility programs that provide incentives for integrated design will base the incentives on modeled and deemed per square foot estimates of energy savings for principal occupancy types (retail, schools, offices, etc) for various HVAC systems and measure packages.

Average Annual Expected Savings

The savings due to integrated design will include the savings due to efficient lighting, efficient HVAC equipment, and controls. Taken as a package these savings can easily be on the order of 20-40 percent of the standard code compliant design. The current US tax code allows preferred treatment for new buildings that are 50 percent better than code or lighting systems that are 30 percent better than code.

Expected Useful Life

Integrated design can be expected to last the life of the building.

Efficient Package Refrigeration (C-9)

This measure consists of an efficient packaged and optimized new refrigeration system.

Measure Applicability

This measure is applicable in portions of the grocery sector and in some restaurants.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. Based on NWPCC estimates, the efficient packaged refrigeration costs about $0.15/kWh/yr.

Average Annual Expected Savings

It is assumed here that this measure can reduce a building energy use in applicable sites by 10 percent.

Expected Useful Life

Efficient package refrigeration will be considered operational 8760 hours per year with standard refrigerator operation life.

Electronically Commutated Motors (C-10)

An electronically commutated motor is a more efficient motor with variable speed control capability. In fan and pump applications it can save energy by operating at a more efficient speed. Refrigeration applications involving case cooling distribution fans are especially favored because the power reduction leads to a lower refrigeration load.

Measure Applicability

This measure is broadly applicable throughout the commercial sector.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. Based on NWPCC estimates, the premium upgrade costs about $0.33/kWh/yr.

Average Annual Expected Savings

It is assumed here that this measure can reduce a building energy use by 4 percent.

Expected Useful Life

Highly dependent on operational hours, electronically commutated motors are assumed to have a standard motor useful life.

Premium Motors (C-11)

This measure saves energy by reducing energy losses in motors. Motor energy use is preponderant in manufacturing applications where of the order of 40-60 percent of electric energy is used in motors, and these motor applications are frequently full-time operation or near full-time operation.

Motor efficiency varies with the size of the motor as is illustrated in the figure below.

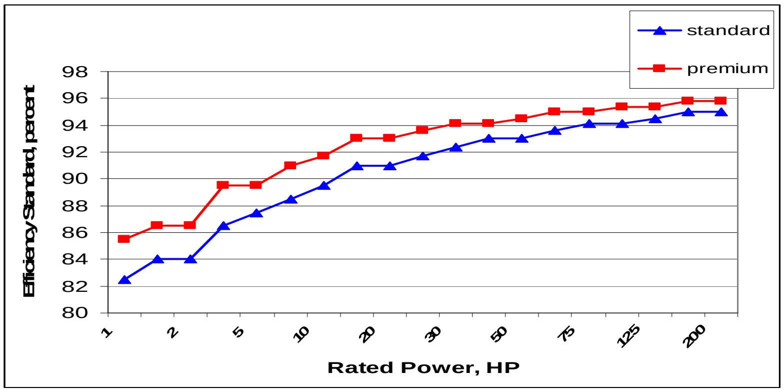

Figure 2. Motor Efficiency Specification NEMA Premium

The figure above shows the efficiency improvement to be gained by using the more efficient motor. While the efficiency gain is only about 2 percent for the smaller motors, it is important because the duty cycle of many motor applications is of the order of 5,000-8,760 hours/year.

In constant speed motor applications, an even greater electric energy savings may be available by properly matching the motor to its load. In particular, the efficiency of smaller motors in the 1-10 horsepower range can vary greatly with the duty load on the motor as illustrated in Figure 3. In this figure it is evident that if a smaller motor is oversized relative to its load, the efficiency can be reduced by of the order of 10 percent.

In motor replacement (and new motor) specifications, it is especially important to consider the fit of the motor to its load in terms of motor horsepower, speed, and starting torque. The greater portion of savings often rests with the proper match of the motor to its load.

A simple one-for-one motor replacement can have unexpected results. An important element in the use of higher efficiency motors is that the equilibrium speed of the higher efficiency motor is often slightly higher than the speed of the lower efficiency motor that was replaced. In fan and pump systems this slight increase in speed will increase the fluid throughput and power. So although a more efficient motor has been used, it may actually lead to an unintended but slight increase in flow and power unless the drive system is adjusted to compensate.

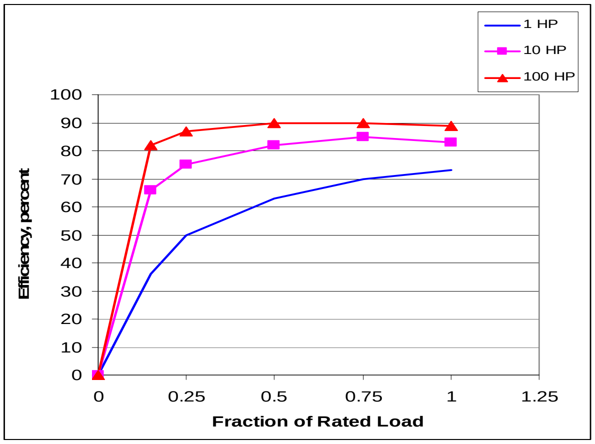

Figure 3. Typical Motor Operating Efficiencies versus Load

Measure Applicability

This measure is applicable in the new commercial and manufacturing sectors, and in suitable retrofit situations.

Incremental Cost

The incremental cost for this technology will be very diverse, and dependent on the size of the motor.

Average Annual Expected Savings

The savings from an efficient motor must assume that the drive has been adjusted as necessary to give equivalent flow or drive effort, and the savings will then depend strongly on the duty cycle hours/yr.

Expected Useful Life

This measure is essentially a built-in measure and is assumed to have a standard motor useful life.

Variable Speed Drives, Controls, and Motor Applications Tune-Up (C-12, C-13)

This measure saves energy by providing an efficient way to match a motor to a varying load. Motor controls, commonly referred to as variable speed or variable frequency drives, alter the frequency applied to the motor and thereby permit the motor to run more efficiently at lower outputs. This control capability is particularly important in process applications where a pump or fan is being controlled to maintain a particular and often varying fluid flow. Often the fluid flow is controlled by means of dampers or throttling valves that force the fan or pump motor to operate inefficiently. The savings associated with the proper speed control are most pronounced when the motor is operating at less than its rated capacity. At full capacity there may be little savings.

Situations involving fans, air compressors or pumps, (which is the most common commercial/industrial application of motors), have a very high energy sensitivity to flow rate; typically the energy varies as the cube of the flow rate. Attention to how the flow is controlled with the use of variable speed controls and elimination of excess flow can often lead to power reductions of the order of 50 percent with only minor reductions in flow. In this manner, variable speed motor control permits finer tuning and control of pumps, fans, compressors, and conveyers.

This is a very broad measure and the cost and savings are based on a complex fully-controlled application, here referred to as C14a. There is also a broad niche for single independent applications of these controls in matching a fan or pump to a fixed load that are much lower cost than a fully controlled application, but can still result in significant savings. This simpler application is here referred to as C-14b.

There is another genre of motors and controls referred to as brushless permanent magnet torque motors. These are very high torque motors that require minimal drive gearing and can be very precisely controlled. These have very good positioning capabilities and are used in machining and manufacturing assembly operations.

Measure Applicability

This measure is applicable in the new commercial and manufacturing sectors, and in suitable retrofit situations.

Incremental Cost

The incremental cost for this technology will be very diverse. Based on NWPPC estimates, an aggregated estimate of the costs of adjustable speed drives is about $0.86/kWh/yr.

Average Annual Expected Savings

It is assumed here that an application of drive control can save about 20 percent of the total building energy.

Expected Useful Life

This measure is essentially a built-in measure and is assumed to have a standard useful life.

Energy Star Transformers (C-14)

This measure saves energy by reducing energy losses associated with stepping down from high service voltages to typical service application voltages. In larger buildings and plants it is often more economic to distribute the power at high voltages to various floors and major areas where it is then stepped down to its ultimate application voltage through a transformer. These transformers are typically efficient (>95%) when they are properly loaded, but an oversized or under loaded transformer can operate at a much lower efficiency; therefore, it is important that the transformers be sized properly. However, even when the transformer is properly sized, it is important to use the most efficient transformer because all power passes through it.

Transformer efficiency varies with the size of the transformer as illustrated in the figure below.

Figure 4. Transformer Efficiency Specification NEMA TP-1

Figure 4 shows the efficiency improvement to be gained by using the more efficient Energy Star labeled transformer. While the efficiency gain is only about 1 percent for the smaller transformers it is important because all power runs through it and the percentage savings will be taken off the top.

Measure Applicability

This measure is applicable in the new commercial and manufacturing sectors, and in suitable retrofit situations.

Incremental Cost

The incremental cost for this technology will vary with the size of the transformer. For this study, we take a 150 KVA transformer as the average.

Average Annual Expected Savings

Transformer savings are based on the size of the transformer, and are based on the power throughput of the transformer as well as standby losses, 8760 hours/year.

Expected Useful Life

This measure is essentially a built-in measure and is assumed to have a standard useful life.

Efficient AC/DC Power (C-15)

A modern office environment has a multitude of electronic appliances, most of which are powered by a small transformer AC/DC converter. Standard transformer based converters are about 30-40 percent efficient. More efficient designs called switching power supplies operate with an efficiency of about 90 percent. The energy savings for this measure proceed from switching to the more efficient power supplies.

Measure Applicability

This measure is applicable in 100 percent of the commercial sector.

Incremental Cost

The incremental cost for this technology will be very diverse. Based on NWPCC estimates, the premium upgrade costs about $0.074/kWh/yr.

Average Annual Expected Savings

Electronics and computers use 12 percent of commercial energy on a US average basis. This equipment is often on 24 hours a day. It is assumed here that doubling the power supply efficiency from 45 to 90 percent would save at least 1.5 percent of the total building energy.

Expected Useful Life

This measure is assumed to have high usage which results in a relatively short useful life.

LED Outdoor Lighting (C-16)

LED lighting applications use much less energy than incandescent or metal halide lighting applications. At the present the color of “white” LED light is somewhat blue tinted and not always suitable for general interior applications. But this color is often suitable for outdoor applications and it is probable that LED lighting will find its place in many outdoor applications. The application considered here is an LED outdoor light, often referred to as a “cobra light”, which is used to illuminate parking lots and outdoor areas.

Measure Applicability

This measure is still evolving but will likely be applicable to a large percentage of the commercial sector.

Incremental Cost

A significant and favorable cost impact for this measure is its long life, leading to maintenance savings in cases where the light is difficult to access. Incremental costs vary based on lighting intensity and usage requirements.

Average Annual Expected Savings

Measure savings proceed from the replacement of a 250 watt light by a 19 watt LED assembly.

Expected Useful Life

The expected useful life for this long-lived measure is highly dependent on replacement bulb quality and usage, with varied results between 10-30 years.

New and Retrofit Efficient Lighting Equipment (C-17, C-18)

Lighting efficiency is the major commercial efficiency measure. Lighting accounts for 35 percent of commercial energy, and lighting also accounts for significant cooling energy that is saved when lighting is more efficient. There are literally hundreds of combinations of more efficient lighting elements that can replace less efficient elements. The most prevalent lighting efficiencies are CFL replacement for incandescent, LED replacement for incandescent and for task lighting, and high efficiency fluorescent T5 replacements for high bay lighting and linear fluorescent lighting. This efficient lighting measure goes beyond the light sources only and includes daylighting controls, bi-level switching and occupancy sensors. Recent improvements in daylighting and lighting controls have been dramatic. Taken together it is common to find efficient lighting that can reduce lighting energy by 50 percent from the minimum code required levels.

Measure Applicability

This measure is applicable in 100 percent of the new commercial buildings and in 85 percent of the existing commercial sector.

Incremental Cost

The incremental cost for this technology is essentially the cost of the efficient lighting components. These costs will be very diverse and site specific. Based on NWPCC estimates, and averaging the full range of conditions, efficient lighting costs about $0.26/kWh/yr. For a retrofit application, the cost is increased by 25 percent to allow for installation constraints.

Average Annual Expected Savings

A comprehensive lighting retrofit or new building lighting can save about 25 percent of the 34 percent lighting end-use, in all 8 percent of building energy.

Expected Useful Life

The useful life of the wide variety of lighting equipment varies widely from one light source or ballast to another. However, these elements are the replaceable elements within an overall installed system that determines overall useful lifetime.

LED Exit Signs (C-19)

Typical existing exit signs are incandescent exit signs. This measure is designed to replace these typical exit signs with an Energy Star Light Emitting Diode (LED) Exit Sign which is more efficient than the incandescent versions.

Measure Applicability

In principal, this measure is applicable in the entire commercial sector, and there are no physical constraints to replacing existing exit signs, but to account for already installed LED exit signs the applicability is assumed to be 85 percent of the commercial sector.

Incremental Cost

The incremental cost of an Energy Star LED Exit Sign over an incandescent exit sign is in the order of $50.

Average Annual Expected Savings

The average annual expected saving for this replacement is 245 kWh/year.[23] In the average building considered in this analysis, there are assumed to be 6 exit signs.

Expected Useful Life

LED exit signs are very long-lived light sources.

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[23] C&RD Database

LED Traffic Lights (C-20)

LED traffic lights[24] save energy because LED light sources are a much more efficient and long-lived light source than the incandescent bulbs they replace. They save energy but they also save in terms of bulb replacement costs. LED traffic lights have a variety of configurations. Each color (red, green, or yellow), each size (8 inch or 12 inch) and each type (thru lane, left turn bay, right turn bay, and don't walk large or small) has different incremental cost, savings and effective useful life values.

Measure Applicability

Measure applicability was not estimated due to lack of data on traffic lights in the DEO service territory. But for this analysis, it is assumed that there are 0.3 retrofittable intersections for every commercial building.

Incremental Cost

Depending on the color, size and type, the incremental cost ranges from $110 to $225. For this analysis we consider LED traffic light replacements in groups of 10, approximately the number of lamp replacements necessary to refit an intersection. For this analysis we will assume the average replaced light costs $200. These incremental costs do not assume an installation cost. It is assumed that the installation is done by the agency controlling the lights, and that it is more than paid for by the ongoing maintenance savings.

Average Annual Expected Savings

Depending on the color, size and type, the savings range from 111 to 808 kWh/year. For this analysis we consider LED traffic light replacements in groups of 10, approximately the number of lamp replacements necessary to refit an intersection. For this analysis we will assume the average replaced light saves 500 kWh/yr.

Expected Useful Life

Depending on the color, size and type, the expected useful life ranges from 3 to 16 years.

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[24] All values for LED Traffic Lights are available in the C&RD Database.

Small Commercial LED Change-out (C-21)

The Small Commercial LED Change-out is a pilot measure to change from incandescent or halogen lamps to LEDs in restaurants and small/medium retail shops, typically mall shops or small street-front shops. LED prices continue to decline and with their long measure life will be cost-effective in many small commercial change-out applications. LED light sources are a much more efficient and long-lived light source than the incandescent or halogen bulbs they replace. They save energy but they also save in terms of bulb replacement costs.

Measure Applicability

Measure applicability will be determined through the pilot application. Care will need to be taken insure each project is individually cost-effective. This will depend primarily on equipment in place.

Incremental Cost

Depending on floor arrangement and types of display for on-floor merchandise, the type of LED will vary. Primarily, the LEDs installed will range from 10 to 16 Watts. Retail price per bulb is expected to range from $9 to $15, and price to the program is estimated at $6 to $15. Total assumed installation cost is $30 per bulb. The price will be the outcome of negotiation. It is expected that bulbs will be retrofit into existing sockets, and that likely fewer bulbs will be required than were originally in place.

Average Annual Expected Savings

Depending on the size, the savings range from 180 to 300 kWh/year per bulb. For this analysis we consider replacements in groups of 35, approximately the number of lamp replacements necessary to refit a small business in a typical mall shop. For this analysis we will assume the average replaced light saves 236 kWh/yr.

Expected Useful Life

The expected useful life is assumed to be 6 years with an average operation history of 4,000 hours per year.

Perimeter Daylighting (C-22)

This measure saves energy by reducing energy to lighting that is in or adjacent to day lit spaces. Some cooling energy savings are also possible because well controlled day lighting contributes less internal gain to a space. This measure controls lighting based on a well placed day light sensor. This measure also includes design and details to control glare or over lighting.

Measure Applicability

This measure is applicable in the new commercial sector, and in suitable retrofit situations.

Incremental Cost

The incremental cost for this technology will be very diverse. Based on NWPCC estimates, perimeter daylighting costs about $0.85/kWh/yr.

Average Annual Expected Savings

It is assumed here that a full application of perimeter daylighting can save about 3 percent of the total building energy.

Expected Useful Life

This measure is essentially a built-in measure and is assumed to have a standard useful life.

Low Flow Fixtures (C-23)

This technology consists of a new showerhead rated at 2.0 gpm at 80 psi (or 1.5 gpm @60 psi) and a swivel aerator for any kitchen faucets, and fixed aerators for the lavatory faucets. The current US standard for showerheads is 2.5 gpm. And measurements of the existing shower flows in building stock show a range of 2.75 to 3.75 gpm with frequent individual cases showing in excess of 5 gpm. Evaluations have shown that programs that replace with 2.0 gpm heads have greater savings than programs that replace with the standard 2.5 gpm shower heads. Program shower heads should be 2.0 gpm at 80 psi and with a lifetime scaling and clogging warranty. It is important also to be cautious about the use of “pressure compensating” showerheads. These are more prone to clogging, and can lead to unintentional increases in flow rate in low pressure situations such as well water systems or older systems with occluded piping. Customer acceptability is an important component in a showerhead program. Customers will remove new low flow showerheads if the quality of the showering experience declines with the new showerhead. Therefore it is important to research and test the showerhead chosen for the program carefully. In addition the old showerhead must be removed from the premises to decrease the likelihood of having it reinstalled.

Measure Applicability

This measure is applicable to circumstances where there is showering; such as, schools, hospitality, health clubs, etc. The best application will be a site where the water is heated electrically.

Incremental Cost

The incremental cost for this measure is taken as $1,000, reflecting the installation of 15-40 showerheads by appropriately licensed professionals. Because the cost of the showerhead varies significantly and quality is so important for this program, it is essential to test, choose, and pay for a high quality showerhead. This measure is so cost effective that even with a more expensive showerhead the program will still remain cost effective and a quality showerhead will ensure measure persistence.

Average Annual Expected Savings

The average annual savings for this measure are directly related to the daily number of showers taken. For this study the showering load is assumed similar to a residential one and the overall savings are taken as 6,000 kWh/yr, representing the savings from 15-40 showerheads. The flow of the showerhead used has a significant impact on savings. Programs should be designed around a 2.0 gpm showerhead as compared to a 2.5 gpm showerhead. Therefore the savings will be more than the 120–133 kWh per unit listed in DEER. In addition the climate is different and the inlet water temperature is lower so the savings in this DEO program will be greater. Several studies have measured final savings in terms of electric input to the tank, but usually these studies have included savings from comprehensive treatments including other measures including tank and pipe insulation, kitchen and bath lavatory aerators, tank thermostat set back, and leaky diverter replacement. Savings can vary from program to program depending strongly on the choice of showerhead. A significant but unquantified addition to savings is associated with the water and sewer savings.

Expected Useful Life

The lifetime of this equipment is the key to its cost effectiveness. If an adequate, even pleasant, shower can be provided through lifetime warranted equipment, then the practical lifetime of the equipment is the length of time until the equipment is replaced in the course of renovation. DEER uses a lifetime of 10 years for this measure. Normally showerheads will last longer but with renovations and changes in ownership the average showerhead useful lifetime will be somewhat shortened.

Solar Water Heaters (C-24)

The water heating end-use in commercial buildings is a smaller end-use than in residences. In the DEO service area large commercial water heating will be done by gas and it will not be a very good candidate for this measure. But the smaller commercial water heating applications will be residential scale in usage and often these smaller applications will be electrically heated. These are the candidate applications for this measure. In the case of electrically heated water, the annual water heating energy is about 4,800 kWh/yr. Countless demonstration cases have shown that solar energy can supply all or a portion of this heating. The portion of the water heating load assumed by a solar water heater depends on the size of the solar water heater in relation to the size of the load. Field experience has shown that the best combination of system size to load favors the more moderately sized systems that can fully meet the summer water heat load, but that only meet about 40-50 percent of the non summer load. In physical terms, this is a system consisting of about 40-65 square feet of solar collector and an additional 80 gallon heated water storage tank and appropriate pumps and controls.

Measure Applicability

This measure is applicable to large commercial buildings with reasonably low hot water use, and the system is sized as if it were residential. This measure is taken as applicable to 25 percent of the commercial sector.

Incremental Cost

The installation of a solar water heating system involves a mix of building skills including plumbing, electrical, roofing and general carpentry. In the general market, a turn-key installation for one of these systems is in the range of $5,000-$7,000.

Average Annual Expected Savings

The savings from solar water heaters depend on site specifics, principally solar insulation, air temperature, incoming water temperature, and hot water usage rate. Considering these dependencies for the DEO service area, annual savings are determined for a system sized and designed to be within a cost effective range.

Expected Useful Life

Solar water heating systems are essentially plumbing fixtures that are certified products (Solar Rating & Certification Corporation - SRCC) and are often inspected by local building officials. A well designed system will have lifetime in excess of 25 years, even though the system will take some intermediate maintenance such as inspecting the pump and fluid level.

Heat Pump Water Heaters (C-25)

The water heating end-use in commercial buildings is a smaller end-use than in residences. In the DEO service area large commercial water heating will be done by gas, and it will not be a very good candidate for this measure. But the smaller commercial water heating applications will be residential scale in usage, and often these smaller applications will be electrically heated. These are the candidate applications for this measure. In the case of electrically heated water, the annual water heating energy is about 4,800 kWh/yr. The heat pump water heater is essentially a small heat pump drawing heat from the air by cooling and de-humidifying it and injecting this heat into a storage tank. Physically, this measure consists of a small, self-contained heat pump and a water storage tank and associated pumps and controls.

Measure Applicability

This measure is applicable to large commercial buildings with reasonably low hot water use, and the system is sized as if it were residential. This measure is taken as applicable 25 percent of the commercial sector.

Incremental Cost

The incremental cost of this measure consists of the cost of the heat pump water heater, water storage tank and installation plumbing and general construction labor. The siting of such a unit is important; it should never be sited in an attic, and freezing situations should also be avoided. Therefore, some special site adaptation and plumbing may be necessary.

Average Annual Expected Savings

For this study it is assumed that the heat pump water heater will perform with a coefficient of performance of 2.

Expected Useful Life

The useful life of this measure is assumed to be that of a similar appliance, a window air conditioner.

HE Food Prep and Holding (C-26)

This measure involves cooking and storage equipment that saves energy by keeping prepared food warm more efficiently, providing more efficient cooking methods and water conservation. The measures aggregated within this category are: convection ovens, combination ovens, steam cookers, efficient food holding cabinets and low-flow pre-wash sprayer nozzles.

Measure Applicability

This measure is applicable in portions of the restaurant, hospitality, and education sectors.

Incremental Cost

Incremental cost for this category of measures combines a weighted ratio of costs among the bundled measures. Individual measure costs range from $50 for a single spray nozzle with installation and $17,000 for a new combination oven.

Average Annual Expected Savings

It is assumed here that this bundle of measures will provide an average annual savings based on the individual penetration of each measure within the available population. Weighted averages were developed with the following assumptions:

Measure	**Market Penetration**
Spray Nozzles	35%
Convection Ovens	15%
Combination Ovens	7%
Steam Cooker	2%
Holding Cabinets	10%

Expected Useful Life

Measure life for this aggregate was based on a weighted average dependent on individual component potential market penetration rates.

Energy Star Clothes Washer (C-27)

Energy Star rated commercial clothes washers provide a marked savings increase over standard washers with higher volume wash loads and greater energy and water savings per cycle. Energy Star rates washers as Tier 1, Tier 2 and Tier 3 (MEF>1.80, 2.00, 2.20 respectively). For the purpose of this evaluation, Tier 1 washers were assumed to be the installed measure at all sites.

Measure Applicability

This measure is applicable in portions of the hospitality sector.

Incremental Cost

DEER lists the incremental cost of Tier 1 clothes washers as $347 per unit with an assumed installation cost of $116.

Average Annual Expected Savings

Savings are based on Tier 1 clothes washers with electric dryers. The average treated site is assumed to have 3 washers.

Expected Useful Life

This measure is assumed to have a standard useful life.

Restaurant and Grocery Audit (C-28)

This measure consists of an audit conducted by a restaurant and grocery energy professional to identify the potential for efficiency in a commercial kitchen and food storage facility. Savings proceed from small things such as leaky faucets and unnecessary equipment operation to larger things such as major process changes. Since kitchen equipment is energy intensive the audit includes identification of cost effective equipment changes.

Measure Applicability

This measure is applicable to grocery stores and related facilities and to commercial kitchens in the restaurant, hospitality, and education sectors.

Incremental Cost

The incremental cost for this measure is limited to the cost of the audit only. The cost of any major equipment changes is associated with other measures. The cost for the audit is assumed to be $.0738/kWh/yr.

Average Annual Expected Savings

It is assumed here this measure can reduce the energy use in an applicable facility by 8 percent for the average building considered in this analysis.

Expected Useful Life

This measure will have a relatively short life.

Grocery Refrigeration Tune-Up and Improvements (C-29)

This measure consists of cleaning heat exchangers and assuring proper airflow at the freezer cases and condenser coils. It also involves appropriate belt adjustment and refrigeration charge correction and the addition of a floating head pressure control if appropriate.

Measure Applicability

This measure is applicable in portions of the grocery sector and in some restaurants.

Incremental Cost

Based on NWPCC estimates, the grocery refrigeration tune-up costs about $0.19/kWh/yr.

Average Annual Expected Savings

It is assumed here that this measure will save 6 percent of site electrical usage for the average building considered here.

Expected Useful Life

This measure is assumed to have a short useful life.

Refrigeration Casework Improvements (C-30)

This measure refers to improvements to refrigeration casework that can lower the refrigeration load. These include high quality insulated glass doors on the refrigeration case or other transparent refrigeration case covers that limit mixing of the warmer store air with the refrigerated air.

Casework improvements also include attention to two refrigeration case auxiliaries that emit heat into the refrigerated space. The first is the anti-sweat heater made part of the clear refrigeration door to melt frost that could accumulate on the door and obscure the view of the contents. These heaters are commonly on all the time when they are only needed during high humidity episodes with humidity greater than 55 percent. The control improvement is to control the anti-sweat heaters with a humidistat thus allowing operation only to times when it is needed. While this control improvement will depend on the store humidity and the specific heater size, the savings for a typical refrigeration case are estimated here to be 400 kWh/yr.

The second heat emitting auxiliary is lighting and small fans used to distribute the cooled air inside the refrigerated case. These fans typically use a small inefficient motor coupled to an inefficient fan blade. In a typical medium-sized refrigeration case the existing fans may use about 70 watts, with the efficient fans using only about 20 watts, for a savings during 8,760 hours/yr of 50 watts or about 450 kWh/yr/case.

Measure Applicability

This measure is applicable in portions of the grocery sector and in some restaurants.

Incremental Cost

Based on NWPCC estimates, an average refrigeration case upgrade costs about $0.33/kWh/yr.

Average Annual Expected Savings

It is assumed here that this measure will save 5 percent at a suitable site.

Expected Useful Life

This measure is assumed to have a standard useful life.

VendingMiser® and Vending Machine Timer Control (C-31)

The VendingMiser® is a controller placed on vending machines which powers down the lighted vending machine face during low use times while maintaining product quality. It cycles the machine to maintain temperature and uses occupancy sensors to control the lighting on the vending machine.

Measure Applicability

This measure is assumed to be applicable in 25 percent of the commercial sector.

Incremental Cost

According to DEER, the incremental cost for a VendingMiser® unit is $179 and installation costs are expected to be $35.50 in labor for a total incremental cost of $215.

Average Annual Expected Savings

Measure savings range from 800 to 1,200 kWh/yr, depending on the vending machine. Large machines with an illuminated front save 1,200 kWh/yr; and small machines or machines without an illuminated front save 800 kWh/yr.

Expected Useful Life

The expected useful life for this measure is the useful life of the associated vending machine.

Smart Plug (RC-1)

This measure consists of a power strip with load sensing capability. When the primary load is turned off, the secondary loads connected to the power strip are automatically powered down. This measure is typically used in home office spaces where support equipment (printers, projectors, etc.) may be left on after the connected computer is turned off.

Measure Applicability

This measure is applicable to residential home office space and some entertainment center applications.

Incremental Cost

The incremental cost for this measure is determined to be the cost of purchase of the smart plug.

Average Annual Expected Savings

Savings associated with this measure are based on home-energy use surveys, with typical household electronics usages and reasonable assumptions of secondary equipment usage patterns. It should be noted that the household loading due to electronics is increasing steadily and projected savings from this measure will likely increase over time.

Expected Useful Life

This measure will have a medium-term useful life.

Exhibit NM-3

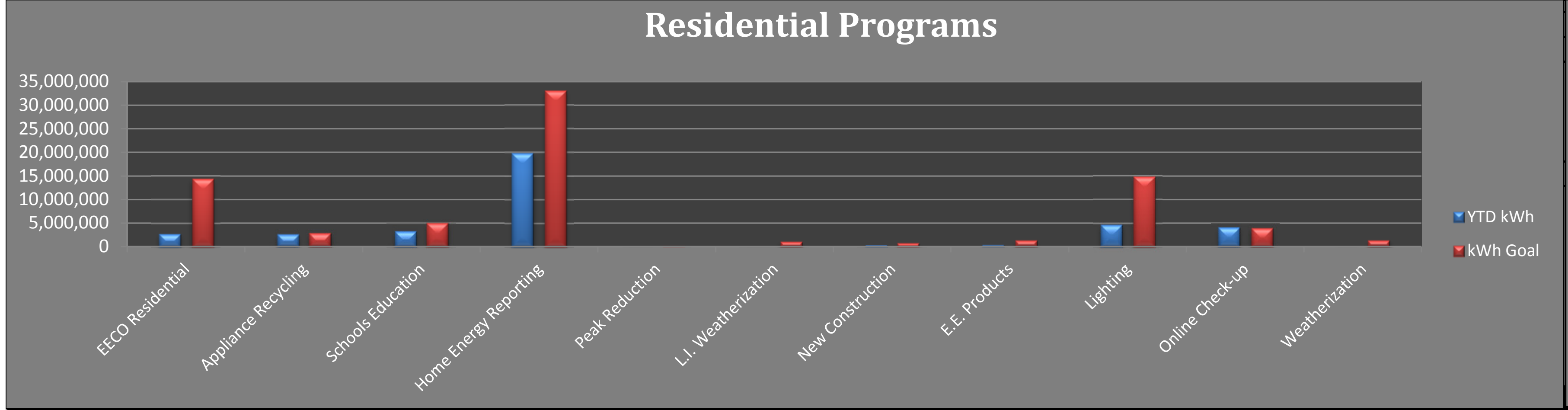
I&M DSM/EE Program Scorecard October 2015

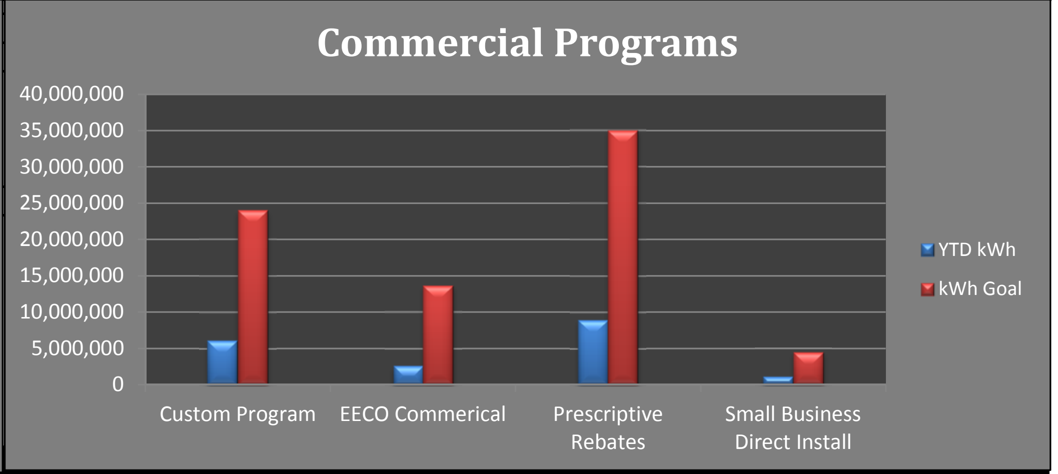
AEP INDIANA MICHIGAN POWER
A unit of American Electric Power

Cause No. 43827 DSM 5
CAC Set 6, Q11

I&M
DSM/EE Program Scorecard
October 2015
Program Year 6: January 1, 2015 - December 31, 2015

	Measures Implemented				Program Budget Expenditures				Gross Energy Impacts (kWh)				Gross Demand Impacts (kW)				Net kWh		Net kW
Program	Current Month	YTD	Planning Goal	% to Goal	Current Month Actuals	YTD	Budget	% to Goal	Current Month kWh Savings	YTD	Energy Savings Goal	% to Goal	Current Month kW Savings	YTD	Demand Savings Goal	% to Goal	NTG Ratio	YTD	YTD
C&I Programs																			
Prescriptive Rebates	9,598	32,601	0		$242,832	$1,357,928	$2,763,894	49%	2,753,899	11,672,369	35,000,000	33%	726	2,676	5,600	48%	0.81	9,454,619	2,168
Custom Program	1,454	7,666	0		$282,387	$1,429,265	$2,704,917	53%	3,212,930	9,306,059	24,000,000	39%	426	1,336	5,021	27%	0.99	9,212,998	1,323
Small Business Direct Install	432	3,616	0		$31,619	$352,188	$823,042	43%	140,586	1,271,102	4,430,770	29%	31	323	349	93%	1	1,271,102	323
EECO Commerical	18	18	27	67%	$7,940	$44,895	$107,393	42%	485,995	3,136,190	13,581,338	23%	99	637	2,810	23%	1	3,136,190	637
Subtotal	**11,502**	**43,901**			**$564,778**	**$3,184,276**	**$6,399,246**	**50%**	**6,593,410**	**25,385,720**	**77,012,108**	**33%**	**1,283**	**4,972**	**13,780**	**36%**		**23,074,909**	**4,450**
Residential Programs																			
EECO Residential					$87,039	$489,960	$1,177,207	42%	513,995	3,316,876	14,371,293	23%	103	662	3,044	22%	1	3,316,876	662
Appliance Recycling	427	3,061	3,350	91%	$58,459	$527,041	$648,693	81%	411,656	2,966,424	3,068,260	97%	49	351	361	97%	0.72	2,135,825	253
Online Check-up	646	7,729	11,423	68%	$53,211	$436,287	$676,785	64%	302,349	4,330,779	3,865,320	112%	33	476	483	99%	0.85	3,681,162	405
Schools Education	3,506	11,261	11,755	96%	$168,382	$609,954	$647,775	94%	1,480,198	4,754,282	4,962,843	96%	210	676	705	96%	0.997	4,740,019	674
Home Energy Reporting	168,156	168,156	145,000	116%	$81,757	$921,735	$1,181,647	78%	1,872,158	21,707,865	33,000,000	66%	369	2,923	3,762	78%	1	21,707,865	2,923
Peak Reduction	0	8,079	9,000	90%	$13,119	$576,122	$824,835	70%	0	31,496	112,014	28%	0	5,632	5,670	99%	1	31,496	5,632
L.I. Weatherization	0	105	5,117	2%	$19,554	$193,272	$1,205,905	16%	0	5,068	1,029,804	0%	0	0	109	0%	1	5,068	0
Weatherization	0	815	8,878	9%	$43,946	$222,885	$1,432,478	16%	0	39,189	1,276,803	3%	0	4	395	1%	0.72	28,216	3
New Construction	54	280	449	62%	$54,624	$303,254	$492,422	62%	85,950	459,839	731,022	63%	67	340	545	62%	0.8	367,871	272
E.E. Products	133	962	1,183	81%	$43,321	$241,295	$371,264	65%	71,827	430,256	1,294,877	33%	7	48	397	12%	0.52	223,733	25
Lighting	31,768	195,680	513,715	38%	$108,100	$524,398	$1,072,014	49%	902,007	5,610,078	14,770,000	38%	108	670	2,300	29%	0.5	2,805,039	335
Subtotal	**204,690**	**396,128**	**709,870**	**56%**	**$731,512**	**$5,046,203**	**$9,731,025**	**52%**	**5,640,140**	**43,652,151**	**78,482,236**	**56%**	**946**	**11,782**	**17,771**	**66%**		**39,043,170**	**11,183**
INDIRECT COSTS																			
Staff Dev. & Prof. Organizations					$12,053	$49,355	$65,000	76%	OCTOBER 2015 SCORECARD SUMMARY										
Computer System Development					$13,801	$178,048	$200,000	89%											
Marketing & Cust. Awareness					$17,359	$132,586	$300,000	44%											
New Program Development					$0	$0	$50,000	0%											
Potential Studies					$0	$0	$65,000	0%											
Planning & Analytic Support					$8,034	$68,840	$100,000	69%											
Budgeting & Acct. Support					$8,767	$120,634	$125,000	97%											
Subtotal					**$60,014**	**$549,463**	**$905,000**	**61%**											
PORTFOLIO TOTALS																			
Total Residential	204,690	396,128	709,870	56%	$731,512	$5,046,203	$9,731,025	52%	5,640,140	43,652,151	78,482,236	56%	946	11,782	17,771	66%		39,043,170	4,450
Total C&I	11,502	43,901			$321,946	$1,826,348	$6,399,246	29%	6,593,410	25,385,720	77,012,108	33%	1,283	4,972	13,780	36%		23,074,909	11,183
Total Portfolio	***204,690***	***396,128***	***709,870***	***56%***	***$1,356,304***	***$8,779,942***	***$17,035,271***	***52%***	***12,233,550***	***69,037,871***	***155,494,344***	***44%***	***2,229***	***16,754***	***31,551***	***53%***		***62,118,080***	***15,633***





PROGRAM NOTES:

EECO	Participants = Number of Circuits with VVO equipment; Budget Expenditures are split 91.64% Residential, 8.36% Commercial
EECO	Revised Savings target based on number of Stations with Volt Var installed & operating.
Home Energy Reports	Program Savings are based on total # of active participants which is fluid based on opt outs & move outs / Updated Opower savings with final ytd totals received in August.
Peak Reduction	YTD participants includes all that have enrolled since 2012; minus opt outs, move outs, & removals.
Indirect Costs	$25,000 transferred from Planning & Analytical Support, $10,000 transferred from Market Potential Studies; to Staff Development & Memberships. ($35,000 total)
Total Portfolio	% to Goal for Measures doesn't include Commercial Measures

12/11/2015

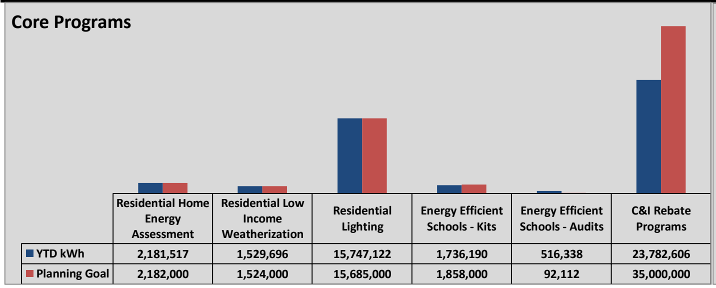
Exhibit NM-4

I&M Discovery Request Response to CAC Set 4, Q1
I&M DSM/EE Program Scorecard EMV December

AEP INDIANA MICHIGAN POWER
A unit of American Electric Power

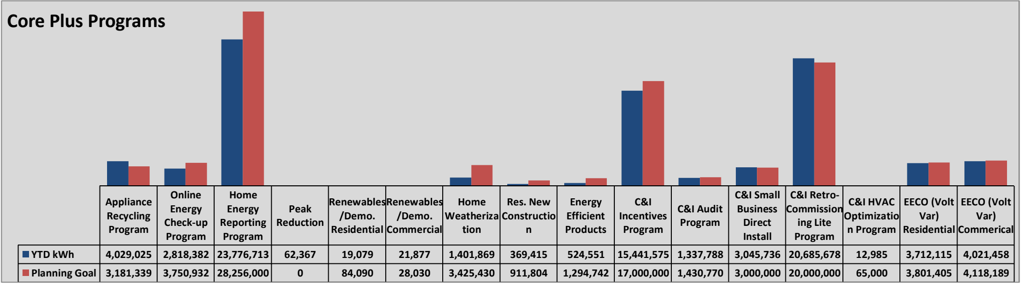
I&M
DSM/EE Program Scorecard - December 2014
Program Year 5: January 1,2014 - December 31, 2014

		Measures Implemented				Program Budget Expenditures				Gross Energy Impacts (kWh)				Gross Demand Impacts (kW)					Net kWh	Net kW
Program	End Note	Current Month	YTD	Planning Goal	% to Goal	Current Month Actuals	YTD	Budget	% to Goal	Current Month kWh Savings	YTD	Energy Savings Goal	% to Goal	Current Month kW Savings	YTD	Demand Savings Goal	% to Goal	NTG Ratio	YTD	YTD
CORE PROGRAMS																				
Residential Home Energy Assessment		0	1,632	2,106	77%	$7,143	$756,980	$787,357	96%	0	2,181,517	2,182,000	100%	0	239	924	26%	87%	1,897,920	208
Residential Low Income Weatherization		0	1,104	1,425	77%	$5,155	$975,379	$1,113,647	88%	5,314	1,529,696	1,524,000	100%	0	139	661	21%	100%	1,529,696	139
Residential Lighting		0	407,950	358,069	114%	$6,822	$855,233	$910,819	94%	0	15,747,122	15,685,000	100%	0	1,874	3,787	49%	50%	7,873,561	937
Energy Efficient Schools - Kits		62	3,820	6,048	63%	$32,482	$567,661	$586,561	97%	28,179	1,736,190	1,858,000	93%	4	237	495	48%	97%	1,684,104	230
Energy Efficient Schools - Audits		0	12	12	100%				N/A	0	516,338	92,112	561%	0	33	1	3300%	377%	1,946,594	124
C&I Rebate Programs		0	36,691	114,821	32%	$1,658	$2,576,019	$3,111,298	83%	0	23,782,606	35,000,000	68%	0	3,684	5,645	65%	80%	19,026,085	2,947
Subtotal		**62**	**451,209**	**482,481**	**94%**	**$53,260**	**$5,731,272**	**$6,509,682**	**88%**	**33,493**	**45,493,470**	**56,341,112**	**81%**	**4**	**6,206**	**11,513**	**54%**		**33,957,961**	**4,585**
CORE PLUS PROGRAMS																				
Appliance Recycling Program	7	260	3,879	3,137	124%	$43,270	$676,921	$649,077	104%	271,892	4,029,025	3,181,339	127%	34	506	943	54%	68%	2,739,737	344
Online Energy Check-up Program	8	71	5,395	6,882	78%	$8,765	$306,314	$338,585	90%	38,930	2,818,382	3,750,932	75%	3	245	262	93%	85%	2,395,625	208
Home Energy Reporting Program	9	94,295	96,278	100,000	96%	$1,433	$721,384	$735,348	98%	2,429,547	23,776,713	28,256,000	84%	251	2,596	1,930	135%	100%	23,776,713	2,596
Peak Reduction	10	0	8,440	9,000	94%	$18,103	$1,147,690	$1,047,129	110%	0	62,367	0	#DIV/0!	0	5,294	4,814	110%	100%	62,367	5,294
Renewables/Demo. Residential		1	2	5	40%	$8,757	$37,444	$134,545	28%	3,804	19,079	84,090	23%	1	3	6	53%	87%	16,599	3
Renewables/Demo. Commercial		1	2	2	100%	$2,920	$12,456	$44,848	28%	18,953	21,877	28,030	78%	3	4	2	181%	87%	19,033	3
Home Weatherization		1,694	5,973	6,929	86%	$156,582	$650,292	$1,457,738	45%	441,311	1,401,869	3,425,430	41%	60	216	1,047	21%	91%	1,275,700	197
Res. New Construction		33	204	449	45%	$31,440	$264,884	$333,751	79%	50,895	369,415	911,804	41%	40	237	77	308%	98%	362,027	232
Energy Efficient Products		267	1,063	2,816	38%	$57,445	$259,079	$630,916	41%	190,794	524,551	1,294,742	41%	40	149	3,542	4%	98%	514,060	146
C&I Incentives Program		124	238	34	700%	$616,544	$1,805,460	$1,987,002	91%	8,831,992	15,441,575	17,000,000	91%	0	821	4,888	17%	96%	14,823,912	788
C&I Audit Program		36	67	139	48%	$200,734	$766,465	$774,551	99%	473,392	1,337,788	1,430,770	94%	21	214	778	27%	84%	1,123,742	180
C&I Small Business Direct Install		72	206	175	118%					1,098,232	3,045,736	3,000,000	102%	0	0	n/a		100%	3,045,736	0
C&I Retro-Commissioning Lite Program		33	57	70	81%	$949,384	$2,030,692	$2,187,808	93%	12,047,037	20,685,678	20,000,000	103%	0	0	n/a		97%	20,065,107	0
C&I HVAC Optimization Program		35	35	357	10%	$3,065	$21,549	$435,669	5%	12,985	12,985	65,000	20%	2	2	528	0%	80%	10,388	2
EECO (Volt Var) Residential		9	9	9	100%	$34,020	$334,734	$396,483	84%	381,447	3,712,115	3,801,405	98%	109	1,061	1,086	98%	100%	3,712,115	1,061
EECO (Volt Var) Commerical						$4,205	$41,372	$49,004	84%	413,234	4,021,458	4,118,189	98%	118	1,149	1,177	98%	100%	4,021,458	1,149
Subtotal		**96,931**	**121,848**	**130,004**	**94%**	**$2,136,667**	**$9,076,736**	**$11,202,454**	**81%**	**26,704,445**	**81,280,612**	**90,347,731**	**90%**	**683**	**12,496**	**21,080**	**59%**		**77,964,319**	**12,202**
INDIRECT COSTS																				
Staff Development & Prof. Organizations						$3,833	$34,595	$95,000	36%											
Computer System Development						$14,963	$126,164	$235,000	54%											
Marketing & Customer Awareness						$41,161	$195,668	$300,000	65%											
New Program Development						$0	$0	$210,000	0%											
General EE Management & Collaboration						$0	$0	$105,000	0%											
Codes Work						$0	$0	$100,000	0%											
MPS & Action Plan						$0	$0	$75,000	0%											
Evaluation & Related						$4,250	$56,624	$140,000	40%											
Subtotal						**$64,207**	**$413,051**	**$1,260,000**	**33%**											
PORTFOLIO TOTALS																				
Total Residential		96,692	535,749	496,875	108%	$411,417	$7,553,995	$9,121,956	83%	3,842,114	57,908,041	65,954,742	88%	542	12,796	19,574	65%		47,840,224	11,594
Total C&I		229	37,102	115,435	32%	$1,778,510	$7,254,013	$8,590,180	84%	22,895,825	68,866,041	80,734,101	85%	144	5,906	13,019	45%		61,036,319	5,193
Total Portfolio		**96,993**	**573,057**	**612,485**	**94%**	**$2,254,134**	**$15,221,059**	**$18,972,136**	**80%**	**26,737,938**	**126,774,082**	**146,688,843**	**86%**	**687**	**18,702**	**32,593**	**57%**		**111,922,280**	**16,787**



Core Programs

	Residential Home Energy Assessment	Residential Low Income Weatherization	Residential Lighting	Energy Efficient Schools - Kits	Energy Efficient Schools - Audits	C&I Rebate Programs
🟦 YTD kWh	2,181,517	1,529,696	15,747,122	1,736,190	516,338	23,782,606
🟥 Planning Goal	2,182,000	1,524,000	15,685,000	1,858,000	92,112	35,000,000



Core Plus Programs

	Appliance Recycling Program	Online Energy Check-up Program	Home Energy Reporting Program	Peak Reduction	Renewables /Demo. Residential	Renewables /Demo. Commercial	Home Weatherization	Res. New Construction	Energy Efficient Products	C&I Incentives Program	C&I Audit Program	C&I Small Business Direct Install	C&I Retro-Commissioning Lite Program	C&I HVAC Optimization Program	EECO (Volt Var) Residential	EECO (Volt Var) Commerical
🟦 YTD kWh	4,029,025	2,818,382	23,776,713	62,367	19,079	21,877	1,401,869	369,415	524,551	15,441,575	1,337,788	3,045,736	20,685,678	12,985	3,712,115	4,021,458
🟥 Planning Goal	3,181,339	3,750,932	28,256,000	0	84,090	28,030	3,425,430	911,804	1,294,742	17,000,000	1,430,770	3,000,000	20,000,000	65,000	3,801,405	4,118,189

Exhibit NM-5

I&M Discovery Request Response to CAC Set 5, Q2
DSM Historic Performance in Forecast

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1															
2		**Incremental**													**current filed**
3		**Energy (kWh)**	Res - Low/Moderate Income	Res - Rebates	Res - Appliance Recycling	Res - Whole House	Res - URWP Loans	Res - Statewide Core Lighting	Res - Statewide Core Home Energy Assessments	Res - Statewide Core Income Qualified Weatherization	Res - Online Energy Checkup	C&I - Rebates Prescriptive	C&I - Incentives	R/C/I - School Energy Education	Res - Online Audit
4		2008					18,000	1,800,000							
5		2009					9,200	875,440							
6		Year 1 - 2010	467,000	9,816,000	2,469,000					90,000		4,079,000		12,000	
7		Year 2 - 2011	591,552	38,991,004	3,030,422	877,408						24,910,220		766,479	
8		Year 3 - 2012		(1,411,010)	4,260,656	15,295	779	21,229,646	4,237,391	1,723,888	465,733	38,491,566	5,451,966	2,063,010	
9		Year 4 - 2013			2,493,000	6,161,000		15,685,000		2,151,000		29,994,000	11,254,000	2,386,000	4,994,000
10		Year 5 - 2014			3,181,339	3,434,997		16,542,202		2,593,708	2,293,183	35,578,622	29,710,026	2,015,432	735,892
11															
12		**Peak (kW)**													
13		2008					3	164							
14		2009					1	79							
15		Year 1 - 2010	133	2,659	706					8		851		3	
16		Year 2 - 2011	169	10,490	866	14						5,086		219	
17		Year 3 - 2012		(403)	484	4	-	6,079	1,855	709	91	8,808	1,285	588	
18		Year 4 - 2013			1,785	1,784		4,481		616		15,151	7,397	683	3,280
19															
20															
21				lighting				lighting							

	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
1															
2	**programs**														
3	Res - New Construction	Res - Solar Siting	Res - Home Weatherization	Res - Home Energy Reporting	Res - Renewables & Demonstration	C&I Retro Commisioning Lite	C&I HVAC Optimization	C&I Audit	C&I New Construction	C&I Rebates	Res - Peak Reduction	Internal Facility / Other	Total	Energizing Indiana	I&M
4			471,000										2,289,000	-	489,000
5			291,000									3,299,037	4,474,677	-	300,200
6				259,000							26,331	1,755,214	18,973,545	102,000	17,116,331
7												491,492	69,658,577	766,479	68,400,606
8				3,662,381				100,691		687,018		8,588,707	89,567,717	29,940,953	45,586,091
9	-	-	997,000	11,994,000	28,000	21,845,000	4,996,000	6,494,000	-		-		121,472,000	20,222,000	89,996,000
10	236,432		2,395,292	7,517,350	24,420	28,489,293	3,051,608	6,501,040			-	7,919,594	152,220,429	21,151,342	93,439,467
11															
12															
13			95										262		
14			107									-	187		
15				7							175	-	4,542		
16												-	16,845		
17				1,046				29		149		-	20,724		
18	243	48	641	5,257	9	11,075	4,632	783	778		59		58,703		
19															
20															
21															

	AE
1	
2	
3	Total
4	489,000
5	300,200
6	17,218,331
7	69,167,085
8	75,527,044
9	110,218,000
10	114,590,808
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Exhibit NM-6

I&M Discovery Request Response to CAC Set 1, Q11
Billing Energy and Demand for Existing Indiana DSM Opt Out Customers

Indiana Michigan Power Company
Billing Energy and Demand for Existing Indiana DSM Opt Out Customers

Calendar 2014

	Billing kWh			Billing kW			Number of Accounts		
	Opt Out Customers	Total Class	Percentage of Total	Opt Out Customers	Total Class	Percentage of Total	Opt Out Customers**	Total Class***	Percentage of Total
GS	9,075,837	2,806,758,982	0.32%	58,724	10,126,643	0.58%	24	53,706	0.04%
LGS	5,304,189	1,557,688,186	0.34%	20,282	3,958,410	0.51%	2	1,637	0.12%
IP/IRP	850,655,228	4,161,134,157	20.44%	1,492,740	8,934,043	16.71%	19	244	7.79%
WSS	19,238,840	148,606,992	12.95%	49,303	377,749	13.05%	3	507	0.59%
MS	120,374	36,435,502	0.33%	882	128,470	0.69%	2	367	0.54%

Jan. - Oct. 2015*

	Billing kWh			Billing kW			Number of Accounts		
	Opt Out Customers	Total Class	Percentage of Total	Opt Out Customers	Total Class	Percentage of Total	Opt Out Customers**	Total Class**	Percentage of Total
GS	8,965,039	2,142,085,092	0.42%	58,724	8,731,743	0.67%	25	53,541	0.05%
LGS	0	1,480,763,835	0.00%	0	4,292,917	0.00%	0	1,998	0.00%
IP/IRP	742,725,319	3,594,074,436	20.67%	1,314,359	8,597,232	15.29%	20	251	7.97%
WSS	16,581,016	120,760,347	13.73%	41,869	340,555	12.29%	3	509	0.59%
MS	139,995	29,250,454	0.48%	1,046	120,570	0.87%	2	362	0.55%

*Data was compiled prior to the recording all November 2015 bills.

**Count of Opt Out Customers reflects all approved Opt Out accounts that were billed during the period.

***Customer counts are averages of the monthly counts.

Exhibit NM-7

I&M Discovery Request Response to CAC Set 8, Q1
I&M Housing Stock Statistics for Counties in Service Area

Indiana and Michigan Power Company - Indiana
Housing Stock Statistics for Counties in Service Area

	2014 Actual	**2015** Forecast/Actual	**2016** Forecast
Mobile Homes	33,943	33,555	33,230
Change from prior year	(420)	(388)	(325)
Single Family	547,770	549,575	551,758
Change from prior year	1,775	1,805	2,183
Multi-Family	119,128	119,628	120,285
Change from prior year	295	500	657

Source: U.S. Census Bureau and Moody Analytics

Exhibit NM-8

Cause No. 44634, NIPSCO Discovery Request Response to CAC Set 2, Q6, Attachment A

NIPSCO CAC Set 2-006 Attachment A
Cause No. 44634

NIPSCO	Number of Eligible Customers/ Accounts	Eligible Customer/ Accounts Total Load	Number of Opt Outs	Opt Out Load	Opt Outs as a % of Eligible Load	Total System Load	Opt Out Customers/ Accounts as a % of Total Load	Total C/I Load	Opt Out Customers/Accounts as a % of C/I Load	Number of Opt Outs by Customer Size
		MWh		**MWh**		**MWh**		**MWh**		
NIPSCO Opt Out 1	200 Customers representing 235 Accounts	9,221,625	25 Customers representing 69 Accounts	1,660,139	18%	16,760,588	9.9%	13,221,589	12.6%	2 > 50 MW 0 > 25 MW 3 > 10 MW 1 > 5 MW 10 > 2 MW 9 > 1 MW
NIPSCO as of 11/15/14 Opt Out 2	174 Customers representing 199 Accounts	7,878,413	25 Customers representing 112 Accounts	3,865,415	49%	16,760,588	23.1%	13,221,589	29.2%	2 > 50 MW 0 > 25 MW 0 > 10 MW 2 > 5 MW 14 > 2 MW 7 > 1 MW
Total NIPSCO Opt Out	Eligibility changed based usage		50 Customers representing 181 Accounts	5,525,554		16,760,588	33.0%	13,221,589	41.8%	4 > 50 MW 0 > 25 MW 3 > 10 MW 3 > 5 MW 24 > 2 MW 16 > 1 MW

Exhibit NM-9

Cause No. 43955 DSM 3, Duke Witness Douglas' Public Workpaper #2

Workpaper 2

DUKE ENERGY INDIANA, INC.

December 2014 YTD Non-Residential by Rate Class

			4/1/2014 Opt Out		1/1/2015 Opt Out		Participants	
Description	**Billed KWH**	**Revenues**	**Billed KWH**	**Revenues**	**Billed KWH**	**Revenues**	**Billed KWH**	**Revenues**
AL	-	$ -	-	$ -	-	$ -	-	$ -
CS	1,115,986,962	2,038,732	2,432,452	1,744	1,108,904	2,114	1,112,445,606	2,034,874
FS	499,083	907	-	-	-	-	499,083	907
HL	14,639	26	-	-	-	-	14,639	26
HLF	10,736,740,353	12,682,304	5,349,061,739	2,857,669	937,422,895	1,791,732	4,450,255,719	8,032,903
HLS	1,261,848	2,283	-	-	-	-	1,261,848	2,283
LLF	4,616,498,907	7,555,837	684,067,415	373,730	105,404,556	192,048	3,827,026,936	6,990,059
MHLS	4,327,091	7,887	-	-	-		4,327,091	7,887
MOLS	2,159,609	3,942	-	-	5,655	10	2,153,954	3,932
MS	2,507,498	4,576	176	-	793	1	2,506,529	4,575
OL	-	-	-	-	-	-	-	-
SL	41,421,428	74,938	-	-	751,461	1,359	40,669,967	73,579
TS	6,462,773	11,669	11,640	15	-		6,451,133	11,654
UOLS 1/	108,318,850	195,089	1,348,377	833	1,340,264	2,436	105,630,209	191,820
UT	-	-	-	-	-	-	-	-
WHTL	2,892	5	-	-	-	-	2,892	5
WP	149,647,087	262,274	8,993,690	4,908	160,160	290	140,493,237	257,076
CUSTOMER D	40,165,365	72,659	40,165,365	72,659	-	-	-	-
CUSTOMER O FIRM	1,156,802,970	115,349	1,156,802,970	115,349	-	-	-	-
CUSTOMER O INTER	-	728,116	-	728,116	-	-	-	-
CUSTOMER O INTR2	-	-	-	-	-	-	-	-
CUSTOMER L FIRM	128,826,317	86,299	128,826,317	86,299	-	-	-	-
CUSTOMER L RTP	80,516,252	47,711	80,516,252	47,711	-	-	-	-
CUSTOMER C TOU	58,839,120	26,234	58,839,120	26,234	-	-	-	-
CUSTOMER C HLF - BULK	443,758,160	302,878	443,758,160	302,878	-	-	-	-
CUSTOMER J - HLF	175,362,172	121,494	175,362,172	121,494	-	-	-	-
Non-Residential Sales 2/	**18,870,119,376**	**$ 24,341,209**	**8,130,185,845**	**$ 4,739,639**	**1,046,194,688**	**$ 1,989,990**	**9,693,738,843**	**$ 17,611,580**

-

1/ Includes KWH sales for OL and AL rate groups due to rate migration.

2/ Previously excluded RTP and TOU Sales. These customers have now opted out, so their KWH is included for allocation purposes.

Exhibit NM-10

Cause No. 44645, Vectren Discovery Request Response to CAC Set 2, Q5

Vectren South
Cause No. 44645
Exhibit CAC DR 2-5

Line No.	Reference	Tariff	2014 Eligible Premises	2014 2014 KW Eligible	2014 2014 KWH Eligible
1		SGS	93	-	675,570
2		DGS1	106	24,176	6,894,657
3		DGS2	51	52,407	20,040,609
4		DGS3	30	359,836	110,304,953
5	(2+3+4)	Total DGS	187	436,419	137,240,219
6		OSS	29	42,464	11,887,808
7		LP	73	3,429,796	1,710,186,463
8		HLF	2	1,532,802	1,002,492,000
9	(7+8)	Total Large	75	4,962,598	2,712,678,463
10	(1+5+6+9)	**Total**	**384**	**5,441,480**	**2,862,482,060**

Line No.	Reference	Tariff	2014 Opt Out Premises	2014 2014 Opt Out KW	2014 2014 Opt Out KWH	2014 2014 Total KWH	2014 % of Total Eligible	2014 % of Total
11		SGS	39	-	268,227	65,505,983	40%	0%
12		DGS1	25	7,376	2,699,562		39%	0%
13		DGS2	19	28,220	11,736,712		59%	1%
14		DGS3	10	115,834	37,500,255		34%	3%
15	(12+13+14)	Total DGS	54	151,430	51,936,529	1,144,032,437	38%	5%
16		OSS	16	3,812	1,211,864	97,403,667	10%	1%
17		LP	23	1,845,927	946,636,263	1,802,105,988	55%	53%
18		HLF	2	1,532,802	1,002,492,000	1,002,492,000	100%	100%
19	(17+18)	Total Large	25	3,378,729	1,949,128,263	2,804,597,988	72%	69%
20	(11+15+16+19)	**Total**	**134**	**3,533,971**	**2,002,544,883**	**4,111,540,075**	**70%**	**49%**

Line No.	Reference	Tariff	2015 Opt Out Premises	2015 2014 Opt Out KW	2015 2014 Opt Out KWH	2015 2014 Total KWH	2015 % of Total Eligible	2015 % of Total
21		SGS	8	-	35,808	65,505,983	5%	0%
22		DGS1	17	2,663	783,175		11%	0%
23		DGS2	4	4,179	1,194,200		6%	0%
24		DGS3	5	48,240	19,007,800		17%	2%
25	(22+23+24)	Total DGS	26	55,081	20,985,175	1,144,032,437	15%	2%
26		OSS	3	33,950	9,436,500	97,403,667	79%	10%
27		LP	9	281,090	116,217,000	1,802,105,988	7%	6%
28		HLF	0	-	-	1,002,492,000	0%	0%
29	(27+28)	Total Large	9	281,090	116,217,000	2,804,597,988	4%	4%
30	(21+25+26+29)	**Total**	**46**	**370,121**	**146,674,483**	**4,111,540,075**	**5%**	**4%**

Line No.	Reference	Tariff	Total 2014 2015 Opt Out Premises	Total 2014 2015 2014 Opt Out KW	Total 2014 2015 2014 Opt Out KWH	Total 2014 2015 2014 Total KWH	Total 2014 & 2015 % of Total Eligible	Total 2014 & 2015 % of Total
31		SGS	47	-	304,035	65,505,983	45%	0%
32		DGS1	42	10,038	3,482,737		51%	0%
33		DGS2	23	32,399	12,930,912		65%	1%
34		DGS3	15	164,074	56,508,055		51%	5%
35	(32+33+34)	Total DGS	80	206,511	72,921,704	1,144,032,437	140%	6%
36		OSS	19	37,762	10,648,364	97,403,667	90%	11%
37		LP	32	2,127,017	1,062,853,263	1,802,105,988	62%	59%
38		HLF	2	1,532,802	1,002,492,000	1,002,492,000	100%	100%
39	(37+38)	Total Large	34	3,659,819	2,065,345,263	2,804,597,988	106%	74%
40	(31+35+36+39)	**Total**	**180**	**3,904,092**	**2,149,219,366**	**4,111,540,075**	**75%**	**52%**

Exhibit NM-11

I&M Discovery Request Response to CAC Set 1, Q13

INDIANA MICHIGAN POWER COMPANY
CITIZENS ACTION COALITION'S
DATA REQUEST SET NO. 1
IURC CAUSE NO. 43827 DSM 5
DATA REQUEST NO Q-1-13

REQUEST

Please provide a summary of all actions the Company has taken to acquire and retain opt out eligible customers (whether they have opted out or not) in its energy efficiency and demand side management programs since March 28, 2014.

RESPONSE

I&M mailed letters to eligible opt out customers in June 2014 for the July 2014 notification date and in September 2014 for the November 2014 notification date. I&M's website was updated to allow customers to view opt out information on-line. Opt out and opt in forms are located on the Indiana Rates and Tariffs web page of the I&M website.

Exhibit NM-12

ACEEE
Review of Lost Revenue Adjustment Mechanisms
June 2015

Valuing Efficiency: A Review of Lost Revenue Adjustment Mechanisms

Annie Gilleo, Marty Kushler, Maggie Molina, and Dan York

June 2015

Report U1503

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About the Authors

Annie Gilleo joined ACEEE in 2013. She is the lead author for the *State Energy Efficiency Scorecard*, and she conducts research on energy efficiency resource standards, utility regulatory structures, and other state-level efficiency initiatives.

Marty Kushler directs numerous national studies of utility-sector energy efficiency policies and programs and provides technical assistance to help advance energy efficiency policies in many states. He has been directing research and evaluation regarding energy efficiency and utilities for three decades, has been widely published, and has been a consultant for numerous states and the federal government. He joined ACEEE in 1998 following a career with the Michigan Public Service Commission.

Maggie Molina is the director of the ACEEE Utilities, State, and Local Policy Program. She conducts energy efficiency program and policy research and analysis, and she provides technical assistance on energy efficiency policy and programs to audiences including state and local policymakers, regulators, utilities, and efficiency program administrators. Since joining ACEEE in 2005, she has authored numerous reports on state policy and utility-sector energy efficiency topics, including the first editions of the *State Energy Efficiency Scorecard*, state-level energy efficiency potential studies, utility business models, the cost of saved energy, and next-generation efficiency programs.

Dan York has more than 20 years of experience in researching, analyzing, and implementing energy efficiency programs and policies. He is widely recognized for his work tracking and analyzing trends and emerging issues in utility-sector energy efficiency programs. His entire educational and professional experience has focused on energy efficiency and conservation as the foundations for a sustainable economy. He joined ACEEE in 2001.

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Executive Summary

Energy efficiency is one of the lowest-cost, cleanest, most reliable options available to utilities to meet customer demand. Yet a number of historical regulatory practices have combined to impede the use of energy efficiency as a resource, and the ability to address some of those practices has played a crucial role in the expansion of utility efforts regarding customer energy efficiency programs.

York et al. (2013) list the three main disincentives to utility investment in energy efficiency:

1. The costs of efficiency programs constitute financial losses to utilities unless they are able to recover those costs through rates or fees.
2. Investments in capital assets like power plants provide a return on investment under the traditional utility business model. Expenditures on energy efficiency programs avoid the need for these capital investments but do not provide a return.
3. The traditional utility business model is based on a throughput incentive, whereby utilities earn more profits by selling more electricity. Investments in energy efficiency drive down energy use and therefore utility revenues. However efficiency does not reduce the short-term, fixed costs of providing service.

State regulators have sought to address these three major disincentives through particular adjustments to utility regulatory frameworks. This paper examines one mechanism meant to deal with a utility's disincentives to invest in energy efficiency: a *lost revenue adjustment mechanism (LRAM)* or *lost contribution to fixed costs (LCFC)*. An LRAM is a rate adjustment mechanism that allows a utility to recover revenues that are reduced specifically as a result of energy efficiency programs.

States often use LRAM as an alternative to decoupling. Decoupling is a mechanism that makes small adjustments to rates and breaks the link between the amount of electricity or natural gas utilities sell and the revenue they are allowed to recover. Rates vary so that revenues—regardless of sales—are fully recovered. With decoupling in place, a utility is indifferent to changes in sales due to any factor, including efficiency programs or weather patterns.

LRAM differs from decoupling in two key ways. First, LRAM requires a utility to estimate energy savings over a given time period. Decoupling requires no such estimation. Second, LRAM is typically not symmetrical. That is, while a utility can recover lost revenues from efficiency programs, regulators do not make additional adjustments if the utility sells more energy than predicted in the test year. Decoupling is symmetrical and can result in both customer refunds and surcharges.

In recent years, many states have adopted the LRAM approach to address utilities' throughput incentive. In 2011, an ACEEE paper detailed the experience of several states with LRAM in place. Since that time, more states have adopted this type of regulatory mechanism, and many states have had several years of experience with it. Currently, 17 states have LRAMs in place for at least one major utility. At the same time, however, several states that had LRAM policies in the past have moved toward decoupling.

ANALYSIS OF CURRENT LRAM POLICIES

We asked states to submit information on their LRAM policies, lost revenue dollars eligible for recovery by utilities in the two most recent program years, and program costs and annual savings from energy efficiency programs for each of those years. Fifteen states responded with quantitative data.

The amount utilities were eligible to recover for electricity savings ranged from $0.02 per kWh to $0.13 per kWh, with a median of $0.05 per kWh. For natural gas, eligible recovery amounts ranged from $0.09 per therm up to $0.33 per therm, with a median of $0.19 per therm. This range speaks to differences in base rate designs and lost revenue calculation inputs for the states and utilities profiled, as well as the effect of pancaked savings, i.e., the compounding of savings from measures installed in multiple years.

LRAM dollars also varied in comparison with program costs for the electric utilities we surveyed. At the low end of the range, dollars collected for lost revenue were equivalent to only about 1% of electricity efficiency program costs in a given year. However for one utility surveyed, lost revenues recovered were equivalent to more than 70% of program costs. In this case it is likely that several years of recovery were rolled into a single rate case.

LESSONS LEARNED

An LRAM can bring parties to the table. Decoupling, or the separation of energy sales from a utility's profit calculation, is the simplest way to ensure that a utility meets its revenue requirement even if other factors dampen sales. But in many states, key parties view decoupling unfavorably. While LRAM is not a perfect substitute for decoupling, it can bring parties to the table in circumstances where decoupling is not feasible. LRAM can serve as a first-step policy solution on the way to decoupling.

Good evaluation, measurement, and validation (EM&V) is important. To prevent overcharging customers or undervaluing a utility's lost revenues, utilities and regulators need to get the savings right. Evaluation of savings is controversial in many of the states in which we conducted interviews. Though evaluation procedures were already in place for efficiency programs in many states, when lost revenues were at stake the scrutiny became far greater. It is important that all parties understand and agree to evaluation procedures. The evaluation process should be rigorous and transparent, with appropriate checks along the way.

Timing matters. Timing is critical to precise, efficient implementation of an LRAM. Since energy efficiency program decisions and rate-making decisions are necessarily intertwined in states with an LRAM in place, aligning these two functions to occur at the same time can help streamline processes. Intervals between rate cases also matter. Frequent rate cases avoid the issues associated with pancaked savings.

An LRAM alone will not fully incentivize efficiency nor remove the throughput incentive. While the lost revenue adjustment can help make a utility whole by compensating it for reduced energy sales associated with efficiency programs, it will do little to *encourage* investment in energy efficiency unless combined with other policy levers. In fact, our analyses indicate that having an LRAM policy itself is not currently associated with higher levels of energy efficiency effort (program spending) or achievement (energy savings) than are found in states without an LRAM policy. Nor does LRAM reduce a utility's motivation to increase sales (although some states do have safety nets in place). To fully remove the throughput incentive, decoupling should be considered. Regulators can prioritize energy efficiency by setting energy savings targets through an energy efficiency resource standard (EERS) and implementing performance incentives tied to specific energy saving levels. They can also help encourage efficiency investments by requiring utilities to evaluate energy efficiency in the same manner as other supply-side resources during resource planning.

CONCLUSION

Creating a regulatory environment that incentivizes utilities to invest in efficiency is critical for programs to be successful, impactful, and long lasting. Doing so requires a mix of policy tools. In addition to energy efficiency targets, utilities need a business model that aligns their financial interests with energy efficiency, including program cost recovery, performance incentives that encourage utilities to achieve high levels of savings, and some policy mechanism to neutralize the throughput incentive. It is our opinion that decoupling is the best third leg of this stool. However it is also clear that decoupling is not always an option for states for a variety of reasons. In such scenarios, LRAM can be a temporary solution, offering a mechanism to address the concern over lost revenues and, possibly, help make parties more comfortable with the idea of full decoupling in the future.

Introduction

Utilities and regulators are making major changes to the utility industry across the country. As utilities try to become more service oriented, they are paying more attention to alternative business models, particularly those that value investments in energy savings. Energy efficiency is one of the lowest-cost, cleanest, most reliable options available to utilities to meet customer demand. Saving energy offers a wealth of opportunities for both utilities and the public. Investments in energy efficiency can reduce energy costs for families and businesses, create jobs, and improve the environment. Efficiency programs can help consumers control how and when they use energy, and they can help utilities build friendlier, service-oriented relationships with their customers.

Utility investments in energy efficiency have greatly increased since the mid-2000s. In 2004, utilities nationwide invested slightly less than $1.5 billion in energy efficiency programs. By 2014, investments had jumped to $7.7 billion (Gilleo et al. 2014). A variety of factors spurred this investment. Utilities were searching for cheaper ways to meet rising demand, states were looking for cleaner energy options for businesses and residents, and consumers wanted to reduce their utility bills.

A number of historical regulatory practices have combined to impede the use of energy efficiency as a resource. In order to address these barriers, states have adopted regulatory mechanisms to incentivize utilities to include energy efficiency in their portfolios. These adjustments to the traditional business model have played a crucial role in the expansion of utility energy efficiency programs.

TRADITIONAL REGULATION AND ITS PITFALLS

It is an unfortunate fact that the traditional utility business model conflicts with the objective of increasing customer energy efficiency. Traditional utility regulation structures developed with a focus on raising large amounts of capital to build the giant power plants and massive transmission and distribution network that we have in place today. Despite shifts in the energy industry in recent years, including far more emphasis on distributed resources and energy efficiency, the traditional utility regulatory structure is still generally in place, with little variation from state to state (York and Kushler 2011).

Utilities and regulators have historically set rates for electricity or gas sales through adjudication processes called rate cases. First they set revenue requirements by aggregating all of the utility's costs of providing service. They then calculate the rates necessary to recover these costs plus some reasonable return to the utility. Traditional regulation relies on two basic formulas (RAP 2011):

> *Revenue requirement* = *Expenses* + *Return* + *Taxes*
> *Rate* = *Revenue requirement/Units sold*

This traditional business model gives a utility the incentive to sell more electricity or natural gas. If it can sell more units of energy than were used to calculate its rate, the utility can earn more than its base revenue requirement.

This underlies one of the three disincentives to utility investment in energy efficiency under the traditional regulatory approach as described by York et al. (2013):

1. The costs of efficiency programs constitute financial losses to utilities unless they are able to recover those costs through rates or fees.
2. Investments in capital assets like power plants provide a return on investment under the traditional utility business model. Expenditures on energy efficiency programs avoid the need for these capital investments but do not provide a return.
3. The traditional utility business model is based on a throughput incentive, whereby utilities earn more profits by selling more electricity. Investments in energy efficiency drive down energy use and therefore utility revenues. However efficiency does not reduce the short-term fixed costs of providing service.

Despite these disincentives, state regulators and other stakeholders across the country see value in efficiency investments, and they have been working with utilities to adjust the traditional business model in ways that encourage them. Utilities are key partners in delivering efficiency, and states need to get them on board to maximize energy savings. The traditional business model is not going to work for the utilities of the future.

COMMON STRATEGIES FOR BALANCING INTERESTS

State regulators have sought to address the disincentives to energy efficiency investments through adjustments to utility regulatory frameworks.

Program cost recovery is a widespread regulatory practice that allows utilities to recover the costs of energy efficiency programs through rates. Efficiency program costs are typically treated as pass-through expenses which the utility may recover by adding a surcharge to the rates it charges customers. Alternatively the costs may be capitalized and the utility may raise rates to earn a return on the money it invested in efficiency

Performance incentives offer utilities financial rewards for saving energy through efficiency programs. Incentives make these programs into a source of earnings rather than just pass-through expenses. This puts energy efficiency investments on a comparable footing with investments in new power plants or transmission and distribution, which are allowed to earn a rate of return. Performance incentives help make up for the earnings opportunities utilities forego when, due to energy efficiency, they do not need to invest as much in their supply infrastructure. The companion report to this one (Nowak et al. 2015) discusses incentive designs, which vary widely.

Decoupling is the most straightforward solution to the throughput incentive. It breaks the link between the amount of electricity or natural gas the utility sells and the revenue it is allowed to take in (RAP 2011). Under decoupling, a utility is guaranteed to earn a specific amount, no more, no less, regardless of how much energy it sells. Its revenue is based on a regulatory formula rather than on the amount of energy its customers use. Revenue requirements are established in rate cases, and then decoupling true-ups occur outside of these cases. True-ups make small adjustments to rates based on actual sales. If the utility sells more energy than projected, it is required to refund customers. If it sells less, it is allowed to raise rates to reach its revenue requirement. Under decoupling, a utility is indifferent to changes in sales due to any factor, whether weather, efficiency programs, or anything else. Decoupling is in place in about half of the states for electric or natural gas utilities or both (Morgan 2013).[1]

As an alternative to decoupling, many states have opted to address the throughput incentive with a different regulatory tool—a *lost revenue adjustment mechanism (LRAM)* or *lost contribution to fixed costs (LCFC)*.[2] Under LRAM, a utility is allowed to recover revenues it has lost, not just due to any cause (as with decoupling) but specifically as a result of energy efficiency programs. Regulators calculate the energy savings associated with the efficiency measures installed. They then allow the utility to recoup the revenues it has lost due to those energy savings. Figure 1 shows how LRAM addresses a revenue shortfall.

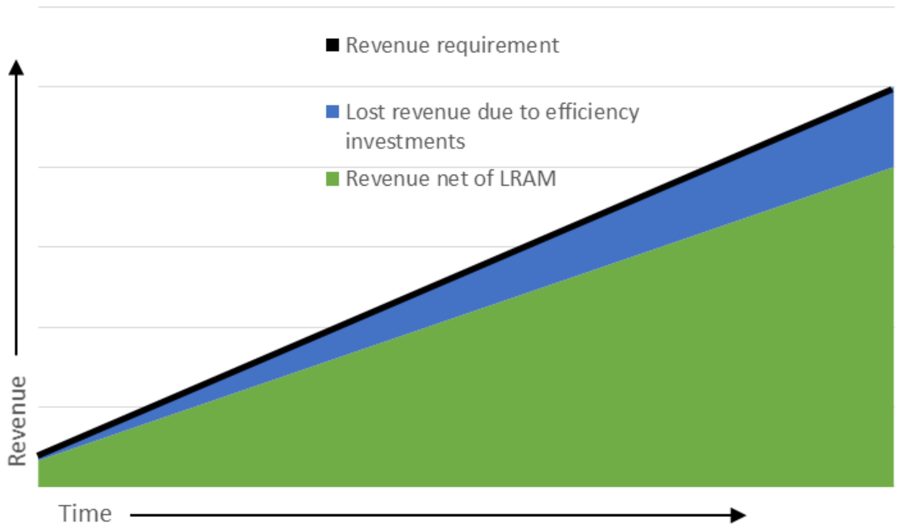

Figure 1. Theoretical application of LRAM to address revenue shortfall. A utility's revenue requirement is shown in black. In a traditional utility business model, savings from efficiency investments eliminate potential energy sales, thereby reducing a utility's revenue (shown in green). Under the LRAM approach, a utility calculates these savings and is able to capture lost revenue, shown in blue.

There are key distinctions between LRAM and decoupling. First, LRAM requires a utility to estimate energy savings resulting from efficiency programs over a given time period.[3] Decoupling requires no such estimation because its adjustments are based on actual sales volume (which is easily observable) rather than projected savings. Second, unlike decoupling, LRAM is typically not symmetrical. As discussed above, decoupling results in customer refunds if the utility sells more energy than expected, and surcharges if it sells less. With LRAM, the utility may recover revenues lost due to efficiency programs, but

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[1] We consider a state to be decoupled when the mechanism is in place for at least one major utility.

[2] We use the term LRAM throughout this paper, although there are other names for this mechanism.

[3] In practice, states estimate energy savings to varying degrees, with some putting greater focus on evaluated savings than others.

regulators do not make adjustments if the utility sells more energy than predicted in the test year. Figure 2 illustrates the potential for over-earning built into the structure of LRAM.

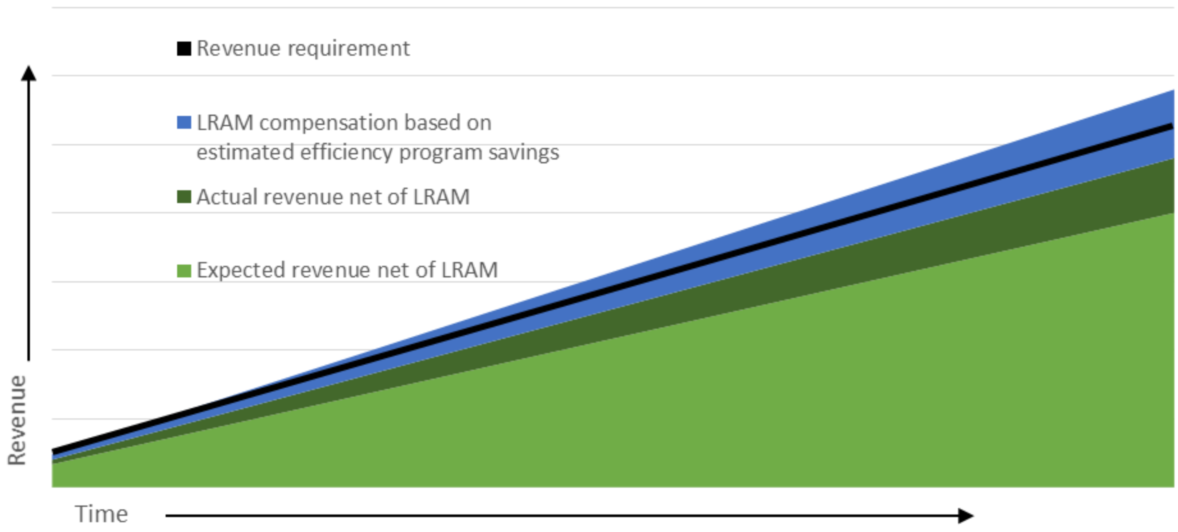

Figure 2. Potential problem with LRAM if sales are above forecast after energy efficiency programs are enacted. The dark green area is revenue above what was predicted in the test case. By evaluating savings generated through efficiency, utilities are often still able to recover the total amount of lost revenues shown in blue, even the portion above the revenue requirement.

Unlike decoupling, then, LRAM does not completely remove the link between a utility's sales and its revenues. As can be seen in figure 2, a utility could have the incentive to boost sales above the level originally forecast to allow recovery of authorized revenues beyond the revenue requirement. Some states have tried to design LRAM policies to address this issue. For example, in Nevada, utilities are explicitly prevented from over-earning and in recent years have refunded excess revenues to customers.

One more initial point should be made about LRAM. This mechanism does not reimburse utilities for the cost of energy efficiency programs; rather, it makes them whole for revenues they have lost as a result of selling less energy. Analysts should not regard LRAM as a cost of energy efficiency, and they should not include it in cost calculations, for example when they compare the cost of energy efficiency with that of other resources. This mischaracterization becomes especially misleading when LRAM dollars compound over time if there are long intervals between rate cases. We discuss this issue in the section below on the "pancake effect."

LRAM IN THE STATES

In recent years, many states have adopted the LRAM approach to address utilities' throughput incentive. In 2011, an ACEEE paper detailed the experiences of several states with LRAM in place (Hayes et al. 2011). The authors found 13 states with current or pending LRAMs for at least one electric or natural gas utility, but only 4 states with more than a year of experience. Since that time, more states have adopted this type of regulatory mechanism, and many have had several years of experience. Currently, 17 states have LRAMs in place for at least one major electric or gas utility (figure 3).[4]

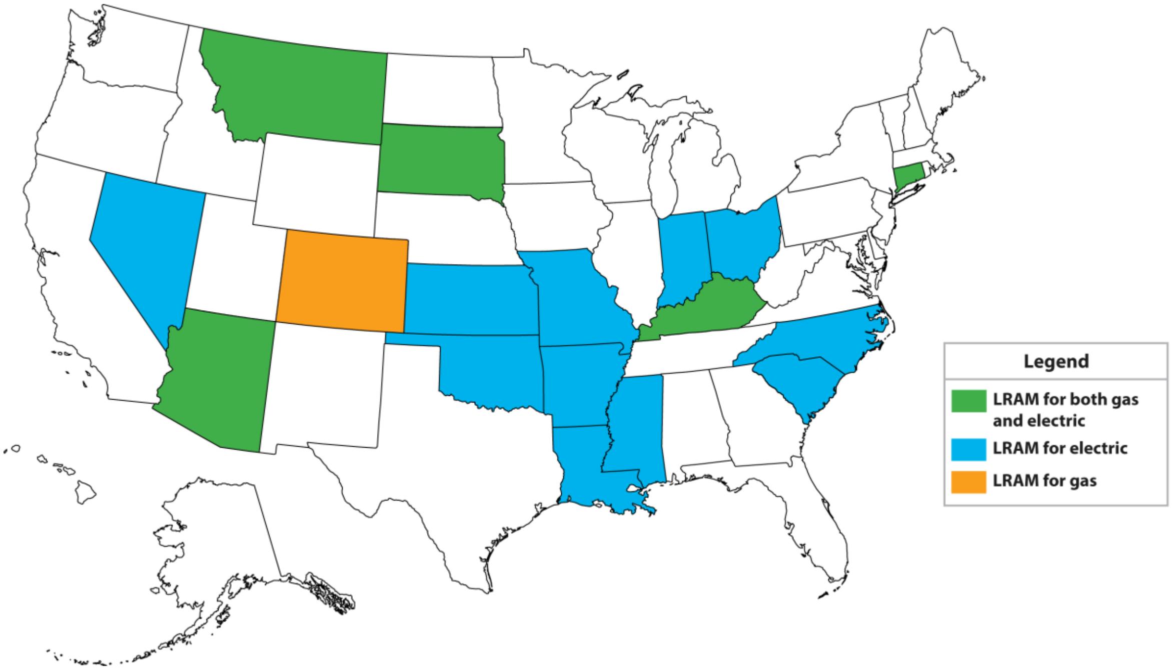

Figure 3. States with at least one utility with an LRAM currently in place. Note that decoupling or other rate adjustment mechanisms may also be in place for some utilities in these states. In Connecticut, CL&P, the only electric utility in the state with an LRAM, included a decoupling mechanism in its most recent rate case.

ACEEE tracks LRAM and decoupling policies through its *State Energy Efficiency Scorecard*.[5] Information on utility business models is also maintained in the ACEEE State and Local Policy Database.[6] However we have not examined these policies in detail since 2011 (see Hayes et al. 2011). This report expands on our prior research, describing state experiences to date and detailing the outcomes. We describe the current landscape of lost revenue adjustment across states, summarize the available data, discuss our results, and offer recommendations.

Methodology

To begin research for this report, the authors sent a questionnaire to public utility commissions in each state with an LRAM in place (see Appendix C). We asked commission staff to submit both qualitative and quantitative data on mechanisms in place for electric utilities, gas utilities, or both. In total, we distributed 24 questionnaires. Through the data collection process, we learned that six states had policies that did not fit our definition of a lost revenue adjustment mechanism. We did not include these states in this report. Four

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[4] LRAM is currently pending in Louisiana but has not yet been implemented.

[5] Most recently, see Gilleo et al. 2014.

[6] http://database.aceee.org/

states did not complete the questionnaire. Many other states returned the questionnaire but indicated that at least some relevant data were unavailable or unclear.

Using the questionnaires as a starting point, we conducted interviews with states selected to represent a variety of geographical locations and regulatory experiences. Interviews with public utility commission staff, consumer advocates, utility representatives, and efficiency advocates added context to the technical details of the LRAMs in place in each of these states. We also parsed additional information from utility dockets when necessary. Using case studies and the quantitative data available, we developed a set of observations regarding state experiences with LRAMs.

Through this process we found that LRAM is being implemented in a variety of ways across the states. Because of the differences in regulatory structures and true-up timelines and the nuances in spending and savings data submitted, we cannot make apples-to-apples comparisons of dollars awarded under LRAMs. However we do present quantitative data where they are available to illustrate both trends and variation.

Each state profiled in this report treats lost revenue differently. While quantitative data are useful for understanding patterns and variances, it is also important to understand the subtleties of both policy design and policy priorities in each state. In the sections below, we describe state experience with LRAM, discuss our findings, and offer recommendations.

LRAM: History and Current Practice

HISTORICAL PERSPECTIVE

Lost revenue adjustment mechanisms are not new. In the 1980s and early 1990s, several states enacted policies allowing utilities to recover revenues lost from energy efficiency programs. However state experience with LRAM during this period was fraught with long and contentious proceedings. LRAM led to price increases, and lost revenue dollars recovered approached the amount of total dollars invested in energy efficiency (Hayes et al. 2011). These issues led many states to abandon the policy.

Historic Example: Minnesota

A prominent example of issues associated with lost margin recovery can be found in Minnesota, where an LRAM policy adopted for the state's electric utilities in 1991 was creating rapidly escalating LRAM costs for ratepayers. Due to the accumulating lost revenues between rate cases (see the discussion of pancaking that begins on page 11 of this report), the cost for lost revenues to ratepayers in 1997 was equivalent to 60% of the energy efficiency program costs, and climbing. In a filing to the Minnesota Public Utilities Commission (MPUC), the Minnesota Department of Public Service (MDPS) cited the following concerns in Docket No. E002:

- The period between rate cases is much longer than that envisioned when [the lost margin policies] were approved, significantly increasing the level of lost margins accrued.
- Lost margins increase rates without any tangible benefit to ratepayers.
- True lost margins are shrinking because, in the long run, "fixed" costs become variable costs.
- Utilities have growing opportunities to sell their saved energy on the wholesale market.

The MDPS noted:

> [I]t has now been 12 years since Otter Tail Power filed a rate case, 5 years since NSP-Electric filed, 4 years since Minnesota Power filed, and 3 years since Interstate filed. The frequency of rate cases is an important issue. The longer time lag has increased lost margins significantly, thereby raising the costs of electric utilities' DSM investments to ratepayers.

The MDPS added, "Clearly, [lost margin recovery was] intended to compensate utilities for short-term revenue losses between relatively frequent general rate proceedings. They were not intended to provide long-term windfall gains to shareholders."

For the state's largest utility (Northern States Power), while the energy efficiency program budget actually declined somewhat from 1994 through 1997, the annual lost revenue recovery increased eightfold over that time period. The MDPS recommended ending the LRAM policy after that case, and the MPUC subsequently agreed (Docket No. E002/M-98-443).

Despite the outcomes in the 1980s and 1990s, in recent years a number of states have again begun to adopt LRAM as a tool to encourage energy efficiency. The policy is meant to address utilities' concerns about revenues lost (contributions to fixed costs) as a result of customer energy efficiency programs. ACEEE's previous review of LRAM (Hayes et al. 2011) found that although the use of LRAM was increasing, there were limited data available to assess both the types of approach and the outcomes. The report also noted that no standard approach to implementation of an LRAM had emerged. Several years later, we see that the variation in these policy mechanisms is just as great. In Appendix A, we outline the details of lost revenue adjustment mechanisms currently in place in the United States.

Our research also brought to light several states where it was unclear whether a policy could be categorized as an LRAM. For example, Georgia allows utilities to earn an "additional sum," and its state code directs the utilities commission to "consider lost revenues…between the utility and its retail customers." While there had been some question as to whether Georgia's additional sum included the recovery of lost revenues, state contacts preferred to describe their regulatory mechanism as something closer to a performance incentive.[7] Alabama's Rate Stabilization and Equalization (RSE) Mechanism also is similar to an LRAM, although its purpose is to smooth customers' rates rather than remove the throughput incentive. We did not include Alabama's RSE or Georgia's additional sum calculation in this study. Wisconsin had a pilot program similar to Alabama's RSE from 2009 to 2013 and is likewise not included in this study. The mechanism captured over- and under-collections of Wisconsin Public Service Company's gross margin due to any cause, based on the number of bill counts. We also did not include Wyoming in our analysis of LRAMs. Wyoming does have a mechanism in place that allows Montana Dakota Utilities to recover lost revenues, but this mechanism applies only to load management programs. Since the LRAM does not apply to energy conservation efforts, we omitted it from our analysis.

Other states have had LRAMs in place in the past but have since eliminated these policies, opting instead to allow utilities to meet revenue requirements through decoupling or other rate design methods.[8] We did not include such states in our research for this report, focusing instead on policies currently being implemented.

BY THE NUMBERS

We asked states to submit information on lost revenue dollars eligible for recovery by utilities in the two most recent program years, along with information on program costs and annual savings from energy efficiency programs for each of those years. Not all states were able to provide this information. In total, we received data covering 32 utilities in 17 states, most outlining program expenditures, annual savings, and eligible LRAM dollars in years 2012 and 2013, with a few results from 2011 and 2012. Figure 4 shows eligible dollars for recovery from lost revenue associated with electricity efficiency programs.[9] LRAM dollars are normalized over electricity savings.

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[7] See Nowak et al. (2015) for more information on Georgia's and other states' performance incentives.

[8] For example, Hawaii terminated its LRAM mechanism in 2010 in favor of decoupling. Minnesota recently approved a decoupling mechanism.

[9] Note that in certain states, utilities may not *actually* recover all eligible dollars. For example, in Nevada, utilities are instructed to return lost revenue dollars to ratepayers after exceeding revenue requirements.

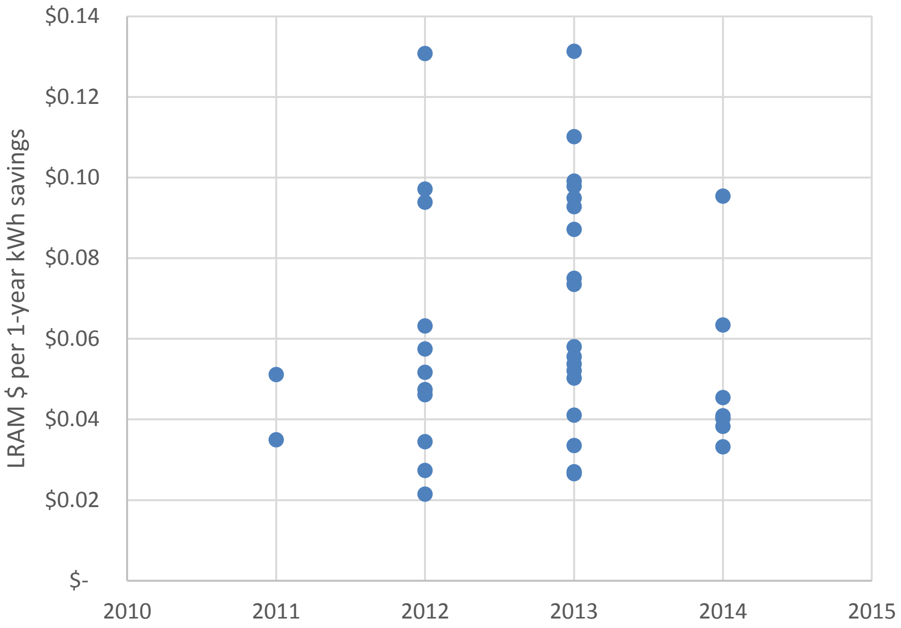

Figure 4. Lost revenue adjustment dollars recovered per kWh savings for electricity efficiency programs. Savings are annual one-year program savings. Data supplied by state public utility commissions. Note that not all states were able to provide data.

The amount utilities were eligible to recover per unit of electricity saved ranged from $0.02 per kWh to $0.13 per kWh, with a median of $0.05 per kWh. This range speaks to several factors that may influence LRAM collection:

- Different rate structures put varying amounts of rates in fixed and variable charges. The more that bills vary with consumption, the higher the LRAM rate will be.
- A utility's fixed charges also play a large role. Some utilities are vertically integrated, so LRAMs capture generation fixed costs. Other states have distribution-only utilities, so customers are not assessed generation-related fixed costs in LRAMs.
- States also have different limits in place for the time over which a utility may collect LRAM dollars for a given program year. In some cases, regulators were not able to say definitively that LRAM dollars were associated with a particular year's programs. In such situations, it is possible that recovery is also associated with additional savings from previous programs, making recovery amounts seem artificially high in comparison with energy savings.

Figure 5 shows eligible dollars for recovery of lost revenues associated with natural gas efficiency programs. LRAM dollars are normalized over natural gas savings.

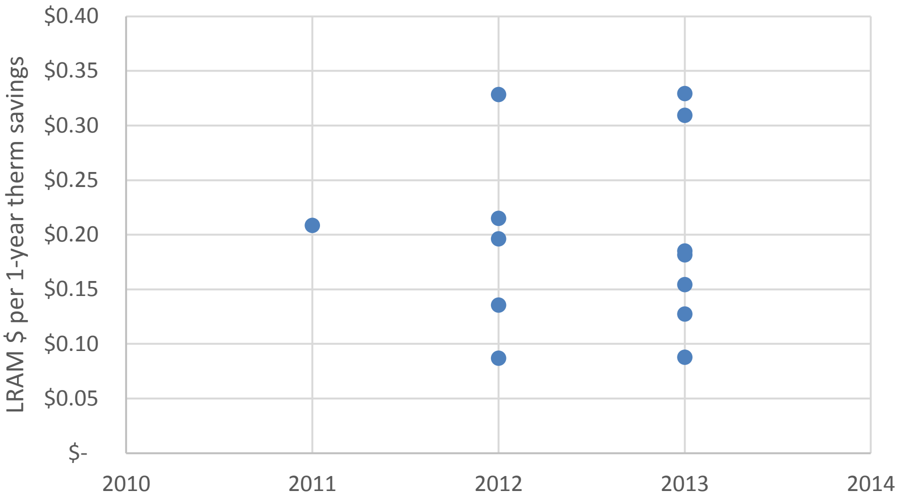

Figure 5. Lost revenue adjustment dollars recovered per therm savings for natural gas efficiency programs. Savings are annual one-year program savings. Data supplied by state public utility commissions.

As with LRAM dollars associated with electricity efficiency programs, we see notable variation in LRAM dollars eligible for recovery per unit of natural gas savings. Eligible recovery amounts range from $0.09 per therm up to $0.33 per therm, with a median of $0.19 per therm. Here too, differences in base rates may play a role. The inability to separate total lost revenues to show the amount associated with individual recovery years may also inflate figures.

The range in LRAM dollars per energy unit is dependent on the fixed costs for a given utility, which vary significantly based on a number of different factors. At their most basic, lost revenues are typically calculated as follows:

Lost revenues = Retail rate – Short-term avoided costs

Thus, lost contributions to fixed costs are directly dependent on the factors that make up utilities' base rates, and both fixed and variable costs can have an effect on the lost margin. Fixed costs can include investment costs; unavoidable costs of maintaining power plants, transmission lines, and other infrastructure; and other non-avoidable operating costs like personnel (NARUC 2007). These fixed costs may vary for a number of reasons. Simple avoided costs, as shown in the calculation above, typically represent fuel cost, although they are rarely so straightforward in practice. RAP (2011) calls these costs production costs and notes that in addition to fuel, they can include purchased power expenses, operation and maintenance costs, and transmission expenses. These too can vary by utility and region.

A variety of factors can influence lost revenue calculations, both in terms of a utility's overall fixed and marginal costs and in terms of the choices regulators make in designing the lost revenue calculation. Many states include separate LRAM calculations for each rate class. Some states factor in peak demand reductions in addition to changes in overall energy consumption.

Perhaps more telling is the comparison of a utility's program costs to the amount of lost revenue it claims each year. Figure 6 shows how the LRAM dollars recovered annually by electric utilities compare to annual program costs.

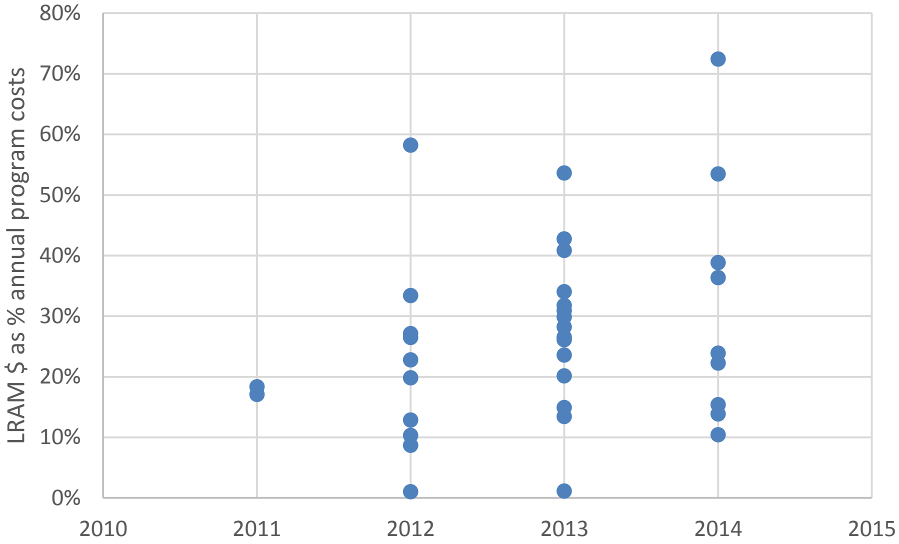

Figure 6. Lost revenue dollars eligible for recovery as a percentage of electricity efficiency program expenditures

Among the electric utilities we surveyed, LRAM dollars as a percentage of program costs varied widely. At the low end, dollars collected for lost revenue were equivalent to only about 1% of electricity efficiency program costs in a given year.[10] Median recovery was 25% of annual program costs. However, for one utility surveyed, lost revenues recovered were equivalent to more than 70% of program costs. It is likely that in such cases, several years of recovery were rolled into a single rate case. Thus, the LRAM dollars reported were not completely tied to a single year of efficiency programs, but rather accrued due to savings achieved over multiple years.

THE PANCAKE EFFECT

As noted above, LRAM dollars are not additional costs of efficiency programs. Rather, they reflect the collection of already authorized utility system fixed costs, and their collection is meant to bring the utility back in line with its revenue requirement. However there is the potential for over-earning under an LRAM if the mechanism is not well designed and closely monitored and if rates are not regularly reset to reflect updated electricity sales forecasts and utility system costs.

Efficiency measures generate savings over time. Absent intervention, and with everything else equal, lower consumption will cause a utility to not collect its fixed costs of providing service until the next rate case. In a rate case, rates are set based on current or projected

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[10] This result was a for a very small efficiency program. The lowest dollar amount collected for a larger program was about 9% of program costs.

future consumption, taking into account already existing energy efficiency. LRAMs make a utility whole in the periods between rate cases. But if rate cases are few and far between, balances in a LRAM account can build up, because each year the utility is capturing the revenue lost not only from measures implemented in that year, but also from energy efficiency measures put in place since the last time rates were set. This so-called pancake effect would impose substantial additional costs on customers if many years pass between program implementation and the next rate case. This hypothetical scenario is illustrated in figure 7.

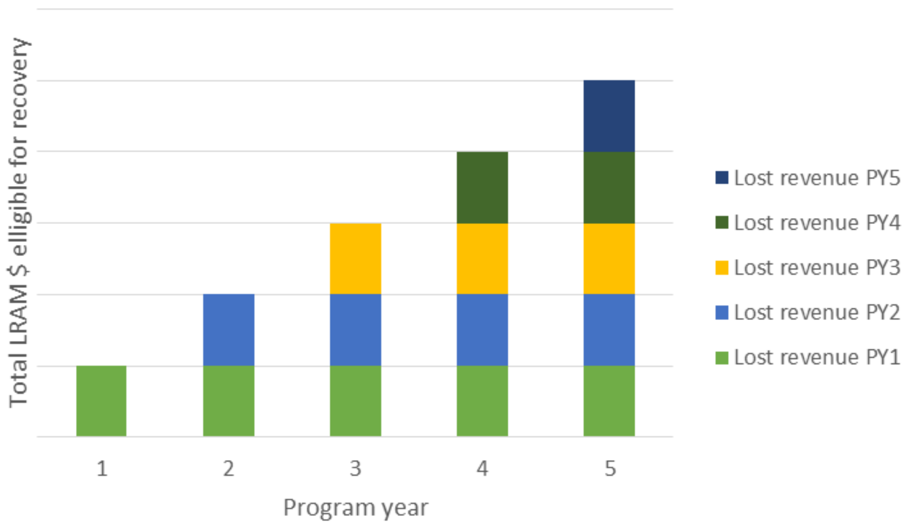
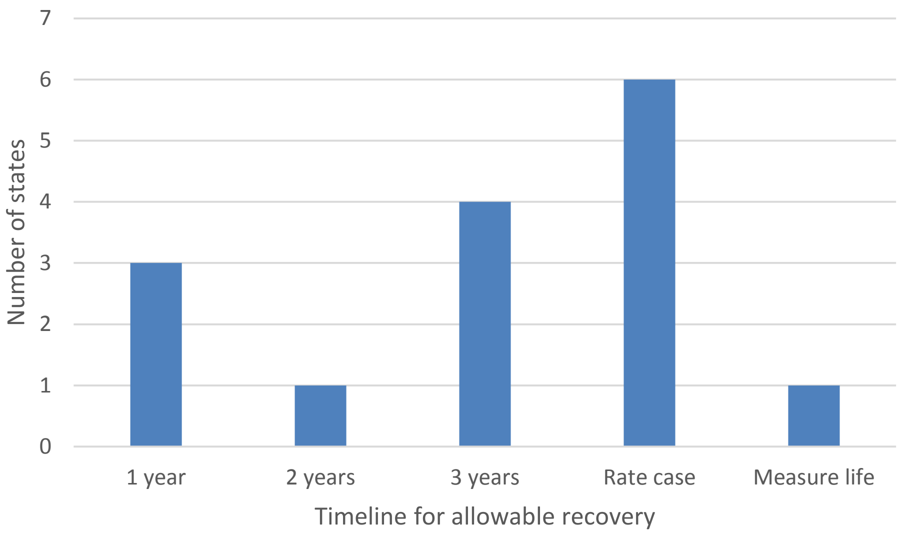


Figure 7. Scenario in which lost revenues pancake over a five-year period between rate cases. Lost revenues typically reset between rate cases, and rates are recalculated on the basis of a more current test year. For these reasons, timely rate cases help minimize pancaking and over-earnings.

As suggested above, regular rate cases can help minimize the pancaking effect, since regulators and utilities will take the effects of past years' energy efficiency programs into account in their predictions of future sales. States often set requirements stipulating the frequency with which utilities must come in for rate cases and reset lost revenues. Figure 8 shows the length of time, according to our research, that utilities are able to collect lost revenues associated with a particular program year.



1 year	3
2 years	1
3 years	4
Rate case	6
Measure life	1

Figure 8. Length of time over which lost revenue may be recovered for a single program year. Data from state responses.

It is most common for states to limit recovery to one to three years, although many states allow utilities to recover lost revenue for an indefinite period of time, resetting lost revenues during base rate cases. Respondents indicated that in these cases, although rules might not be in place specifying the allowable length of time between rate cases, utilities tend to bring them forward every two to three years. If there is no time limit on recovery of LRAM dollars (or rates are not reset to halt the LRAM collection), those dollar costs can pancake year after year. This has happened in some states, leading to a rejection of the LRAM policy.[11] Only one state indicated that utilities are able to recover lost revenue over the full life of an efficiency measure, regardless of rate cases.

It is also important to note that the pancake effect is an added challenge for regulators. Few regulatory staff were able to parse out lost revenues associated with a particular year's efficiency programs. Since LRAM dollars tend to flow into a single efficiency rider from several years' worth of programs, it can be difficult for regulators to judge the reasonableness of a utility's request for lost revenue. Development of reliable tracking systems is costly in terms of both time and money, and public service commissions are often understaffed and underfunded. Due to these constraints, quantifying the dollars associated with specific program years is often a near-impossible feat.

DOES LRAM FACILITATE GREATER ENERGY EFFICIENCY?

The fundamental purpose of an LRAM policy is to facilitate greater investment in energy efficiency by a utility. The LRAM is meant to address utility concern about lost contributions to fixed costs due to energy efficiency programs. Data on energy efficiency program performance available from ACEEE's annual *State Energy Efficiency Scorecard* allow

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[11] See the Minnesota example above.

us to examine whether electric utility LRAMs are associated with greater energy efficiency accomplishments.

For this analysis we focused on two key indicator variables (energy efficiency spending as a percentage of total revenues, and energy efficiency kWh savings as a percentage of retail sales), using the most recent year (2013) for which complete data were available. Many unique factors in a state or utility will influence utility behavior regarding energy efficiency programs, but it is nonetheless useful to look at how patterns of performance vary across many states under different policy conditions.

Due to a small sample size, we were limited in our analysis and relied on data visualization to make inferences. To begin, we compared states that had an LRAM policy in place for at least one utility in 2013 with states that had no LRAM or decoupling policy in place. (States with decoupling were excluded for the first analysis because decoupling is intended to address the same issue as LRAM.) No clear pattern emerges when comparing efficiency budgets between these two groups of states. While the spread between maximum and minimum budgets is larger for states with no revenue adjustment mechanism, median budgets are about the same (0.85% and 0.95%). Figure 9 shows efficiency budgets for these groups of states.

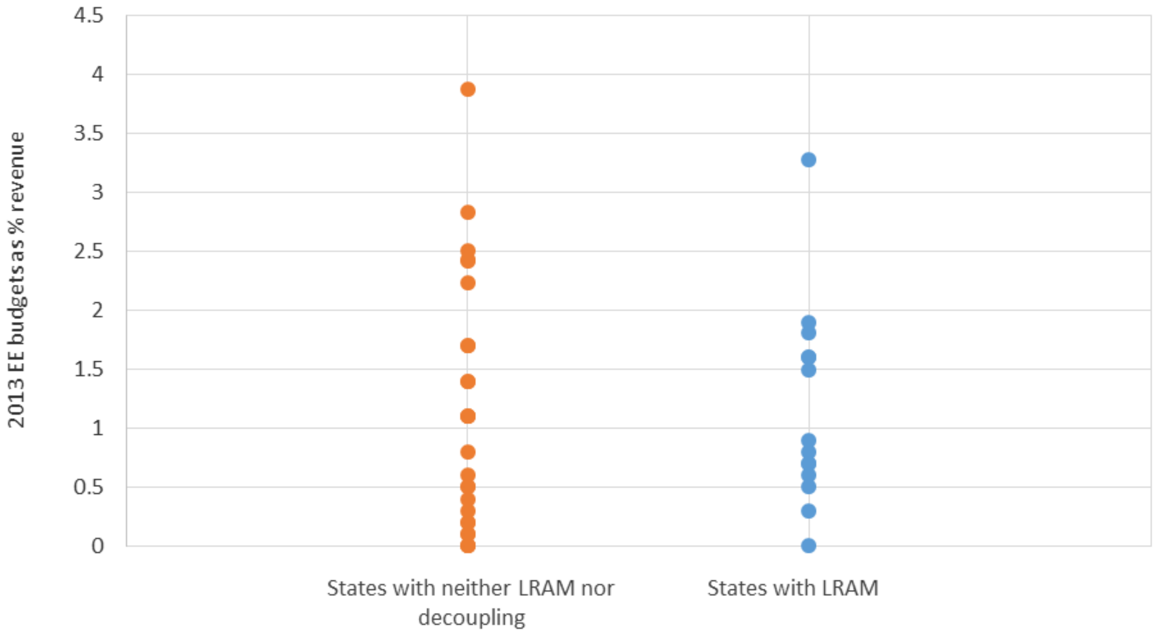

Figure 9. Efficiency budgets in states with LRAM compared with states having no revenue adjustment mechanism

Figure 10 shows 2013 savings data for this same set of states. Median statewide electricity savings for states with LRAM was 0.55% in 2013, compared with median savings of 0.3% in states with no revenue adjustment mechanism.

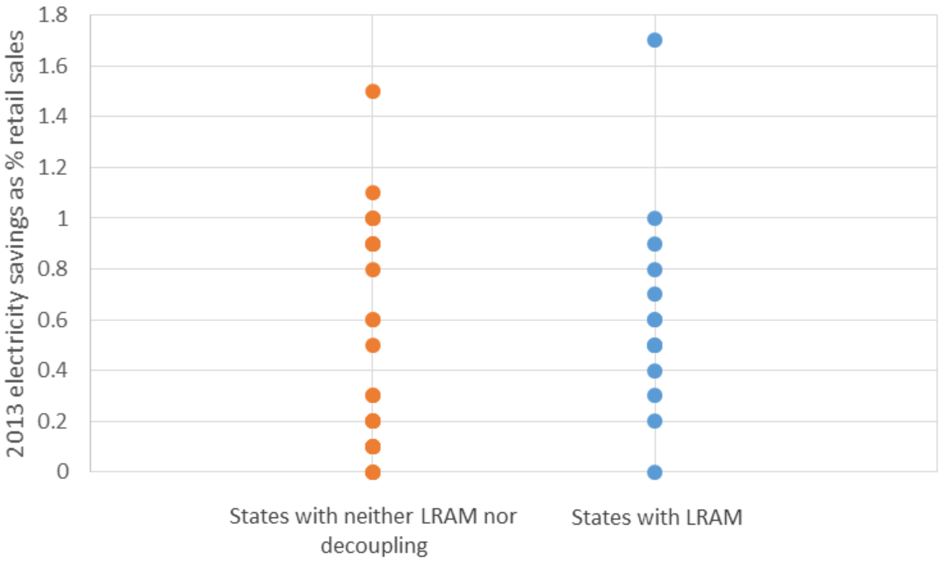

Figure 10. Electricity savings in states with LRAM compared with states having no revenue adjustment mechanism

We then compared states with LRAM against states with at least one electric utility decoupled. Figure 11 shows 2013 electricity efficiency budgets for these states.[12]

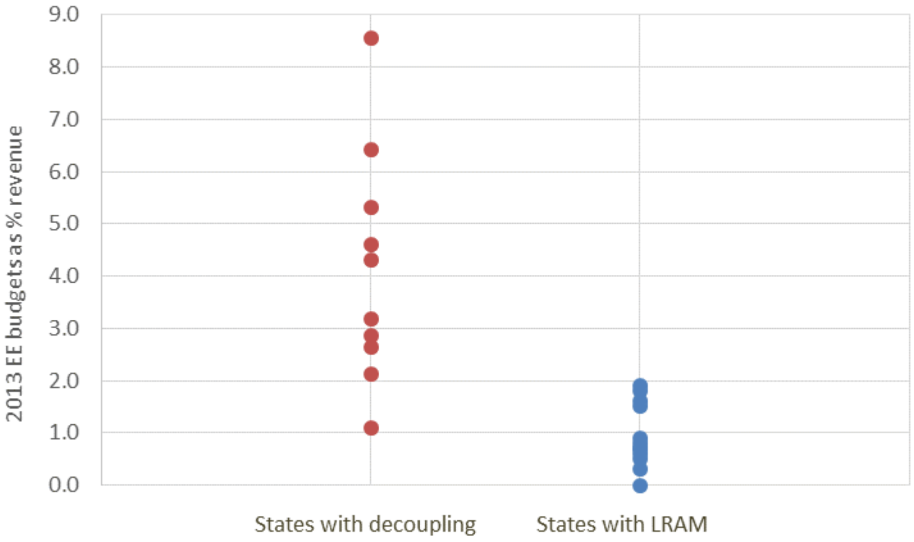

Figure 11. Electricity efficiency budgets in states with LRAM compared with states that have decoupling

Here, we do see some difference between spending in states with decoupling and those with LRAM. Specifically, states with decoupling appear to be spending more on energy efficiency

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[12] States in which at least one utility is decoupled *and* one utility has an LRAM in place were excluded from this analysis.

relative to revenue. We see a similar pattern in our comparison of electricity savings, shown in figure 12.

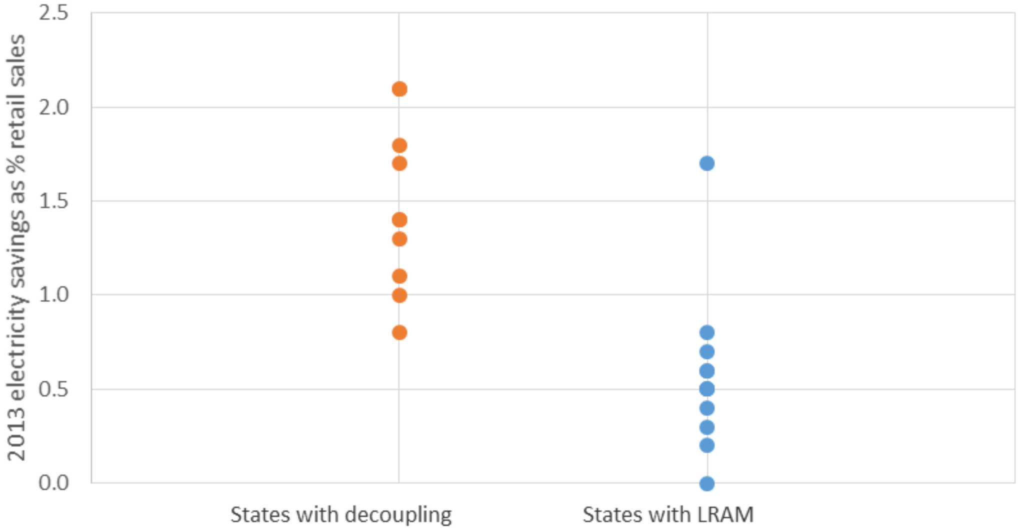

Figure 12. Electricity savings in states with LRAM compared with states that have decoupling

Median incremental electricity savings in 2013 was 1.4% for states with decoupling, compared with median savings of 0.5% for states with LRAM, a stark difference. However, it is important to note that all but one of the decoupling states also had an energy efficiency resource standard (EERS) policy in place, which we have found to be the dominant policy associated with greater energy efficiency spending and savings. To control for that factor, we did two additional analyses. First, we looked just at states with an EERS, charting efficiency budgets for states with LRAM and for those with decoupling. Figure 13 shows the results of this analysis, which included only a small set of states.

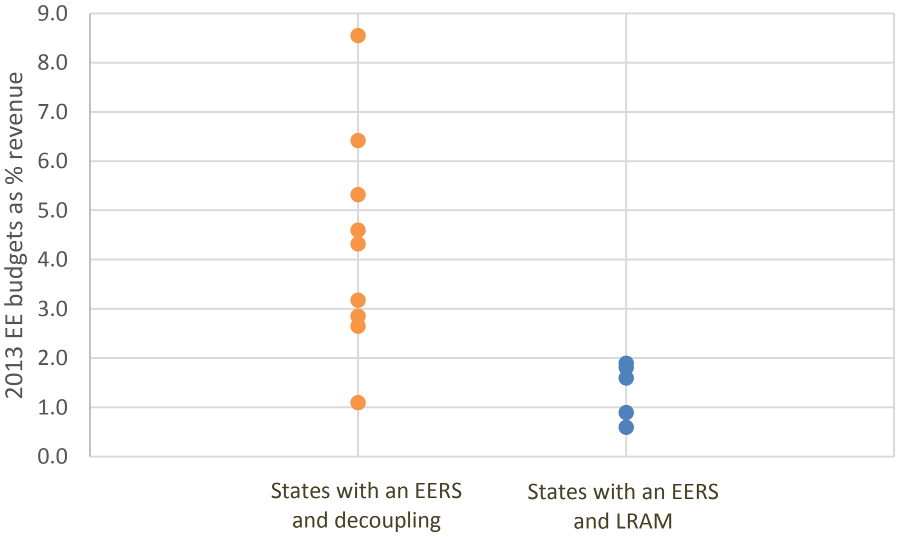

Figure 13. States with LRAM compared with states with decoupling when an EERS policy is in place

Figure 14 shows the results of this analysis for statewide electricity savings in 2013.

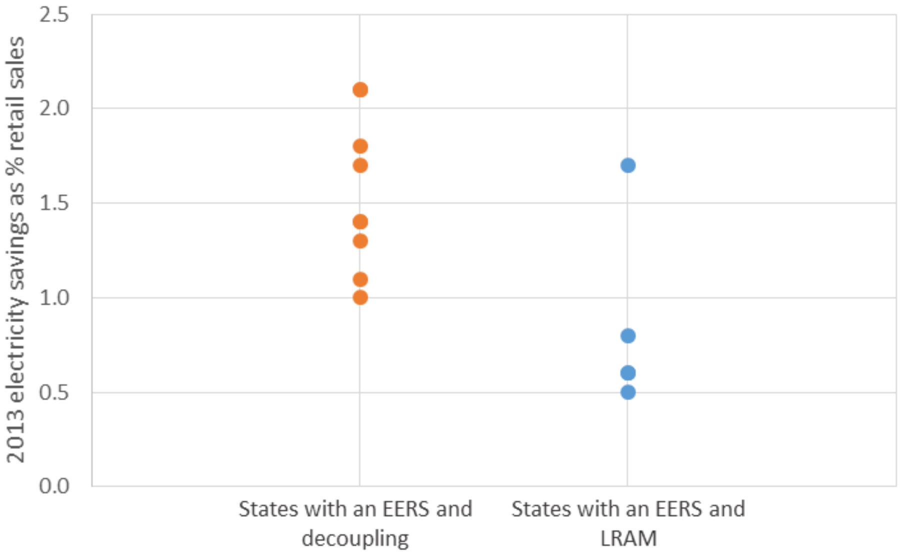

Figure 14. States with LRAM compared with states with decoupling when an EERS policy is in place

Here also, data visualization indicates that when an EERS is in place, states with decoupling tend to have higher electricity efficiency budgets and savings than states with LRAM. However the directionality of cause and effect may be an issue, and other factors could also play a large role, such as specific EERS targets in these states. Year of EERS adoption may also account for some of the variation between groups. Idaho is the only state without an EERS in place to have at least one decoupled electric utility in 2013, so it was not possible to compare budgets for states with decoupling and states with LRAM when no EERS is in place.

These findings are obviously not determinative for every state or utility. Still, the results suggest that, in aggregate, having an LRAM policy is not currently associated with higher levels of energy efficiency effort (program spending) or achievement (energy savings) than can be found in states without an LRAM policy.

Discussion

In its second incarnation, LRAM appears to face many of the same issues that it did in the early 1990s. In its *National Action Plan for Energy Efficiency* (EPA 2007), the US Environmental Protection Agency (EPA) laid out the following pros and cons of lost revenue adjustment mechanisms:

Pros:

1. Removes disincentive to energy efficiency investment in approved programs caused by under-recovery of allowed revenues.
2. May be more acceptable to parties uncomfortable with decoupling.

Cons:

1. Does not remove the throughput incentive to increase sales.
2. Does not remove the disincentive to support other energy saving policies.
3. Can be complex to implement given the need for precise evaluation, and will increase regulatory costs if it is closely monitored.
4. Proper recovery (no over- or under-recovery) depends on precise evaluation of program savings.

The case studies presented in Appendix A further illustrate each of these points. While many states have reported benefits from LRAM policies, many of these same states have also noted the flaws. Moreover, it is not clear that states have been able to strike the necessary balance between accuracy in valuing lost revenues and efficiency in administering the policy. Below, we identify a number of factors that states should weigh in considering adjustments to current policies or deciding whether an LRAM is an appropriate regulatory tool to pursue in the future.

AN LRAM CAN BRING PARTIES TO THE TABLE

Energy efficiency *does* reduce utility sales, and utilities *should* be able to recover their authorized fixed costs. Decoupling is the simplest way to ensure that a utility meets its revenue requirement even if other factors dampen sales. But in many states, key parties view decoupling unfavorably.[13] Utilities often push back against decoupling proposals because they feel they should be allowed some level of reward for the risks they often must bear.[14] Some consumer advocates have also worked to block decoupling proposals, citing added costs, reduced utility risk at the expense of additional risk placed on consumers, and a general opposition to automatic rate adjustment mechanisms.

In many states, LRAM has been used as an alternative to decoupling to make utilities whole after investments in energy efficiency. Utilities may be supportive of LRAM because there is the potential to accrue revenues beyond the regulator-determined revenue requirement, resulting in pure profit for the utility.[15] Since LRAM expressly requires the calculation of energy savings from efficiency programs and omits other variables like weather, consumer advocates may also feel better about allowing utilities to recoup these costs. While LRAM is a less desirable solution than decoupling, it can bring parties to the table in circumstances where decoupling may not be feasible.

GOOD EM&V IS IMPORTANT

Allowing utilities to recover the revenues lost due to implementation of efficiency programs necessitates the need for accurate evaluation of programs. In order to prevent overcharging

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[13] See RAP (2011) for a complete discussion of the arguments often made against decoupling.

[14] See Vilbert et al. (2014) for a discussion of the impact of decoupling on the cost of capital. The study finds that decoupling is not associated with a decreased cost of capital.

[15] Some states have limited lost revenue recovery to prevent over-earning. For example, see the Nevada case study in Appendix B.

customers or undervaluing a utility's lost revenues, utilities and regulators need to get the savings right. Evaluation of savings is controversial in many of the states in which we conducted interviews. Though evaluation procedures were already in place for efficiency programs in many states, when lost revenues were at stake the scrutiny became far greater.

Key parties were reticent about evaluation methods for a variety of reasons. Consumer advocates in some states were wary of "estimations" of savings, saying that it was impossible to judge whether savings were actually achieved. Commissions also noted that changing evaluation methodologies led to lengthy back-and-forth exchanges between utilities and regulatory staff. Ultimately, evaluation procedures do rely on some level of sampling, statistical analysis, and estimation. There may be additional difficulties in states with net savings requirements, as evaluation efforts need to not only focus on engineering estimates but also project what would happen in the absence of programs.[16] Since it is impossible to weigh the results of efficiency programs against a hypothetical (i.e., electricity consumption absent utility-run efficiency programs), it is important that all parties understand and agree to evaluation procedures. The evaluation process should be rigorous and transparent, with appropriate checks along the way.

In a few states we surveyed, there was little oversight of evaluation methods or results by the utility commission. While this led to efficient, uncontested rate case and demand-side management (DSM) proceedings, it also eliminated an important checkpoint for accuracy. We found very few examples of states that had reached a middle ground between accuracy and efficiency. Including stakeholders in discussions of evaluation procedures, setting clear evaluation and reporting guidelines for utilities, and including independent evaluators in the process may help states find this balancing point. Finally, evaluation techniques continue to improve and evolve as new technologies open the door for real-time analysis of certain program types. Embracing these technological innovations may simplify and streamline EM&V processes.

TIMING MATTERS

Timing is critical to precise, efficient implementation of an LRAM. Since energy efficiency program decisions and rate-making decisions are necessarily intertwined in states with an LRAM in place, having these two functions occur at the same time can help streamline processes. In many of the states we spoke to, all parties expressed the difficulty of dealing with lost revenues when rate cases were dealt with separately from DSM decisions. In some states, this increased the number of true-ups needed to recover a single program year's lost revenues. It also ate away at staff time. Several other states with multiyear experience implementing an LRAM had adjusted timelines for rate-making and DSM decisions so that the two proceedings occurred jointly.

While timing of rate cases and DSM proceedings is important from a logistical standpoint, perhaps more important from a financial standpoint is the time between rate cases. Since

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[16] Net savings calculations factor in the impacts of free riders and spillover on efficiency programs. Therefore, not all savings calculated using engineering estimates may be attributed to a utility. Net savings are often about 90% of gross savings (Gilleo et. al 2014), but these ratios can vary greatly from state to state.

adjustments to lost revenue rely on a test year, the more up to date these test cases are, the more accurate the calculation of lost revenue can be. Frequent rate cases also avoid the issues associated with pancaked savings, as discussed above. When revenue adjustments are made infrequently, the result is a large sum of money passing from consumers to utilities. Whether or not this transfer is legitimate, the impression it creates can be a matter of contention among utilities, regulators, and consumer advocates. Policies that cap lost revenue to two or three years can avoid this problem.

AN LRAM ALONE WILL NOT FULLY INCENTIVIZE EFFICIENCY

Lost revenue adjustment is just one (optional) approach to aligning utility incentives with investment in energy efficiency. While the lost revenue adjustment can help make a utility whole by compensating it for reduced energy sales, it will do little to *encourage* investment in energy efficiency unless combined with other policy levers. Our analyses indicate that having an LRAM policy itself is not currently associated with higher levels of energy efficiency effort (program spending) or achievement (energy savings) than are found in states without an LRAM policy. Setting energy savings targets through an EERS and implementing performance incentives tied to specific energy saving levels are ways that regulators can encourage prioritization of energy efficiency.[17] Evaluating energy efficiency in the same manner as other supply-side resources during resource planning also should help to encourage energy efficiency utility investments.

Similarly, an LRAM does not eliminate a utility's throughput incentive. The LRAM compensates a utility for energy savings achieved by its programs, but if a utility can sell more energy while also delivering efficiency programs, it may be able to recover dollars beyond its revenue requirement. Thus, an LRAM can result in a utility's pursing energy savings with one hand while seeking additional sales growth with the other.

Additional Questions and Further Research

RATE IMPACTS OF LRAM

The rate impacts of decoupling are well known due to careful research and tracking over the past several years (most recently Morgan 2013). However a similar analysis has not yet been completed for LRAM. Such research would be complicated but would better show the impacts of a policy that could be effective at its best but overly generous at its worst. Data on the impacts of dollars recovered through lost revenue are murky. Public utility commission staff are often unable to untangle LRAM dollars to align dollar amounts with individual program years. However future research should endeavor to tease out these intricacies in order to better understand the rate impacts of LRAM policies. Then more straightforward comparisons with decoupling could be made—both in terms of overall savings achieved under the policy and in terms of the financial impacts on ratepayers.

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[17] For an overview of EERS policies, see Downs and Cui (2014). For further discussion of performance incentives, see Nowak et al. (2015).

EFFECTS OF OFF-SYSTEM SALES

Over the course of this study, many utilities noted that efficiency programs left a hole in their revenues that LRAM was able to close. However utilities have other avenues for selling unused energy and may still earn profits from power that is not provided directly to their customer base. For example, most utilities can sell unused energy off system. These sales allow companies to make profits above the allowed revenue requirements and to make up lost revenues from several different factors. Some states allow shareholders to keep most of the earnings from off-system sales as profit, although many include requirements for crediting back some of the earnings to ratepayers (NARUC 2008). Off-system sales can be in the tens of millions of dollars and can be a huge part of a rate case (AEP 2014). If utilities are generating excess capacity and selling it off system, it may be that they are not truly losing revenues to efficiency but are simply earning those revenues outside of their customer base. In such cases, LRAM may be an additional earnings pathway, doing more than just making a utility whole. While this paper does not dive into the connection with off-system sales, future research should investigate how often these sales can effectively fill the hole that efficiency programs create in utility revenue, potentially negating the need for an LRAM.

Conclusion

Creating a regulatory environment that incentivizes utilities to invest in efficiency is critical for programs to be successful, impactful, and long lasting. Doing so requires a mix of policy tools. In addition to energy efficiency targets, utilities need a business model that aligns their financial interests with energy efficiency, including program cost recovery, performance incentives that encourage utilities to achieve high levels of savings, and some policy mechanism to neutralize the throughput incentive. It is our opinion that decoupling is the best "third leg" of this stool. However it is also clear that decoupling is not always an option for states for a variety of reasons. In such scenarios, LRAM can be a temporary solution, addressing concerns over lost revenues and, possibly, helping to make parties more comfortable with the idea of full decoupling in the future.

But LRAM as a permanent policy fix is fraught with flaws. The regulatory burden is great, and the potential to shortchange customers and overcompensate utilities is ever present. As states gain more experience with LRAMs, problems continue to arise. Several states are striving for a simpler and fairer way to implement an LRAM that all parties will sign on to. In practice, an ideal LRAM possessing all of those qualities has yet to present itself. Finally, as noted above, having an LRAM policy in place does not currently appear to be associated with states' achieving higher levels of energy efficiency program spending or energy savings.

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Appendix A. Summaries of Currently Implemented LRAMs

State	Applicable utilities	Year authorized	Description of mechanism	Relevant rules and statutes
Arkansas	All electric and gas investor-owned utilities	2010	Arkansas rules allow recovery of lost contributions to fixed costs. These have been generally calculated as net savings times base rates, with savings being adjusted to take into account the timing (within the year) of measure installation and seasonality of the equipment.	Docket 08-137-U Order No. 14
Arizona	Arizona Public Service Company, UNS Gas, Tucson Electric Power Company, and UNS Electric	2012–2013	A lost fixed cost rate is determined at the conclusion of a rate case by taking the sum of allowed distribution and transmission revenue for each rate class and dividing each by their respective class adjusted test year kWh or therm billing determinants. The lost fixed cost rate is multiplied by the recoverable kWh or therm savings, by rate class.	Decision Nos. 73183, 73142, 73912
Colorado	Investor-owned natural gas utilities	2008	Each utility is to calculate a dollar per therm value that represents the utility's annualized fixed costs that are recovered through commodity sales on a per therm basis with the supporting methodology and documentation for the calculation. The dollar per therm value, as approved by the Commission, is multiplied by the annualized number of therms saved as the result of the DSM program, as reported in the utility's annual report. The approved amount is recovered through the Demand Side Management Cost Adjustment (DSMCA) and applies to first-year savings only.	Code of Colorado Regulations (CCR) 723-4 Part 4
Connecticut	Connecticut Natural Gas, Southern Connecticut Gas, Yankee Gas, Connecticut Light & Power[18]	1995 for natural gas utilities, 2013 for CL&P	Lost sales from conservation program expenditures are tracked by program and rate class, matched with expenditures, and carried forward monthly for the balance of the Conservation Adjustment Mechanism (CAM) period. Lost revenues are estimated by taking cumulative savings (savings carried forward year to year between rate cases) and are applied a lost margin rate. The lost revenues are recovered through the CAM ($.046 Ccf). The energy savings are multiplied by a margin amount per unit, accumulated over the period, and results in the lost margin component of the CAM.	PA-13-298 Docket No. 93-02-04 Docket No. 93-03-09 Docket No. 11-10-03 Docket No. 14-03-01

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[18] The most recent CL&P rate case (December 2014, Docket 14-05-06) included a decoupling mechanism per Connecticut Public Act 13-298.

State	Applicable utilities	Year authorized	Description of mechanism	Relevant rules and statutes
Indiana	Indiana Michigan Power, Northern Indiana Public Service Company, Vectren Indiana, and Duke Energy Indiana. Request for lost revenue recovery by Indiana Power & Light is currently before the commission.	1995	Each utility must propose a process for calculating an LRAM. The calculation must account for the impact of free riders and the change in the number of program participants between base rate changes and the revised estimate of a program-specific load impact that results from the utility's evaluation activities. Efficiency savings are measured by an independent evaluator. Revenue is recovered either annually of semiannually. Lost revenues are recovered for the life of the measure or until the company's next base rate case.	170 IAC 4-8-6
Kansas	Westar Energy	2011	The Kansas Corporation Commission will consider proposals from electric and gas utilities that include shared savings performance incentives on a case-by-case basis. KCC approved lost margin recovery for Westar Energy's Simple Savings program.	Docket 08-GIMX-441-GIV Docket 10-WSEE-775-TAR
Kentucky	All regulated electric and natural gas utilities	1995	Energy savings are calculated based on engineering estimates for either participants, projects, or programs and multiplied by the number of participants, projects, or programs. This is multiplied by the lost revenue factor (energy charges less fuel and other variable costs). There is typically a three-year sunset provision for lost revenues.	Kentucky Statute 78.285 Case No 2014-00271 Case No 2014-00003
Louisiana	Cleco Power, Entergy Gulf States, Entergy Louisiana, and Southwestern Electric Power Company (SWEPCO)	2014	The lost contribution to fixed cost (LCFC) level for each customer class is initially determined by multiplying the "Class LCFC Factor" by the projected annual level of energy savings to be achieved through each Quick Start program. Generally, the "Class LCFC Factor" is calculated by dividing 12 months of customer class energy charge-related revenue, including formula rate plan increases or decreases, by the class kWh sales from the same period. There is no ceiling for LCFC recovery, but there is an overall cap on Energy Efficiency Riders of $75 monthly as set forth by the EE rules.	Docket No. R-31106
Missouri	Ameren, GMO, KCPL	2013–2014	Utilities earn a percentage of net benefits calculated using deemed gross savings. Measure level annual energy and demand savings, measure lives, rates for avoided energy saving, and rates for avoided demand savings are deemed. Staff of the Missouri Public Service Commission performs a prudence review no less often than every 24 months to verify the calculation of net benefits used for the throughput disincentive mechanism. Lost revenues are recovered continuously through a rider.	SB 376 Case No. EO 2012-0142 Case No. EO 2012-0166 Case No. EO-2012-0009 Case No. E)-2012-0175

State	Applicable utilities	Year authorized	Description of mechanism	Relevant rules and statutes
Mississippi	Atmos Energy Corporation and Centerpoint Energy. Mississippi Power Company's cost recovery rider has not yet been approved.	2014	The company uses estimates for the coming year of savings due to energy efficiency programs normalized for weather and multiplies that number by the base rates less any customer charge. Lost revenues are recovered annually with a true-up to adjust for any under- or over-recovery.	Docket No. 2010-AD-2 Order Adopting Rule 29
Montana	NorthWestern Energy	2005	Lost revenues are recovered annually, with true-ups following the tracking period once actual numbers are available and again following a comprehensive report. Lost revenues are calculated by multiplying energy savings by an adjustment factor by rates. The adjustment factor takes into account free ridership and spillover rates.	Docket No. D2014.6.53 Docket No. D2012.5.49
North Carolina	Duke Energy Carolinas, Duke Energy Progress, Inc., and Dominion North Carolina Power	2007, with implementation orders in 2010–2013	The basic calculation of net lost revenues (NLR) is performed by multiplying net kWh (and, in some cases, kW) savings from each approved DSM/EE program by the billing rates that would have been applied to those kWh, if actually sold, and then reducing those lost revenues by the fuel cost recovery included in the billing rate, as well as nonfuel variable operations and maintenance expenses. In general, recovery of NLR for each installed measure is limited to a maximum of 36 months, subject to certain other limitations. NLR are also reduced by any net found revenues (or revenues associated with other activities that cause an increase in demand).	NCGS 62-133.9 Docket No. E-100 Sub 113
Nevada	Nevada Power Company and Sierra Pacific Power Company	2011, with updates in 2013–2014	The total lost revenue amount is estimated by first allocating estimated savings to each class that incurred the savings. The amount of savings is then multiplied by the general rate associated for that class to calculate implementation revenue. The implementation revenue for all the classes is summed along with the estimated lost demand revenue for a total lost revenue implementation revenue requirement. Lost revenues are estimated and a rate is put in place annually, but true-ups can occur for a single implementation year over several years. Lost revenue collection is suspended when a company is over-earning.	NRS 704.785(1)(a)(2) NAC 704.95225(1)(b) Dockets 10-10024 and 10-10025

State	Applicable utilities	Year authorized	Description of mechanism	Relevant rules and statutes
Ohio	Dayton Power & Light	2007	Lost revenue recovery mechanisms are determined on a case-by-case basis. Lost revenues are recovered through a rider and are calculated as the amount of kWh savings times the energy charge for each rate class. Variable costs are removed, and the amount is divided by expected sales for a future year. Lost revenues may be collected for three years. Decoupling is in place for Duke Ohio and AEP.	Docket 08-920-EL-SSO Docket 11-3549-EL-SSO Docket 11-0351-EL-AIR
Oklahoma	Public Service Oklahoma and Oklahoma Gas & Electric	2008	Lost revenues are calculated annually and are continued until the next base rate case or adjustment to rates, during which time the lost revenues are zeroed out and the appropriate volume reduction (adjustment) is included in that filing. Lost revenues are calculated by multiplying energy savings by an embedded cost factor. The embedded cost factor is calculated by taking the embedded costs approved in the most recent rate case (less fixed customer charges) divided by the kWh used in the cost study.	PUD Cause No. 200700449, Order No. 555302
South Carolina	Duke Energy Progress, Duke Energy Carolinas, and South Carolina Electric and Gas	2008, reestablished in 2013	Lost revenues are estimated annually and trued up once EM&V is available. Lost revenue can be collected for three years after installation or for the life of the measure, whichever is shorter. Lost revenues are calculated by multiplying energy savings by avoided costs.	S.C. Code Ann § 58-37-20 Docket No. 2008-251-E (Order No. 2009-373)
South Dakota	All investor-owned utilities	2009, most recent version in 2014	The lost revenues are negotiated as a percentage of approved budget spending. Savings are not included in the calculation of lost revenues, although they are estimated to ensure cost-effective programs. Recovery is limited to the year expenses are incurred.	Docket NG09-001 Docket EL11-002

Appendix B. Case Studies from Selected States

NEVADA

History

In 2009, the Nevada legislature passed SB 358. The law required the Public Utility Commission of Nevada (PUCN) to remove financial disincentives caused or created by the reasonable implementation of energy efficiency and conservation programs. The legislation specified that the rules had to include cost recovery for program expenses and removal of financial disincentives, and also noted that commission rules could—but were not required to—include financial incentives to help promote the participation of customers in energy efficiency programs. The legislature also stipulated that the regulation to be adopted by the PUCN could not authorize the utility to earn more than the rate of return authorized by the commission (NRS 704.785). In response to the 2009 legislation, the PUCN adopted rules creating a lost revenue adjustment mechanism.

The legislation was spurred in part by a changing population and economic dynamics within the state. Prior to 2009, the population of Nevada had been increasing dramatically from year to year, and electricity consumption had followed suit. During that time, the effect of lost revenues from efficiency programs was somewhat dampened by ever-increasing consumption. Utilities were allowed to book energy efficiency expenditures as an investment to earn a rate of return-on-equity 500 points higher than that authorized for supply-side investments. But lost revenues were not directly addressed. However, due to the recession, population growth stopped for a year and then resumed at a much slower rate. As a result, it became apparent that the state needed a more comprehensive approach to encourage further investment in efficiency.

Other Relevant Regulatory Features

Nevada has had a renewable portfolio standard (RPS) in place since 1997. In 2005, the RPS was revised, increasing portfolio requirements and allowing utilities to use energy efficiency to meet a portion of these requirements. Currently, cumulative energy efficiency savings can meet up to a quarter of the total standard in any given year. In other words, utilities may assign cumulative savings of about 6.25% of electricity sales toward meeting the requirement through 2025. While the RPS allowances may have spurred utilities to bulk up efficiency programs, utilities have now achieved the maximum level of efficiency allowed to count toward the requirement, meaning the policy has little effect in encouraging continued investments in efficiency. In 2013, the legislature voted to completely phase out efficiency from the RPS in coming years, further diminishing the effect the policy may have had in spurring investments in efficiency. Advocates and others have said there may be some discussion of a separate efficiency standard in coming years, but no specific docket has been opened on the subject.

LRAM Policy Details

The PUCN first authorized a lost revenue adjustment mechanism for electric utilities in May 2011 (Dockets 10-10024 and 10-10025). The state's two investor-owned electric utilities, Nevada Power Company and Sierra Pacific Power Company, both recover lost revenues from efficiency programs using the same mechanism type. The two utilities also share a parent company, NV Energy. Lost revenue in Nevada is recovered through the Energy

Efficiency Program Rate (EEPR). Program costs are recovered through the Energy Efficiency Implementation Rate (EEIR). Nevada uses the net savings achieved by energy efficiency and conservation programs in the determination of lost revenues.

The company begins with a revenue requirement for each customer class and removes customer charge revenue, customer-specific facilities revenue, and fuel costs from the class revenue requirement. The remaining dollar figure is divided by total sales of each rate class. This per-kWh rate is reduced by a variable operations and maintenance component the utility has derived from a marginal cost of service study. Each class-specific rate is then applied to a program savings forecast for each class.

Lost revenues continue to be collected for pancaked savings effects until the company comes in for a rate case and resets the billing determination. Companies are mandated to file a rate case with the commission at least every three years. There is also a requirement that lost revenues cannot cause a utility to earn more than its authorized rate of return. The result in Nevada has been the return of lost revenues—in part or in whole—to customers in 2013 and 2014. Details of policy results, including energy savings and lost revenue dollars recovered, are reported in the following section.

Outcomes

Nevada's lost revenue adjustment mechanism is complex and requires significant time and effort from both utility and commission staff. While utilities have expressed that the lost revenue adjustment mechanism is necessary for them to become whole after investing in energy efficiency, the arduous regulatory requirements of the LRAM have led the PUCN to open an investigatory docket looking at other ways for Nevada electric utilities to recover lost revenues. Concerns regarding whether utilities are over-earning as a result of the LRAM have led to recent settlements and the return of LRAM monies to customers. Meanwhile, statewide electricity savings have declined since 2010.

ENERGY SAVINGS

While utilities in Nevada continue to invest in cost-effective energy efficiency, it is unclear whether the LRAM is a sufficient policy lever to encourage them to ramp up investments. Overall incremental electricity savings in Nevada, while still higher than the national average, have dropped in recent years.[19] Since avoiding rate hikes was a key concern for all parties in Nevada, some programs may actually have been scaled back as a result of the LRAM. There was some concern over the optics of customer funds being used to recover large amounts of lost revenues, and efficiency portfolios were scaled down somewhat from electric utilities' initial proposals. Annual incremental energy savings are shown in figure B1.

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[19] In 2010, statewide electricity savings were second highest in the country, totaling about 1.28% of retail sales. In 2013, Nevada ranked 21st, with total incremental electricity savings of 0.81%. (See the State Energy Efficiency Scorecard for more details). Note also that since 2010, the PUCN has determined that CFL measures no longer count toward savings claimed by utilities.

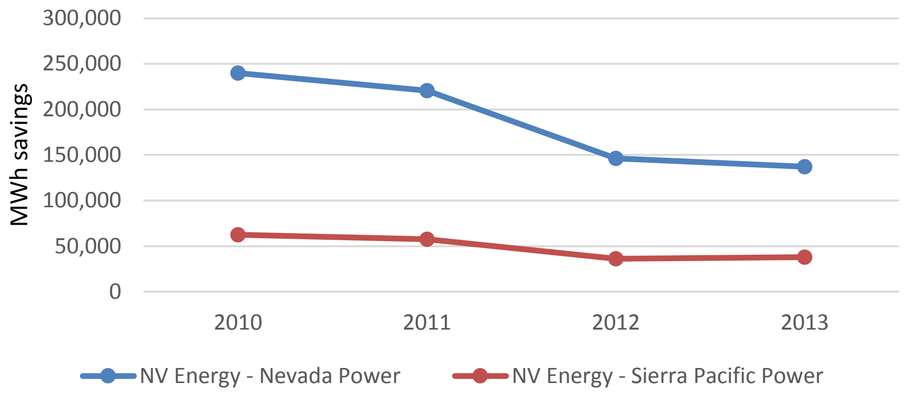

Figure B1. Net incremental savings (MWh) in 2010–2013 for Nevada energy companies. ***Sources:*** **Utility annual reports.**

FINANCIAL OUTCOMES

The most recent estimates of lost revenue recovery from efficiency programs are presented in table B1. The legislation and the PUCN rules that followed are clear that utilities are eligible to recover the full retail rate for energy savings achieved. However there were concerns that the companies were over-earning in recent years as a result of the LRAM. The state's consumer counsel asked the commission to open a proceeding to determine if the utilities were eligible for lost revenues in a year in which they achieve their authorized rate of return. Subsequently, the commission adopted a follow-up rule requiring the companies to return funds to ratepayers in the event of over-earning. The companies were required to refund to customers the lost revenue amounts collected for 2012. As a condition of a merger approved by the PUCN, the companies agreed to forgo lost revenues in 2013 and half of lost revenues in 2014. In 2015, the utility is slated to collect and retain lost revenues as normal.

Table B1. Lost revenue recovered in recent years

Utility	Lost revenue dollars eligible for recovery[1]	Cost of energy efficiency programs	Total annual energy savings achieved (kWh)[2]	Eligible LRAM recovery per energy unit saved[3]
		2013		
Nevada Power Company	$14,692,023 (returned to customer base)	$34,376,982	358,021,585	$0.04
Sierra Pacific Power Company	$5,566,833 (returned to customer base)	$5,017,084	110,812,881	$0.05
		2014		
Nevada Power Company	$19,546,227 (portion returned to customer base)	$50,300,000[4]	484,415,682	$0.04
Sierra Pacific Power Company	$2,484,850 (portion returned to customer base)	$10,410,000[4]	60,797,089	$0.04

[1] Estimates of dollars recovered or budgets. [2] Energy savings figures do not match those shown in figure B1 since lost revenues are calculated based on annual, not incremental, energy savings. [3] Estimate of what utility would have recovered if dollars were not returned to customers. [4] Estimate of energy savings.

Discussion

Nevada now has several years of experience implementing a lost revenue adjustment mechanism. However the LRAM remains contentious. Parties identified evaluation procedures and the timing of rate cases and demand-side management cases as pieces of the regulatory structure that need improvement. Evolving utility portfolios that include next-generation program offerings have also raised questions about the type of programs eligible for lost revenue recovery.

EVALUATION, MEASUREMENT, AND VERIFICATION

Nevada's LRAM has had a significant effect on the time and money spent on evaluation procedures for efficiency programs and has led to some level of controversy and conflict among parties. Utilities have more than doubled their expenditures on EM&V, and the public utilities commission has likewise increased its staff to accommodate the additional workload. Getting the energy savings values correct is important to avoid over- or under-recovery of lost revenues by utilities (and the potential overpayment by ratepayers), but parties in Nevada are at odds as to the proper level of time and resources to devote to EM&V. Key elements of EM&V, including inputs and general methodology, have also been adjusted over time. This has led to confusion and the impression of subjectivity in calculations in some cases.

EVOLVING PROGRAM OFFERINGS

As utility portfolios mature, it is natural to move toward more cutting-edge program offerings. Utilities in Nevada have recently begun offering home energy reports and programs aimed at changing consumer behavior. While energy savings from these types of programs and the necessary EM&V processes have been demonstrated and accepted in states across the country, some parties in Nevada have questioned the amount of allowable revenue recovery for these program types.

PROCESS ISSUES

The timing and process of truing up lost revenues have been complex. Two proceedings occur each year: one focused on demand-side management portfolios, the other focused on lost sales and rates. Currently, the PUCN will continue to adjust and true up lost revenue dollars for a single program year over the course of three or more years. Parties have expressed the need to better synchronize efficiency program years and rate years.

Looking Forward

The PUCN opened an investigatory docket in 2014 to take a closer look at the state's lost revenue adjustment mechanism. All parties have expressed that the current LRAM is overly complex and that there is significant room for improvement. In 2015, the PUCN issued a notice of its intent to act upon a new mechanism (Docket 14-10018). The mechanism would provide a rate of return on the program costs for DSM programs. Some parties have expressed that they believe the PUCN has the authority and latitude to implement a decoupling policy without going back to the legislature, but many others have questioned whether the commission has such latitude under existing authority.

OKLAHOMA

History

Energy efficiency programs are required by Oklahoma Administrative Code, although specific efficiency portfolios and their associated energy savings are determined largely by investor-owned utilities (IOUs). Under OAC 165:35:41, all electric utilities regulated by the Oklahoma Corporation Commission (OCC) must propose and implement energy efficiency and demand response programs within their service territories, with new proposals issued at least every three years. Energy efficiency programs were initiated throughout the state in 2008, after the OCC launched a stakeholder collaborative to explore potential structures for demand response programs within the state.

From the beginning, stakeholders recognized the need to motivate utilities to implement efficiency. With stakeholder input, the OCC laid out a loose set of efficiency rules and encouraged utilities to come forward with their own proposals for incentivizing investments in energy efficiency. Utilities presented the commission with a three-legged stool: in addition to cost recovery, they proposed a shared savings mechanism and a lost revenue adjustment mechanism.

Other Relevant Regulatory Features

Oklahoma does not have an energy efficiency resource standard in place or specific energy savings targets, but utility efficiency investments are influenced largely by a shared savings incentive put in place during the same time as the LRAM. There are no performance thresholds for receipt of the shared savings incentive. Specifics of the performance incentive are detailed in Nowak et al. (2015). Currently, there is an open docket examining the structure of the performance incentive, with a proposal to cap the potential return.

LRAM Policy Details

Oklahoma's LRAM was first approved as part of a settlement in PUD Cause No. 200700449, Order No. 555302. The policy applies to both investor-owned electric utilities in Oklahoma: Public Service Company of Oklahoma (PSO) and Oklahoma Gas and Electric Company

(OG&E). Gas utilities have performance-based rates, and LRAM rules do not apply. Lost margins are calculated by multiplying energy savings resulting from demand response programs by an embedded cost factor determined in the most recent rate case. Savings are reported by utilities to the OCC, and while third parties have been used to verify energy savings, utilities are also given the option to self-verify. Lost revenues are recovered annually, with no ceiling specified. However lost revenues are zeroed out as part of each rate case.

Outcomes

Energy efficiency has received greater attention in Oklahoma in recent years, driven by OCC rulemakings and support from Governor Mary Fallin. The LRAM is an important tool in encouraging utilities to invest in efficiency, especially when coupled with the shared savings incentive. Over several years of implementation, the need for clear requirements and process transparency has become evident. Furthermore, although energy savings have ramped up, IOUs have yet to achieve the energy savings currently being realized in other states across the country.

ENERGY SAVINGS

Oklahoma has seen an uptick in energy savings in recent years. Statewide, net electricity savings grew from 0.04% of sales in 2009 to 0.27% of sales in 2013 (Sciortino et al. 2011; Gilleo et al. 2014). This has been driven largely by increased investment in efficiency by the state's investor-owned utilities. Because Oklahoma began implementing performance incentives and LRAM at around the same time, it is difficult to determine which of the two has had a greater influence on utility behavior. However stakeholders in the state firmly believe growth in efficiency is driven by the entirety of the three-legged stool of cost recovery, incentives, and LRAM, and that no one policy lever could drive efficiency without support from the others. Annual incremental energy savings for the two IOUs are shown in figure B2.

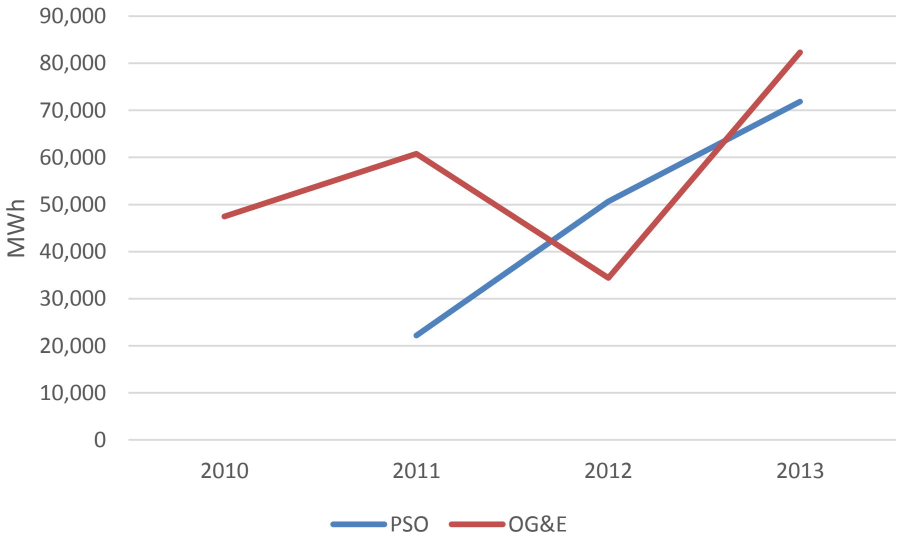

Figure B2. Net incremental savings (MWh) in 2010–2013 for Oklahoma electric IOUs. 2010 energy savings were not available for PSO. *Sources:* Utility annual reports and OK OCC data.

Figure B2 also characterizes energy savings patterns as a result of the three-year planning process. The drop in OG&E savings in 2012 is likely due to its overachievement of savings in earlier years, reducing pressure to generate savings during the third year of the program cycle. In 2013, OG&E achieved significant (and likely unexpected) energy savings as a result of its SmartHours program, which was originally targeted at reducing peak demand.

While savings have grown noticeably in the state since 2009, the question of whether efficiency is being encouraged *sufficiently* still exists. IOUs have ramped up programs in response to the policy levers in place in the state, but Oklahoma statewide electricity savings were well below the national average of 0.56% of retail sales in 2013 (Gilleo et al. 2014). Stakeholders were unsure whether energy savings would continue to climb solely on the basis of the existing policy environment in Oklahoma.

FINANCIAL OUTCOMES

The most recent estimates of lost revenue earnings from efficiency programs are presented in table B2.

Table B2. Lost revenue recovered in recent years

Year	Lost revenue dollars recovered*	Cost of energy efficiency programs	Total energy savings achieved*	LRAM earnings per energy unit saved
		OG&E		
2011	$3,105,699	$18,200,806	60,743,474	0.05
2012	$3,342,530	$14,662,068	34,405,983	0.10
		PSO		
2012	$4,348,385	$21,963,690	50,632,000	$0.09
2013	$6,301,020	$22,335,179	71,880,000	$0.09

* OG&E 2013 recovery request was still under review at the time of research, so 2013 LRAM numbers were not available.

Discussion

After several years of LRAM in Oklahoma, stakeholders point to a number of areas where lessons have been learned. Stakeholders have been proactive in applying several of these lessons, making tweaks to the existing rules. Many of these adjustments address methods of smoothing the regulatory process. However those aimed at encouraging IOUs to achieve higher levels of electricity savings have faced significant opposition from several parties.

CONSISTENT AND CLEAR EXPECTATIONS

Oklahoma stakeholders emphasized the importance of clear definitions and standards that apply to all utilities affected by an LRAM. For instance, though stakeholders were under the impression that OCC rules intended that LRAM apply to net savings, original rules did not specify whether utilities should report lost revenues calculated from net or gross energy savings. As a result, one IOU reported net energy savings while another reported gross energy savings. In 2014, the utilities commission approved new demand rules for future portfolio filings that specifically require the use of net savings for calculation of lost revenues. IOUs also differed in their calculations of embedded costs. Stakeholders felt that more clearly defining requirements and expectations during the rule design process might have been simpler than making changes after the fact and might have led to the sense of a more even playing field.

EVALUATION, MEASUREMENT, AND VERIFICATION

Recently, auditing of efficiency program evaluations has received greater attention from OCC staff. In prior years, utilities self-verified energy savings numbers. However IOUs are now required to hire independent contractors to evaluate programs and verify energy savings. Some stakeholders in the state noted that even this requirement may not lead to truly independent verification of savings. Utilities have also been tasked with diving more deeply into their assessment of net savings, accounting for free-ridership and the overlap between programs. The OCC has bulked up its efficiency-focused staff to handle increased back-and-forth with utilities related to demand response program filings.

TRANSPARENCY

Though utilities and the OCC have worked to create consistency in reporting systems, other stakeholders have expressed frustration that many filings are not publicly available. To date, utility EM&V reports have not included numbers for lost revenues, making it difficult for outside parties to track processes and leading to surprises when utility lost revenue filings are significantly higher than predicted. New rules require that EM&V filings include data on lost revenues and performance incentives, which should help ease these tensions in the future.

Looking Forward

The OCC recently approved new rules that apply to both electric and gas companies in future efficiency portfolio filings.[20] These rules do not largely change the structure of the LRAM within the state, but they do clarify definitions and methodologies. Important changes have also been made to the performance incentive in the state. In addition, efficiency advocates have proposed mandatory energy savings targets in recent years. While these targets were incorporated into a draft OCC rulemaking, they were later dropped. Stakeholders have indicated it is unlikely that Oklahoma will consider energy savings targets in the near future.

INDIANA

History

Back in 1983, Indiana was actually one of the first states to enact a Certificate of Convenience and Public Necessity statute, which required utilities to demonstrate need before constructing or purchasing new generation facilities. In 1995, Indiana adopted an Integrated Resource Planning (IRP) rule (170 IAC 4-7), requiring electric utilities to develop an IRP that evaluated demand-side and supply-side resources on a comparable basis.

In spite of that framework, the fact that Indiana utilities were achieving very little energy efficiency savings led to a series of hearings and investigations by the Indiana Utility

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[20] See OAC 165:45-23 (Gas Demand Rules) and OAC 165:35:41 (Electric Demand Rules).

Regulatory Commission (IURC) beginning in 2004, culminating in a landmark order in 2009 (Cause 42693, December 9, 2009). The order established a two-part approach: Utilities were required to contract with a single, independent, third-party administrator for a basic set of statewide "Core" programs, and also to individually administer additional energy efficiency programs ("Core Plus") in their own service territories to address aspects not covered by the Core initiatives. The order also established an energy efficiency resource standard (EERS), requiring utilities to meet annual savings goals. The goals began at 0.3% of annual sales in 2010, increasing to 1.1% in 2014 and leveling off at 2.0% in 2019.

With regard to lost revenues, Indiana had actually established an administrative rule for lost revenue recovery in 1995 (170 IAC 4-8-6) as part of its guidelines for demand-side management cost recovery. However, as noted above, very little DSM was taking place. Now, subsequent to the 2009 order, four of the five major electric utilities (Indiana Michigan Power [I&M], Northern Indiana Public Service Company [NIPSCO], Vectren Indiana, and Duke Energy Indiana) have approved mechanisms. Indianapolis Power and Light (IPL) sought commission approval of a mechanism but was denied (Cause No. 43523), in part because of the long period of time since its last rate case and the resulting uncertainty of the lost margin calculation based on those dated rates. (IPL subsequently filed an updated request, Cause No. 44497.)

In March 2014 the Indiana legislature voted (SB 340) to end many of the aspects of the IURC 2009 order, effectively eliminating both the Core program requirement and the annual savings goals that order had established. Governor Mike Pence neither signed nor vetoed the bill, and it became law in April 2014. While the legislation did not alter the state's lost revenue policy, the entire framework for utility energy efficiency programs in Indiana is somewhat uncertain at this point.

LRAM Policy Details

The utilities all follow the Indiana general administrative guidelines (170 IAC 4-8-6), with the details on each mechanism spelled out in each individual utility case filing (e.g., Duke: Cause No. 43955; Vectren: Cause Nos. 43938 and 43405; I&M Cause No. 43827). These case filings also represent their initial three-year plans following the issuance of the 2009 landmark order. The utilities must provide evaluation data on the energy savings impacts of their programs (Core and Core Plus), net of free riders, and those amounts are used to calculate the total lost revenues. Lost revenues are recovered annually for Duke, I&M, and Vectren, and semiannually for NIPSCO. Under current policy, lost revenues are recovered for the life of the measure or until the company's next rate case, whichever comes first, and there is no limit or ceiling on lost revenue recovery.

Other Relevant Regulatory Features

Four of the investor-owned electric companies in Indiana are eligible to earn performance incentives for achieving energy savings goals. Of the four, Indiana Michigan Power and IPL have a shared savings performance incentive. The other two operate under a tiered incentive approach, receiving a greater performance incentive as performance increases. There are no electric companies in Indiana with decoupled rates. However, of the three largest natural gas distribution companies operating in the states, two have decoupled rates for most rate classes. Finally, Indiana offers companies the opportunity to participate in a voluntary renewable portfolio standard to earn a higher return on equity for rate-base facilities. Energy efficiency savings are one means by which a company can meet the voluntary standard. However no company has formally requested commission approval to participate in the standard.

Outcomes

ENERGY SAVINGS

Statewide energy savings increased dramatically in Indiana subsequent to the 2009 order. In 2012, utilities achieved electricity savings of 0.59% of retail sales, about the national average. Statewide energy savings are shown in figure B3.

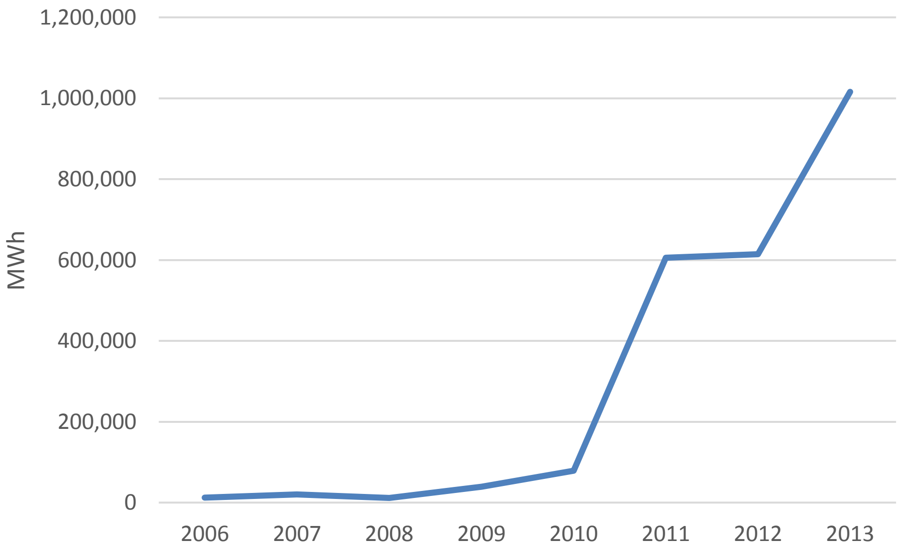

Figure B3. Indiana energy savings (MWh), 2006–2013. *Source*: ACEEE *State Energy Efficiency Scorecard* 2007–2014.

FINANCIAL OUTCOMES

Table B3 shows the dollars recovered under the LRAM for three IOUs in Indiana.

Table B3. Indiana lost margin recovery and savings 2012–2013

Company	LRAM recovered	Program cost	Total annual energy savings (MWh)
		2013	
Duke Energy	$3,669,344	$36,587,777	267,711
Vectren	$6,014,360	$11,251,668	63,072
Indiana Michigan Power	$9,115,961	$22,335,442	121,472
		2012	
Duke Energy	$2,521,055	$22,905,994	215,795
Vectren	$3,765,798	$11,068,667	64,864
Indiana Michigan Power	$3,819,984	$11,436,775	60,460

Amounts subject to reconciliation process where estimated lost revenues, program costs, and savings are trued up with actual lost revenues program costs and savings based on program evaluation results. *Sources:* Indiana Utility Regulatory Commission Case Filings: Duke (Cause No. 43955 DSM-2); Vectren (Cause No. 43405 DSM-10 and DSM-11); Indiana Michigan Power (Cause No. 43827 DSM -3).

Discussion

Indiana utilities have clearly significantly ramped up their energy efficiency spending and savings since the 2009 IURC order. It is unclear what role the LRAM policy has played in that, since the utilities have had that LRAM policy available since 1995.

Lost revenue recovery has emerged as a somewhat contentious issue in Indiana, with advocates expressing concern about the potential for adding considerable costs to ratepayers. Although Indiana has only a couple of years' experience with large-scale energy efficiency programs, one can see from the table that the LRAM costs are already substantial. The open-ended potential for pancaking of lost revenue costs over multiple years is of particular concern, given that there is no cap or time limit on the recovery of lost revenues. Documents filed by several utilities in recent cases indicate that if lost revenues are collected for the life of the measures, total lost revenue costs would exceed the total program costs.

True symmetrical decoupling is an alternative that avoids many of the problems of LRAM, and some advocates are considering recommending that alternative. At one time Vectren sought a decoupling mechanism for its gas and electric utilities. However decoupling was rejected for electric utilities in a 2011 IURC order (Cause No. 43839).

EVALUATION

The Core programs were evaluated by an independent third party, selected by the DSM Coordinating Committee established by the IURC (comprising the utilities and the Office of the Utility Consumer Counselor [OUCC] and involving other key stakeholders). For the Core Plus programs, each utility is responsible for hiring a third party to evaluate its own programs. However the utilities generally have oversight committees for the Core programs with members including the OUCC and often other stakeholders. These committees often participate in decisions regarding the selection of a third-party evaluator; they also review the evaluator's reports and analyses. Energy savings are defined as being net of free riders. The results of these evaluations are used both in determining lost revenues and in calculating performance incentives for the utilities.

PROCESS

The process for tracking and awarding lost revenues is already proving to be fairly complicated. IURC staff noted that timely EM&V is particularly important to accomplish for the full portfolio of programs. If EM&V data are submitted for only some programs because the EM&V process for other programs is not complete, it results in challenges in tracking and reconciling subsequent evaluations. Also, it is important that all utilities use consistent definitions related to reported, actual, and verified savings. Although it is still early in the experience with LRAM, stakeholders acknowledge that tracking lost revenues over multiple years raises concerns about keeping track of pancaked lost revenues. They further say that trying to adjust those amounts as energy efficiency measures reach the end of their estimated lifetimes would be extremely challenging.

Looking Forward

The policy landscape for utility energy efficiency in Indiana is fairly uncertain at this point. In his letter to the legislature after the enactment of SB 340, the governor stated, "I have requested the Indiana Utility Regulatory Commission to immediately begin to develop recommendations that can inform a new legislative framework for consideration during the 2015 session of the Indiana General Assembly." This suggests that the entire framework for utility energy efficiency programs in Indiana is up for revision. It is yet to be determined whether there will be any type of utility energy efficiency requirements at all (much less annual savings targets), and what associated policies (e.g., LRAM, decoupling, shareholder incentives) will remain or will be put in place.

At this point the Indiana utilities have all filed, and had approved, one-year plans to continue some energy efficiency programs during 2015. It is noteworthy that now that the IURC annual savings targets have been struck down by SB 340, the projected savings from the voluntary utility plans are, in aggregate, about half of what would have been required under the previous IURC standard.

SOUTH DAKOTA

History

South Dakota is unusual in that energy efficiency programs are not a legislative or regulatory requirement. In the mid-2000s, the South Dakota Public Utilities Commission (PUC) tasked staff with investigating options to encourage the state's six investor-owned utilities to offer energy efficiency programs. Initially, staff suggested a standard program design. However five of South Dakota's six IOUs operate in other states, many with established efficiency programs. They were opposed to the standard program design, noting it would be simpler to offer portfolios that mirrored their existing efficiency programs in other states.

The commission asked utilities to bring other options for efficiency programs to the table. Several utilities approached the PUC with the idea of performance incentives and lost revenue adjustment mechanisms. The commission originally approved performance incentives but moved away from that approach in 2010. Working in collaboration with utilities, the commission authorized an LRAM that applied to all IOUs. Unlike other states, the LRAM does not take energy savings into account.

Other Relevant Regulatory Features

South Dakota does not require utilities to offer energy efficiency programs.[21] The PUC authorized performance incentives in the past, but none is currently in place or pending. Most utilities in the state are interconnected and deliver the majority of their loads out of state; due to South Dakota's small population, they tend not to consider the South Dakota portion of their load in supply-side decisions. Many of the efficiency programs throughout the state began as extensions of existing, more robust programs in other, neighboring states.

LRAM Policy Details

South Dakota's LRAM was first authorized for Montana-Dakota Utilities in 2010.[22] The LRAM applies to all investor-owned utilities for both electricity and natural gas. Lost revenues are not based on verified energy savings. Instead, they are negotiated as a percentage of approved budget spending. Utilities estimate savings to determine the cost effectiveness of efficiency programs but are not required to submit savings details to the commission as part of LRAM proceedings. Lost revenues are recovered contemporaneously through a rider and trued up over time. Recovery is limited to the year in which expenses are incurred.

Outcomes

The South Dakota PUC is prohibited from requiring utilities to implement efficiency programs, and therefore the LRAM is the primary method by which the PUC has sought to encourage efficiency programs throughout the state. Efficiency offerings are influenced by South Dakota's demographic and geographic characteristics. The small population relative to the number of utilities, and the fact that nearly all of the state's utilities are interconnected, mean that utility experience in neighboring states is largely what drives efficiency in South Dakota. Since programs are small, the costs of evaluation are disproportionately high to utilities. Furthermore, all parties have agreed that simplicity is a practical strategy to maximize the efficiency of the programs. As a result, little emphasis is placed on verification of actual energy savings.

ENERGY SAVINGS

PUC staff have been successful in working with IOUs to initiate some level of energy efficiency programming in South Dakota. Efficiency budgets have slowly but steadily increased in recent years. Figure B4 illustrates relatively consistent savings levels. South Dakota's statewide savings remain well below the national average of 0.56% savings as a percentage of retail sales.

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[21] In 2009, the PUC did adopt a modified Public Utilities Regulatory Policies Act (PURPA) standard requiring IOUs "to integrate cost-effective energy efficiency resources into [their] plans and planning processes," but there is no rule or law requiring specific energy efficiency programs or savings levels.

[22] See docket NG09-001 (http://puc.sd.gov/Dockets/NaturalGas/2009/ng09-001.aspx).

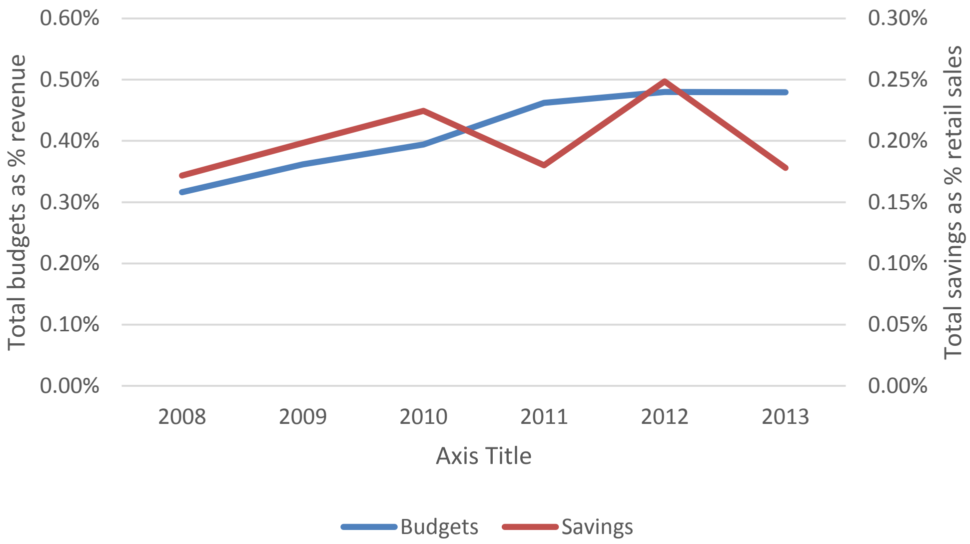

Figure B4. Total statewide spending and savings on energy efficiency, 2008-2013. *Source:* ACEEE *State Energy Efficiency Scorecard*, 2008–2014.

FINANCIAL OUTCOMES

South Dakota's LRAM is a function of utility budgets for energy efficiency rather than energy savings achieved. Dollars recovered, program budgets, and non-verified estimates of energy savings are shown in table B4. Recovery is based on budgets rather than actual spending, so any overspending by utilities does not result in greater allowable lost margin recovery. Similarly, while programs must be cost effective, the commission places little emphasis on verification of energy savings.

Table B4. Sample of lost revenue recovered in recent years

Utility	Lost revenue dollars recovered*	Cost of energy efficiency programs	Total energy savings achieved*	LRAM earnings per energy unit saved
		2013		
Otter Tail Power	$84,000	$281,548	1,611,525	$0.05
Montana-Dakota Utilities	$14,264	$168,026	46,130	$0.31
		2012		
Otter Tail Power	$84,000	$309,911	3,910,104	$0.02
Montana-Dakota Utilities	$6,056	$51,554	30,840	$0.20

*Estimates

Table B4 also shows the small size of programs in South Dakota. Each utility serves a relatively small customer base, and opportunities to work with industrial customers are limited. The small size of efficiency programs is one of the main reasons little emphasis has been placed on actual energy savings to date. Parties noted that lost margin recovery to date has been relatively minimal, and there has not been much scrutiny by external stakeholders.

Discussion

The driving force behind South Dakota's LRAM has been an emphasis on simplicity. To date, this seems to have worked for the state. Customer bases are limited, programs are small, and outside stakeholders pay little attention to regulatory features like lost margin recovery. However, in exchange for simplicity, the state has made a significant tradeoff: verification of energy savings.

SMALL SERVICE TERRITORIES AND NEIGHBOR STATE INFLUENCE

Programs in South Dakota are shaped largely by neighboring states. Utilities also provide service to Iowa, Illinois, Minnesota, and Montana, all of which have relatively robust energy efficiency programs that predate those in South Dakota. These experiences were shifted over the border to shape portfolios in South Dakota. However modifications were made to account for the small population of the state. For example, because the industrial base is small, programs targeted at this sector are limited.

EVALUATION, MEASUREMENT, AND VERIFICATION

Unlike many other states, there is little back-and-forth between the commission and utilities regarding verification of savings. There is evaluation of savings at some level—utilities must, for example, estimate savings in order to determine whether programs are cost effective. However no evaluation of savings is required by the commission. Parties indicated that even if savings estimates are off by an order of magnitude, programs would still be cost effective within the state. There has been very little public scrutiny of the budget-based LRAM methodology, likely due to the small size of efficiency programs.

Looking Forward

Though both utilities and commission staff say they recognize the importance of efficiency, there is no clear sign that efficiency will continue to gain traction in the state under the current regulatory structure. However all parties note that potential federal regulations, like the Clean Power Plan, could be a possible turning point. Federal regulations could not only require the ramp-up of programs but also necessitate more careful calculations of energy savings. These potential changes seem to have already influenced utility behavior to some extent, with utilities indicating that they have paid more attention to internal savings verification recently.

ARKANSAS

History

Investor-owned utilities in Arkansas had very little involvement in providing customer energy efficiency programs until 2007, when the Arkansas Public Service Commission (APSC) approved Rules for Conservation and Energy Efficiency Programs requiring electric and gas utilities to propose and administer energy efficiency programs (Docket No. 06-004-R, Orders No. 1, 12, 18). The state's jurisdictional IOUs filed Energy Efficiency Plans in July 2007 containing proposed Quick Start efficiency programs. The utility response was relatively small, with the utilities expressing concern about adverse financial impacts. In response, in 2010 the commission took several actions to increase the energy efficiency efforts.

Also in December 2010, the APSC adopted an energy efficiency resource standard (EERS) for both electricity and natural gas, guidelines for efficiency program cost recovery, and a shareholder performance incentive. The EERS targets set by the commission were moderate, calling for an annual reduction of 0.25% of total electric kWh sales in 2011, 0.5% in 2012, and 0.75% in 2013. In 2013 the APSC extended the 0.75% target to 2014 and set a target of 0.9% for 2015. It deferred a ruling on 2016–2017 targets pending completion of a thorough potential study aimed at improving programs.

In December 2010 the Arkansas PSC approved a joint electric and gas utility motion to allow the awarding of lost contributions to fixed costs that result from future utility energy efficiency programs. All investor-owned utilities are approved to recover lost revenues as part of the annual energy efficiency program tariff docket (see Order No. 14 Docket 08-137-U). In 2007 the APSC approved a decoupling mechanism for the three major natural gas distribution companies in the state, but no decoupling has been approved for electric utilities.

In December 2010 the APSC began a process by which it would approve incentives to reward achievement in the delivery of essential energy conservation services by investor-owned utilities (see Order No. 15 Docket 08-137-U). Such incentives were approved for all three gas utilities in the state and the two largest electric utilities in 2012 and 2013.

LRAM Policy Details

The APSC established its LRAM policy in 2010 (Docket No. 08-137-U, Order No. 14, December 10, 2010). All investor-owned electric and gas utilities are eligible under the policy to apply to receive lost contributions to fixed costs (LCFC). There are no minimum energy savings thresholds or other achievements required to qualify for receiving lost revenues.

The LCFC is calculated as the base rate (i.e., the total rate minus variable costs [typically just fuel costs]) times the net savings from the energy efficiency programs. Lost revenues are calculated and recovered annually. The utility is eligible to receive lost revenues for the life of the measure, and there is no limit or ceiling on the amount of lost revenues that can be recovered, except that the LCFC resets to zero at each new rate case.

Other Relevant Regulatory Features

Arkansas has had an EERS in place since 2010 for both gas and electric utilities. The energy savings targets are established by the APSC in three-year cycles. The three natural gas distribution companies in Arkansas are decoupled and eligible to earn performance incentives for efficiency program results. There are no decoupled electric companies in Arkansas but the four electric IOUs do have LRAMs in operation and are able to earn performance incentives.

Outcomes

ENERGY SAVINGS

Statewide electricity savings are shown in figure B5. Energy savings in Arkansas are driven largely by the state's EERS requirements. A 2014 study found that, on the whole, Arkansas met or came close to meeting savings targets in 2011 and 2012 (Downs and Cui 2014). The extent of the LCFC's role in the utilities' commitment to meeting these targets is unclear, particularly since there is no minimum threshold for receiving lost margin.

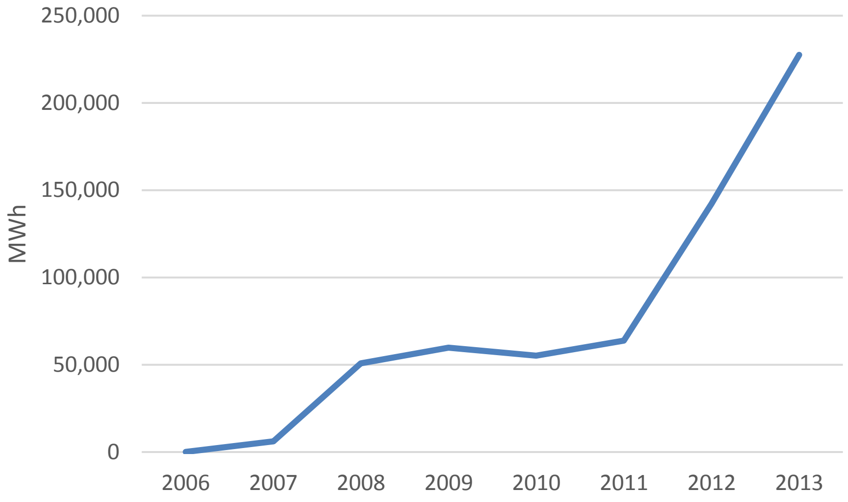

Figure B5. Arkansas energy efficiency program savings 2006–2013. *Source:* ACEEE *State Energy Efficiency Scorecard* 2007–2014.

FINANCIAL OUTCOMES

Dollars recovered through the LCFC are shown in table B5. As savings targets rise, program budgets have ramped up significantly. Resulting lost revenue dollars have also increased in recent years.

Table B5. Arkansas electric utility lost revenue and savings 2012–2013

Company	LRAM recovered	Program cost	Total annual energy savings (MWh)
		2013	
Entergy Arkansas	$10,534,980	$52,285,262	188.468
SWEPCo	$1,015,859	$6,803,249	25,387
		2012	
Entergy Arkansas	$3,665,223	$28,515,019	107,627
SWEPCo	$545,377	$5,289,095	17,767

Source: Arkansas Public Service Commission

Discussion

The major electric utilities in Arkansas have definitely increased their energy efficiency efforts and achievements in response to the various commission orders and policies that have been in place since 2007. How much of that might be attributable to the LRAM policy is difficult to say, but staff did indicate that doing something about the lost revenue from energy efficiency was an important factor for the IOUs.

The APSC established its LRAM policy in 2010 in response to a joint motion by the major investor-owned utilities. At the time, the commission stated:

> While decoupling may eventually prove to be a better way to tame the "throughput incentive," the Commission at this time accepts the EE Utilities' argument that an LCFC mechanism is more appropriate for electric utilities, which expect growth in sales . . . . The Commission commits to approval of LCFC recovery only in the context of significant goal setting and the development of robust EM&V, as detailed in other orders issued contemporaneously with this Order. Thus, recovery of revenues lost is not an independent right of utilities, but rather a component of a coordinated group of policies reasonably calculated to deliver overall benefits to ratepayers, to utilities, and to society in a cost-effective manner. (Docket No. 08-137-U, Order No. 14, p.17-18)

The commission clearly had some reservations about allowing LRAM in the first place, and it certainly left open the possibility of revising the policy in the future. And APSC staff expressed concerns about the asymmetrical nature of LRAM (i.e., utilities collect for sales lost to energy efficiency but have no obligation to refund excess revenues if sales exceed forecasts) and the potential for LRAM costs to mount over time due to pancaking.

A more recent commission order, in 2013, sought to encourage utilities to file decoupling proposals:

> In the expectation that further rate cases will be filed by electric utilities in 2013 and 2014, the Commission issues this order to encourage proposals by electric utilities …that would decouple revenues from sales volumes. (Docket No. 08-137-U, Order No. 19, p.1)

And the commission specifically asked for "proposals that include the following features":

- Customer charges that are set at a level low enough to encourage conservation[23]
- Establishment of separate revenue-per-customer amounts for—at a minimum—residential, small commercial, and demand-metered commercial customers

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[23] Fixed charges are the portion of the customer's utility bill not tied to consumption. It is noteworthy that the commission appears here to be taking a preemptive stance against proposals for high fixed charges, or "straight fixed-variable" rate design (which are sometimes requested by utilities as mechanisms to counter the problem of lost revenues from energy efficiency programs and/or customer-sited solar photovoltaic installations).

- Establishment of a true-up mechanism that credits to or collects from customers any over- or under-recovery of revenue, respectively

EVALUATION

The evaluation process is overseen by the APSC. The commission requires each utility to hire its own independent EM&V contractor to perform evaluations. It further requires the utilities to jointly fund an independent EM&V monitor who provides oversight and guidance and operates under the direction of the commission staff. The commission established an EM&V collaborative (Parties Working Collaboratively, or PWC) to develop a technical resource manual that is updated annually and approved by the commission. Arkansas uses net savings as its evaluation metric.

Looking Forward

As noted above, the commission has expressed interest in receiving proposals from the electric utilities for true symmetrical decoupling, to replace the existing LRAM mechanisms. Thus far, one of the two largest utilities in 2014 did indicate it would file a decoupling proposal in a future rate case. However it should be noted that there will be substantial turnover among commissioners for 2015, so there is the potential for a sea change in the amount of support for efficiency coming from the APSC.

MISSOURI

History

Major legislation enacted in 2009 marked a major turning point for utility energy efficiency programs in Missouri. The Missouri Energy Efficiency Investment Act (MEEIA, SB 376) established a regulatory framework for utility energy efficiency programs to consider demand-side investments in the same framework as traditional investments in supply and delivery infrastructure. The corresponding Public Service Commission (MPSC) rules for implementing the legislation became effective in May 2011. Prior to passage of MEEIA, Missouri had limited energy efficiency programs for utility customers even though electric utilities were required to file and implement integrated resource plans.

Key provisions of MEEIA specifically address the utility business model. Under MEEIA the Public Service Commission is to

- Provide timely cost recovery for utilities
- Ensure that utility financial incentives are aligned with helping customers use energy more efficiently
- Provide timely earnings opportunities associated with cost-effective, measurable, and verifiable efficiency savings

MEEIA opened the door for electric utilities to propose and establish demand-side investment mechanisms (DSIMs) for energy efficiency programs. Addressing the utility business model was critical for Missouri's utilities to move ahead with such programs. One of Missouri's utilities, in fact, had established a fairly large portfolio of programs at the time MEEIA was enacted. Ameren Missouri had launched a portfolio of customer programs totaling about $70 million over a three-year period (2009–2011). However the company rolled back this level of program spending and associated activity when cost recovery and incentive mechanisms were not approved during Ameren Missouri's 2011 rate case. When the commission approved an agreement between the utility and parties to its MEEIA application that established DSIMs, the impact was significant. Ameren soon launched a full portfolio of energy efficiency programs totaling $145 million over the three-year program period.

The story is similar for Kansas City Power & Light (KCP&L), which had limited energy efficiency programs and associated investment in place prior to establishing its own version of a DSIM late in 2014. Once this mechanism was in place, KCP&L initiated a portfolio of energy efficiency programs totaling $28.6 million over 18 months, after which time the company is expected to file a full three-year plan. KCP&L Greater Missouri Operations (GMO), a utility operating company owned by the same corporation as KCP&L, serves an area surrounding Kansas City. GMO had in place a small set of programs prior to establishing a DSIM. With cost recovery in place, the company is proceeding with a greatly expanded set of programs.

Other Relevant Regulatory Features

The DSIMs in place for Missouri's utilities contain provisions not only for recovery of program costs and lost revenues resulting from the programs, but also the opportunity for shareholder incentive awards. These incentive awards are based on a percentage of net shared benefits. Lost revenues are calculated using deemed savings, while shareholder incentive awards are determined based on program evaluations.

MEEIA's provisions supporting energy efficiency are not mandatory but are designed to make energy efficiency a good business investment. The statute states:

> The Commission shall permit electric corporations to implement Commission-approved demand-side programs proposed pursuant to this section with a goal of achieving all cost-effective demand-side savings.

Decoupling requires periodic adjustments to true up rates and allowed revenues; these adjustments are viewed as rate-making outside of general rate cases. Some parties believe Missouri's existing statutes could be interpreted so as to allow decoupling. To date there have been no decoupling proposals associated with DSM programs submitted to or considered by the commission.

LRAM Policy Details

The basic structure of the DSIMs established for Ameren Missouri, KCP&L, and GMO is the same, but details differ.

Ameren Missouri's DSIM was established by a unanimous stipulation and agreement among Ameren Missouri, the staff of the Missouri Public Service Commission, and other stakeholders. The DSIM (Case No. E0-2012-142) approved by the commission addresses program cost recovery, the throughput disincentive, and a performance incentive. The provision addressing net shared benefits relating to the throughput disincentive (TD) is an LRAM structured as follows:

- A sum of $30.45 million shall be added to the revenue requirement determined as if the approved MEEIA Plan did not exist and in each subsequent Ameren Missouri general rate case where new base rates will become effective before the end of the three-year period.
- The $30.45 million is equal to 90% of the estimated amount of Ameren Missouri's "throughput disincentive—net shared benefit" share. It is the annualized value of a three-year annuity of 26.34% of the actual pretax net shared benefits to be recovered to offset the throughput disincentive.
- Net shared benefits are the present value of the lifetime avoided costs for the approved MEEIA programs, using the deemed values in the technical resource manual (TRM) less the present value of all utility costs of administering the MEEIA programs. Avoided costs include energy, capacity, and transmission and distribution.[24]
- The revenue requirement addition is to be trued up according to actual monthly counts of energy efficiency measures installed and the actual monthly programs' costs based on reports provided by program implementers.

Savings used to determine the DSIM applicable to the throughput disincentive are based on measure-level deemed annual energy and demand savings and measure life. The rates for avoided energy saving and rates for avoided demand savings are deemed values. Lost revenues are recovered through either a rider or a tracker mechanism. There is no threshold requirement to receive lost revenues, and there is no limit or ceiling for lost revenue. Lost revenue recovery continues for the deemed measure life after initial program year's savings through a rider or tracker mechanism.

The Missouri PSC authorized similar DSIMs for GMO in January 2013 and for KCP&L in July 2014. The LRAM has been in place only long enough to have one completed program year subject to this rate structure for GMO, and KCP&L has not reported results to date.

Energy Savings and Financial Outcomes

It is too early in the initial program plan periods for the utilities with DSIMs in place to assess the full impacts and associated financial outcomes. Ameren Missouri is exceeding program savings targets and is on track to receive full incentive amounts. Because the DSIMs are based on deemed savings, the cost recovery amounts received by the utilities are determined by reports on actual measures installed and costs incurred in each program year. These costs are built into rate riders or trackers for the programs and recovered contemporaneously, subject to periodic true-ups. Table B6 shows program costs, energy savings, and dollars recovered in 2013.

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[24] While the MEEIA rule definition of avoided cost or avoided utility cost (4 CSR 240-20.093(1)(F) allows for inclusion of probable environmental compliance costs, the Ameren Missouri avoided utility costs for net shared benefits calculation does not include probable environmental costs. However Ameren Missouri does include probable future environmental compliance costs in its assumptions of future market prices.

Table B6. Lost revenue and savings data for Missouri IOUs

	Ameren Missouri	GMO	KCP&L
LRAM $ recovered	$37,148,122	$8,424,395	Programs initiated in 2014; no results reported to date.
Program cost	$34,432,402	$2,674,537	
1-year energy savings	337,368,000 kWh	30,697,000 kWh	

Discussion

Missouri's DSIMs (addressing program costs, throughput disincentive, and shareholder performance incentive) are very new. Nonetheless, their impact has been dramatic. It is clear from discussions with Missouri stakeholders that establishing these mechanisms has enabled and encouraged affected utilities to initiate and fund large portfolios of customer energy efficiency programs.

Ameren Missouri's recent history with energy efficiency program funding illustrates the substantial effect that MEEIA and authorization of DSIMs have had. Prior to MEEIA's passage, Ameren Missouri had energy efficiency programs in place representing total utility investment of about $70 million for the three-year period 2009–2011. During this time, Ameren Missouri received only program cost recovery; there was no lost revenue recovery and no shareholder incentives. Ameren Missouri leadership viewed this business model for energy efficiency as unsustainable. As a result, the utility put the brakes on its programs and reduced its program funding from $30 million in 2011 to a "bridge" of $8 million in 2012. The MEEIA rules had just been approved, and Ameren Missouri sought to retain the basic foundations of its energy efficiency programs in anticipation of getting the regulatory treatment of costs and incentives that would allow it to return to a much higher level of investment. With the commission's approval of its DSIM, Ameren Missouri's investment did indeed jump—up to $35 million in 2013, $45 million in 2014, and as much as $65 million in 2015. Both utility staff and clean energy advocates noted that having all three legs of the stool in place had a major effect on Ameren's decision to invest in energy efficiency.

As noted earlier, MEEIA does not require utilities to fund and provide energy efficiency programs. They are voluntary. Consequently, considering demand-side investments using the same investment criteria as supply and delivery infrastructure, and allowing recovery of all reasonable and prudent costs of delivering cost-effective demand-side programs were critical for the utilities to engage fully and provide energy efficiency programs and services. To date, three of the four regulated electric utilities in Missouri have established energy efficiency programs in response to MEEIA. The remaining utility, Empire Electric, is developing proposals and initiated an MEEIA filing in late 2013.

MECHANISM COSTS

As structured, Missouri's DSIMs provide compensation to utilities for lost revenues associated with energy savings regardless of net system demands. Other states have structured LRAMs based on net system energy sales. This raises the question of whether Missouri's mechanisms are too expensive.

EVALUATION

Because Missouri's LRAMs are determined by deemed values for energy and demand savings along with measure life, the relevant program metric is the number of various measure installations achieved by the different programs. These data are reported by program contractors and staff as part of routine program tracking and are subject to prudence review by commission staff. Divergence from program projections is addressed by periodic true-ups of the DSIM.

PROCESS

Once authorized, the DSIMs are effective for the associated program period. Recovery of costs stemming from the throughput disincentive is achieved through rate riders or trackers for MEEIA programs. Parties noted that learning curve is very steep for utility energy efficiency programs. It is taking time for all involved to work through the processes and issues associated with the development, implementation, and evaluation of programs, including determination of utility incentives.

Looking Forward

The rules established for MEEIA are undergoing a required review in 2015. Missouri's regulations requiring integrated resource planning remain in place; such proceedings occur separately from MEEIA program filings.

Ameren Missouri filed its next three-year MEEIA program plan in December 2014. The existing DSIM is part of this plan. The proposed level of investment in energy efficiency programs is about the same as in the existing three-year MEEIA program plan, but expected savings are about half.

Missouri's DSIMs are too new to allow assessment of their full impact and effectiveness. It is clear that having them in place has been a critical catalyst for Missouri's electric utilities to move ahead with portfolios of customer energy efficiency programs representing significant utility investment. What is not clear yet is whether the costs of providing throughput disincentives are too high.

While more time and analysis will be needed before one can fully assess the effectiveness of Missouri's DSIMs, it already is clear that mechanisms to address the utility business model have been effective in encouraging increased efficiency in a state where no incentives were in place previously.

SOUTH CAROLINA

History

South Carolina does not require or set goals for energy efficiency. Efficiency programs are largely the result of pressure from consumer and advocacy groups. A lost revenue adjustment mechanism was first authorized in South Carolina in 2008. Initially, specific regulatory features of energy efficiency programs were tailored to each utility in the state. Investor-owned utilities approached the South Carolina Public Service Commission with proposals for efficiency programs and mechanisms to recover costs and lost margin. Commission Order No. 2009-373 issued in 2009 stated that Duke Energy Progress (formerly Progress Energy Carolinas) could "recover capital expenditures, the actual costs incurred in providing demand side management and energy efficiency programs, net lost revenues from these programs, incentives… and defer and amortize all demand side management and efficiency program expenses over a ten year period." The Commission approved a lost revenue recovery mechanism for South Carolina Electric & Gas Company (SCE&G) in 2010 (Docket No. 2009-261-E and Docket 2009-251-E). In 2013, a reestablishment of the recovery mechanism for Duke and SCE&G was ordered.

Other Relevant Regulatory Features

The South Carolina PSC has also approved shared savings incentives for investor-owned utilities. Incentives are detailed further in Nowak et al. (2015). Energy efficiency programs in the state have been influenced by programs run by interconnected utilities in North Carolina, where a combined renewable and energy efficiency portfolio standard is in place. Furthermore, a settlement agreement associated with a merger between Duke Energy Carolinas and Progress Energy Carolinas stipulated annual energy savings targets equivalent to 1% of retail sales over the time period 2014–2018.

LRAM Policy Details

South Carolina's lost revenue adjustment mechanism was established in S.C. Code Ann § 58-37-20 and further described in Docket No. 2008-251-E (Order No. 2009-373). Lost revenues are based on estimated net energy savings multiplied by the retail rate less fuel and variable operating and maintenance costs. Utilities are required to hire third parties to evaluate efficiency programs. Lost revenues are estimated annually and trued up once evaluation reports become available. Lost revenues can be collected for three years after measure installation or the life of the measure, whichever is shorter. The South Carolina Office of Regulatory Staff (ORS) publishes a report in every demand-side management rider recovery docket, which is publicly available.

Under the most recent mechanism approved for one utility, a percentage of *estimated* net lost revenue is approved for recovery. During the first year, the estimate is recovered at 75%, the next year at 80%, and in subsequent years 90% and 100%. This stepped recovery is meant to allow estimates to be recalculated as data become available and to avoid unnecessary true-ups. Other utilities have adjusted their recovery to control spikes in rates when necessary and possible to do so.

Outcomes

Regulatory staff and clean energy advocates were united in their feeling that the three-legged-stool approach has been critical in encouraging IOUs to invest in energy efficiency in South Carolina. Over several years, the state's Office of Regulatory Staff (ORS) has worked with utilities to refine their approach to recovery of lost margins. Generally, there is broad support for the LRAM within the state, although some stakeholders noted that South Carolina is still achieving relatively low levels of savings when compared with other states.

ENERGY SAVINGS

South Carolina's energy savings have steadily climbed since the introduction of the LRAM and performance incentives. Figure B6 shows statewide electricity savings and the national median.

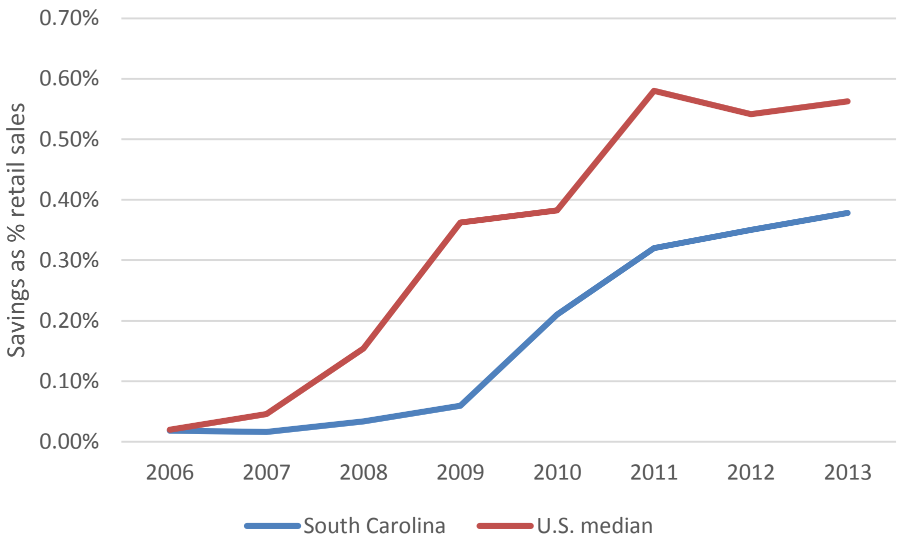

Figure B6. Net incremental savings as a percentage of retail sales for South Carolina compared with US median electricity savings. ***Source:*** **ACEEE *State Energy Efficiency Scorecard* 2007–2014.**

Though South Carolina remains below the national median, stakeholders noted that utilities have performed well in recent years relative to others in the region. However efficiency advocates also noted that savings have varied from year to year for each utility, with good years and bad years.

Regulatory staff also noted that policy mechanisms have changed several times in recent years. Thus, making assertions about the effect of a single mechanism *type* is nearly impossible.

FINANCIAL OUTCOMES

The most recent estimates of lost revenue earnings from efficiency programs are presented in table B7. South Carolina utilities are able to recover lost revenues from each program year for three years. Approved recovery for the relevant program year over the three-year period is also shown.

Table B7. Lost revenue recovered in recent years

Utility	LRAM $ for program year	Cost of energy efficiency programs	Total energy savings achieved	LRAM $ for approved 3-year timeframe
		2013		
SCE&G	$4,215,715	$15,890,902	57,333,000	$20,568,683
Duke Energy Progress	$3,527,268	$6,580,487	35,580,042	$11,294,650
Duke Energy Carolinas	$4,034,970	$17,133,555	120,352,634	$11,332,427

Utility	LRAM $ for program year	Cost of energy efficiency programs	Total energy savings achieved	LRAM $ for approved 3-year timeframe
2014				
SCE&G	$6,432,465	$17,106,108	101,404,418	$27,001,148
Duke Energy Progress	$4,673,374	$6,452,562	23,899,720	$10,718,207
Duke Energy Carolinas	$3,985,437	$17,928,851	104,117,911	$10,116,293

Source: South Carolina Office of Regulatory Staff.

Discussion

After several years of LRAM in South Carolina, mechanisms have been adjusted to promote consistency between utilities and to mitigate potential effects on consumers. Overall, stakeholders expressed that there was limited opposition to South Carolina's LRAM and other utility incentives. All parties believed these regulatory mechanisms were necessary to encourage efficiency, although some said they would like to see more aggressive efforts to achieve energy savings from IOUs.

PROTECTING CONSUMERS

South Carolina's flexible approach to cost recovery is meant to protect consumers from rate shocks. Regulatory staff noted that estimates of lost revenues can be dramatically different from actual lost revenues, and a flexible approach to collection of lost margin minimizes large adjustments that would show up on customers' bills. Utilities in the state have also sought other ways of minimizing bill impacts. For example, SCE&G is investing heavily in nuclear power plants, leading to rising rates for customers. In order to shelter customers from the impact of an additional efficiency rider, the utility has deferred the collection of program costs. It is unclear what the future implication of this deferral will be for consumers.

TRANSPARENCY

Stakeholders emphasized the importance of transparency in South Carolina's LRAM. While clean energy advocates felt that data are generally available, other parties believe transparency could be improved. For example, utilities could submit clearer evidence of what savings were achieved over specific time periods. Since not all measures are subject to the three-year EM&V framework, it can be difficult to parse out specific savings and lost revenues associated with a particular program year. In an effort to make regulation more straightforward and to better align EM&V processes with ratemaking processes, the commission recently approved a new schedule for efficiency program years that aligns with the calendar year.

Looking Forward

South Carolina shows no indication that it will move away from its current approach to energy efficiency regulation. Parties noted that decoupling was largely off the table, as were energy savings targets, and the LRAM has almost no opposition. With new LRAM models approved in recent years, all stakeholders expressed hope that these will prove to be simple and transparent.

Appendix C. State Contact Questionnaire

Regulatory Structure Questions

Please briefly describe the lost revenue adjustment mechanism (LRAM) or lost contribution to fixed cost (LCFC) mechanism in your state.

1. When was it first authorized? When was the most recent version established?
2. To which utilities does it apply?
3. How are lost revenues estimated? (Please describe the basic calculation.)
4. How are the efficiency program savings that are used to determine lost revenues measured and verified? By whom?
5. Are the savings used in determination of lost revenues net or gross?
6. How often are lost revenues recovered (i.e., annually, biannually)?
7. Are there any threshold requirements for a utility to qualify to receive lost revenues? If so, please describe.
8. Is there a limit or ceiling for lost revenue recovery? If so, what is it?
9. For how long after a particular program year does lost revenue recovery for that year's programs continue?

Please provide the following information for up to 3 utilities covered by LRAM in your state. Please reference each of the two most recent program years for which data is available. Indicate program years and fill in information for each year in the table below.

	Utility 1: ____________	Utility 2: ____________	Utility 3:_____________
Program Year ______			
Lost Revenue Dollars Recovered ($)*			
Cost of energy efficiency programs to which LRAM was applied ($)			
Total (1-year annual) energy savings achieved by the programs under LRAM (Please indicate kWh or therms)			
Program Year ______			
Lost Revenue Dollars Recovered ($)*			

Cost of energy efficiency programs to which LRAM was applied ($)			
Total (1-year annual) energy savings achieved by the programs under LRAM (Please indicate kWh or therms)			

*Note: This refers to the total net lost revenues (NLR) the program year generates over the time frame NLR is approved to be collected.

Please provide a citation or reference to the official documentation (e.g., statue, regulatory order, etc.) where the lost revenue recovery mechanism is established or described.

Is there a report or other document describing the mechanism and the results of how it has worked in practice in your state, and/or provides data on the actual award for the last two program years? If so, please provide link, contact person, or reference where we may obtain a copy.

General Questions

1. Are there any suggestions you would make to another state who was thinking of adopting an LRAM such as the mechanism used in your state?

2. Please provide any additional insights or important information about regulatory adjustments to the utility business model in your state that we have not covered above.

Exhibit NM-13

I&M Discovery Request Response to CAC Set 1, Q2, I&M DSM 2016 Plan Exhibits, 2016 Residential Home Energy Products Tab

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1														
2		**2016 Home Energy Products Program**	**kWh/unit**	**kW/unit**	**unit**	**EUL**	**# Units**	**Total Gross Energy Savings (kWh) ***	**Total Gross Demand (kW)**	**Avg Incentive per**	**Total Incentive $**	**NTG**	**Incentive / kWh ($/kWh)**	**Net Total Energy Savings**
3		**Lighting**												
4														
5		9 W Spiral GS CFL	16.05	0.002	bulb	5	-	-	-	$ 1.00	$ -	52%	$0.06	0
6		10 W Spiral GS CFL	17.84	0.002	bulb	5	-	-	-	$ 0.95	$ -	52%	$0.05	0
7		13 W Spiral GS CFL	23.19	0.003	bulb	5	150,000	3,477,825	411.7	$ 0.95	$ 142,500.00	52%	$0.04	1,808,469
8		14 W Spiral GS CFL	24.97	0.003	bulb	5	75,000	1,872,675	221.7	$ 0.90	$ 67,500.00	52%	$0.04	973,791
9		15 W Spiral GS CFL	26.75	0.003	bulb	5	-	-	-	$ 1.00	$ -	52%	$0.04	0
10		18 W Spiral GS CFL	31.32	0.004	bulb	5	5,000	156,600	18.5	$ 0.90	$ 4,500.00	52%	$0.03	81,432
11		19 W Spiral GS CFL	33.06	0.004	bulb	5	5,000	165,300	19.6	$ 0.90	$ 4,500.00	52%	$0.03	85,956
12		20 W Spiral GS CFL	34.80	0.004	bulb	5	5,000	174,000	20.6	$ 0.90	$ 4,500.00	52%	$0.03	90,480
13		23 W Spiral GS CFL	41.22	0.005	bulb	5	45,000	1,854,927	219.6	$ 0.90	$ 40,500.00	52%	$0.02	964,562
14		26 W Spiral GS CFL	46.60	0.006	bulb	5	-	-	-	$ 1.00	$ -	52%	$0.02	0
15		42 W Spiral CFL	75.27	0.009	bulb	5	3,868	291,154	34.5	$ 0.90	$ 3,481.20	52%	$0.01	151,400
16		7 W Specialty CFL	16.05	0.001	bulb	5	350	5,618	0.5	$ 0.90	$ 315.00	52%	$0.06	2,921
17		9 W Specialty CFL	16.05	0.002	bulb	5	3,713	59,599	7.1	$ 0.90	$ 3,341.70	52%	$0.06	30,992
18		11 W Specialty CFL	19.62	0.002	bulb	5	347	6,808	0.8	$ 1.00	$ 347.00	52%	$0.05	3,540
19		12 W Specialty CFL	21.40	0.003	bulb	5	2,547	54,511	6.5	$ 0.90	$ 2,292.30	52%	$0.04	28,346
20		13 W Specialty CFL	23.19	0.003	bulb	5	6,066	140,643	16.7	$ 1.00	$ 6,066.00	52%	$0.04	73,134
21		14 W Specialty CFL	24.97	0.003	bulb	5	8,263	206,319	24.4	$ 0.90	$ 7,436.70	52%	$0.04	107,286
22		15 W Specialty CFL	26.75	0.003	bulb	5	-	-	-	$ 1.00	$ -	52%	$0.04	0
23		19 W Specialty CFL	33.06	0.004	bulb	5	1,365	45,127	5.3	$ 0.90	$ 1,228.50	52%	$0.03	23,466
24		23 W Specialty CFL	41.22	0.005	bulb	5	-	-	-	$ 1.00	$ -	52%	$0.02	0
25		26 W Specialty CFL	46.60	0.006	bulb	5	66	3,075	0.4	$ 1.00	$ 66.00	52%	$0.02	1,599
26		32 W Specialty CFL	57.35	0.007	bulb	5	-	-	-	$ 1.00	$ -	52%	$0.02	0
27		42 W Specialty CFL	75.27	0.009	bulb	5	-	-	-	$ 1.00	$ -	52%	$0.01	0
28		55 W Specialty	98.57	0.012	bulb	5	-	-	-	$ 1.00	$ -	52%	$0.01	0
29		68 W Specialty CFL	121.87	0.014	bulb	5	-	-	-	$ 1.00	$ -	52%	$0.01	0
30		33 W 3 Way CFL	59.14	0.007	bulb	5	2,823	166,960	19.8	$ 0.90	$ 2,540.70	52%	$0.02	86,819
31		7 W Specialty LED	16.05	0.001	bulb	15	4,143	66,501	6.1	$ 3.00	$ 12,429.00	52%	$0.19	34,581
32		9 W Specialty LED	16.05	0.002	bulb	15	1,066	17,111	2.0	$ 3.00	$ 3,198.00	52%	$0.19	8,898
33		11 W Specialty LED	19.62	0.002	bulb	15	-	-	-	$ 3.00	$ -	52%	$0.15	0
34		12 W Specialty LED	21.40	0.003	bulb	15	217	4,644	0.5	$ 3.00	$ 651.00	52%	$0.14	2,415
35		13 W Specialty LED	23.19	0.003	bulb	15	296	6,863	0.8	$ 3.00	$ 888.00	52%	$0.13	3,569
36		14 W Specialty LED	24.97	0.003	bulb	15	-	-	-	$ 3.00	$ -	52%	$0.12	0
37		15 W Specialty LED	26.75	0.003	bulb	15	-	-	-	$ 3.00	$ -	52%	$0.11	0
38		19 W Specialty LED	33.06	0.004	bulb	15	-	-	-	$ 3.00	$ -	52%	$0.09	0
39		23 W Specialty LED	41.22	0.005	bulb	15	2,100	86,563	10.2	$ 3.00	$ 6,300.00	52%	$0.07	45,013
40		26 W Specialty LED	46.60	0.006	bulb	15	-	-	-	$ 3.00	$ -	52%	$0.06	0
41		32 W Specialty LED	57.35	0.007	bulb	15	-	-	-	$ 3.00	$ -	52%	$0.05	0
42		42 W Specialty LED	75.27	0.009	bulb	15	-	-	-	$ 3.00	$ -	52%	$0.04	0
43		55 W Specialty LED	98.57	0.012	bulb	15	-	-	-	$ 3.00	$ -	52%	$0.03	0
44		13 W Retrofit LED	23.19	0.003	bulb	15	4,206	97,518	11.5	$ 3.00	$ 12,618.00	52%	$0.13	50,709
45		33 W 3 Way LED	59.14	0.007	bulb	15	-	-	-	$ 3.00	$ -	52%	$0.05	0
46		9.5 W A Lamp LED	29.86	0.004	bulb	15	30,000	895,785	106.1	$ 3.00	$ 90,000.00	52%	$0.10	465,808
47		11 W A Lamp LED	31.33	0.004	bulb	15	12,000	375,936	44.5	$ 3.00	$ 36,000.00	52%	$0.10	195,487
48		13.5 W A Lamp LED	28.88	0.003	bulb	15	20,000	577,610	68.4	$ 3.00	$ 60,000.00	52%	$0.10	300,357
49		18 W A Lamp LED	34.27	0.004	bulb	15	150,000	5,139,750	609.0	$ 3.00	$ 450,000.00	52%	$0.09	2,672,670
50		9.5 W BR 30 LED	29.86	0.004	bulb	15	2,169	64,765	7.7	$ 3.00	$ 6,507.00	52%	$0.10	33,678
51		15 W BR30 LED	26.75	0.003	bulb	15	3,448	92,243	10.9	$ 3.00	$ 10,344.00	52%	$0.11	47,966
52		18 W PAR 38 LED	34.27	0.004	bulb	15	3,222	110,402	13.1	$ 3.00	$ 9,666.00	52%	$0.09	57,409
53		LED Night Light	13.60	0.003	bulb	15	-	-	-	$ 3.00	$ -	52%	$0.22	0
54		**Efficient Lighting**				9.65	**547,275**	**16,216,832**	**1,919**		**$ 989,716.10**		**$0.06**	**8,432,753**
55														

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
57		**Efficient Products**	**kWh/unit**	**kW/unit**	**unit**	**EUL**	**# of Units**	**Total Gross Energy Savings (kWh)**	**Total Gross Demand Savings (kW)**	**Incentive ($)**	**Total Incentive ($)**	**Net to Gross**	**Incentive / kWh ($/kWh)**	**Net Total Energy Savings (kWh)**
58		Programmable Tstat - Central Air Conditioning	95.91	0.000	Unit	15	180	17,263	0	$70	$12,600	52%	$0.73	8,977
59		Programmable Tstat - HP	475.81	0.000	Unit	15	94	44,727	0	$70	$6,580	52%	$0.15	23,258
60		Heat Pump Upgrade to => SEER 15 / HPF =>8.2	419.89	0.308	Unit	18	50	20,994	15	$200	$10,000	52%	$0.48	10,917
61		Heat Pump Upgrade to => SEER 16 / HPF =>8.7	790.90	0.495	Unit	18	15	11,863	7	$300	$4,500	52%	$0.38	6,169
62		Heat Pump Upgrade to => SEER 17 / HPF =>9.2	1121.11	0.569	Unit	18	30	33,633	17	$400	$12,000	52%	$0.36	17,489
63		Heat Pump Upgrade to => SEER 18 / HPF =>10.1	1601.99	0.684	Unit	18	5	8,010	3	$500	$2,500	52%	$0.31	4,165
64		Ductless HP Replacement of HP to 17 SEER 9.5 HSPF	1276.71	0.101	Unit	18	8	10,214	1	$100	$800	52%	$0.08	5,311
65		Ductless HP Replacement of HP to 19 SEER 9.5 HSPF (or greater	1355.89	0.146	Unit	18	12	16,271	2	$200	$2,400	52%	$0.15	8,461
66		Ductless HP Replacement of HP to 21 SEER 10 HSPF or greater	1658.59	0.187	Unit	18	12	19,903	2	$250	$3,000	52%	$0.15	10,350
67		Ductless HP Replacement of HP 23 SEER 10 HSPF or greater	1711.54	0.225	Unit	18	4	6,846	1	$300	$1,200	52%	$0.18	3,560
68		Ductless HP Displacement of Elec Resistance to 17 SEER 9.5 HSPF	8675.78	0.101	Unit	18	4	34,703	0	$300	$1,200	52%	$0.03	18,046
69		Ductless HP Displacement of Elec Resistance to 19 SEER 9.5 HSPF	8754.95	0.146	Unit	18	12	105,059	2	$400	$4,800	52%	$0.05	54,631
70		Ductless HP Displacement of Elec Resistance to 21 SEER 10 HSPF	9057.65	0.187	Unit	18	12	108,692	2	$500	$6,000	52%	$0.06	56,520
71		Ductless HP Displacement of Elec Resistance 23 SEER or greater 10 HSPF	9110.60	0.225	Unit	18	4	36,442	1	$550	$2,200	52%	$0.06	18,950
72		Central Air Conditioner Upgrade 15 SEER or greater 12 EER or greater	244.64	0.646	Unit	18	175	42,812	113	$200	$35,000	52%	$0.82	22,262
73		Efficient ECM fan motor	733.00	0.066	Unit	10	150	109,950	10	$150	$22,500	52%	$0.20	57,174
74		HP Water Heater 10 to 50 MBH	529.58	0.072	Unit	10	0	0	0		$0	52%	$0.00	0
75		HP Water Heater Energy Star EF >=2.0	1604.80	0.218	Unit	10	85	136,408	18	$350	$29,750	52%	$0.22	70,932
76		HP Water Heater 100 to 300 MBH	3209.60	0.435	Unit	10	0	0	0		$0	52%	$0.00	0
77		VSD Pool Pumps HP 1.0	781.72	1.162	Unit	10	5	3,909	6	$50	$250	52%	$0.06	2,032
78		VSD Pool Pumps HP 1.5	1172.57	1.742	Unit	10	8	9,381	14	$50	$400	52%	$0.04	4,878
79		VSD Pool Pumps HP 2	1563.43	2.323	Unit	10	10	15,634	23	$50	$500	52%	$0.03	8,130
80		ENERGY STAR Ceiling Fan	107.61	0.020	Unit	10	25	2,690	0	$25	$625	52%	$0.23	1,399
81		ENERGY STAR Ceiling Fan Instant Rebate	107.61	0.020	Unit	10	0	0	0	$25	$0	52%	$0.23	0
82		ENERGY STAR Dehumidifier	213.00	0.048	Unit	10	200	42,600	10	$25	$5,000	52%	$0.12	22,152
83		ENERGY STAR Dehumidifier Instant Rebate	213.00	0.048	Unit	10	0	0	0	$25	$0	52%	$0.12	0
84														
85		**Efficient Products**				14.72	1,100	838,004	249		$163,805		$0.20	435,763
87		**Total Home Energy Products Program**				**9.90**	**548,375**	**17,054,836**			**$ 1,153,521.10**			**8,868,516**

	O	P	Q	R	S	T	U	V	W	X
1										
2	**Net Total Demand**	**Gross Lifetime Savings (kWh)**	**Net Lifetime Savings (kWh)**	**% of Total Bulbs**	**% of Total Lighting kWh**		**Source of Savings estimates**	Cost from MEMD		
3										
4										
5	0.00	0	0	0.000%	0.000%		IND TRM Page 15	$ 1.04		
6	0.00	0	0	0.000%	0.000%		IND TRM Page 15	$ 1.04		
7	214.11	17,389,125	9,042,345	27.409%	21.446%		IND TRM Page 15	$ 1.20		
8	115.29	9,363,375	9,363,375	13.704%	11.548%		IND TRM Page 15	$ 1.20		
9	0.00	0	0	0.000%	0.000%		IND TRM Page 15	$ 1.20		
10	9.64	783,000	783,000	0.914%	0.966%		IND TRM Page 15	$ 1.20		
11	10.18	826,500	826,500	0.914%	1.019%		IND TRM Page 15	$ 1.20		
12	10.71	870,000	870,000	0.914%	1.073%		IND TRM Page 15	$ 1.20		
13	114.20	9,274,635	9,274,635	8.223%	11.438%		IND TRM Page 15	$ 1.47		
14	0.00	0	0	0.000%	0.000%		IND TRM Page 15	$ 1.64		
15	17.92	1,455,768	1,455,768	0.707%	1.795%		IND TRM Page 15	$ 1.64		
16	0.27	28,090	28,090	0.064%	0.035%		IND TRM Page 15	$ 1.67		
17	3.67	297,996	297,996	0.678%	0.368%		IND TRM Page 15	$ 1.67		
18	0.42	34,038	34,038	0.063%	0.042%		IND TRM Page 15	$ 1.67		
19	3.36	272,554	272,554	0.465%	0.336%		IND TRM Page 15	$ 1.67		
20	8.66	703,216	703,216	1.108%	0.867%		IND TRM Page 15	$ 1.67		
21	12.70	1,031,594	1,031,594	1.510%	1.272%		IND TRM Page 15	$ 1.67		
22	0.00	0	0	0.000%	0.000%		IND TRM Page 15	$ 1.67		
23	2.78	225,635	225,635	0.249%	0.278%		IND TRM Page 15	$ 1.67		
24	0.00	0	0	0.000%	0.000%		IND TRM Page 15	$ 1.67		
25	0.19	15,377	15,377	0.012%	0.019%		IND TRM Page 15	$ 1.67		
26	0.00	0	0	0.000%	0.000%		IND TRM Page 15	$ 1.67		
27	0.00	0	0	0.000%	0.000%		IND TRM Page 15	$ 1.67		
28	0.00	0	0	0.000%	0.000%		IND TRM Page 15	$ 1.67		
29	0.00	0	0	0.000%	0.000%		IND TRM Page 15	$ 1.67		
30	10.28	834,798	834,798	0.516%	1.030%		IND TRM Page 15	$ 3.75		
31	3.18	997,520	997,520	0.757%	0.410%		IND TRM Page 22	$ 21.00		
32	1.05	256,663	256,663	0.195%	0.106%		IND TRM Page 22	$ 21.00		
33	0.00	0	0	0.000%	0.000%		IND TRM Page 22	$ 21.00		
34	0.29	69,664	69,664	0.040%	0.029%		IND TRM Page 22	$ 21.00		
35	0.42	102,944	102,944	0.054%	0.042%		IND TRM Page 22	$ 21.00		
36	0.00	0	0	0.000%	0.000%		IND TRM Page 22	$ 21.00		
37	0.00	0	0	0.000%	0.000%		IND TRM Page 22	$ 21.00		
38	0.00	0	0	0.000%	0.000%		IND TRM Page 22	$ 21.00		
39	5.33	1,298,449	1,298,449	0.384%	0.534%		IND TRM Page 22	$ 21.00		
40	0.00	0	0	0.000%	0.000%		IND TRM Page 22	$ 21.00		
41	0.00	0	0	0.000%	0.000%		IND TRM Page 22	$ 21.00		
42	0.00	0	0	0.000%	0.000%		IND TRM Page 22	$ 28.00		
43	0.00	0	0	0.000%	0.000%		IND TRM Page 22	$ 36.00		
44	6.00	1,462,773	1,462,773	0.769%	0.601%		IND TRM Page 22	$ 21.00		
45	0.00	0	0	0.000%	0.000%		IND TRM Page 22	$ 21.00		
46	55.19	13,436,775	13,436,775	5.482%	5.524%		IND TRM Page 22	$ 7.00		
47	23.16	5,639,040	5,639,040	2.193%	2.318%		IND TRM Page 22	$ 7.00		
48	35.59	8,664,150	8,664,150	3.654%	3.562%		IND TRM Page 22	$ 7.00		
49	316.68	77,096,250	77,096,250	27.409%	31.694%		IND TRM Page 22	$ 7.00		
50	3.99	971,479	971,479	0.396%	0.399%		IND TRM Page 22	$ 40.00		
51	5.68	1,383,639	1,383,639	0.630%	0.569%		IND TRM Page 22	$ 40.00		
52	6.80	1,656,027	1,656,027	0.589%	0.681%		IND TRM Page 22	$ 40.00		
53	0.00	0	0	0.000%	0.000%		IND TRM Page 22	$ 5.00		
54	**998**	**156,441,074**	**148,094,294**	**100%**	**100%**					
55										

	O	P	Q	R	S	T	U	V	W	X
57	**Net Total Demand (kW)**	**Gross Lifetime Savings (kWh)**	**Net Lifetime Savings (kWh)**		**% of Products Gross Annual Savings (kWh)**			Incremental Cost from MEMD		
58	0.00	258947	134652	retail cost up to a	2.06%		IND TRM Page 155	$ 18.46		
59	0.00	670898	348867	retail cost up to a	5.34%		IND TRM Page 155	$ 18.46		
60	8.00	377898	196507	$ 200	2.51%		IND TRM Page 99-100	$ 304.61		
61	4.00	213543	111042	$ 300	1.42%		IND TRM Page 99-100	$ 456.91		
62	9.00	605397	314806	$ 400	4.01%		IND TRM Page 99-100	$ 609.21		
63	2.00	144179	74973	$ 500	0.96%		IND TRM Page 99-100	$ 761.51		
64	0.00	183847	95600	$ 100	1.22%		IND TRM Page 99-100	$ 703.91		
65	1.00	292873	152294	$ 200	1.94%		IND TRM Page 99-100	$ 703.91		
66	1.00	358255	186293	$ 250	2.38%		IND TRM Page 99-100	$ 703.91		
67	0.00	123231	64080	$ 300	0.82%		IND TRM Page 99-100	$ 703.91		
68	0.00	624656	324821	$ 300	4.14%		IND TRM Page 99-100	$ 703.91		
69	1.00	1891070	983357	$ 400	12.54%		IND TRM Page 99-100	$ 703.91		
70	1.00	1956453	1017355	$ 500	12.97%		IND TRM Page 99-100	$ 703.91		
71	0.00	655963	341101	$ 550	4.35%		IND TRM Page 99-100	$ 703.91		
72	59.00	770612	400718	$ 200	5.11%		IND TRM Page 87-90	$ 184.25		
73	5.00	1099500	571740	$ 150	13.12%		IND TRM Page 106-107	$ 280.00		
74	0.00	0	0		0.00%		IND TRM Page 108-109	$ 1,489.00		
75	10.00	1364080	709322	$400 / unit	16.28%		IND TRM Page 108-109	$ 1,489.00		
76	0.00	0	0		0.00%		IND TRM Page 108-109	$ 1,489.00		
77	3.00	39086	20325	$50 / unit	0.47%		IND TRM Page 146	$ 579.00		
78	7.00	93806	48779	$50 / unit	1.12%		IND TRM Page 146	$ 579.00		
79	12.00	156343	81298	$50 / unit	1.87%		IND TRM Page 146	$ 579.00		
80	0.00	26903	13989	$25 / unit	0.32%		IND TRM Page 56	$ 86.00		
81	0.00	0	0	$25 / unit	0.00%		IND TRM Page 56	$ 86.00		
82	5.00	426000	221520	$25 / unit	5.08%		IND TRM Page 76	$ 50.00		
83	0.00	0	0	$25 / unit	0.00%		IND TRM Page 76	$ 50.00		
84										
85	128	12,333,540	6,413,439							
86										
87	**1,126**	**168,774,614**	**154,507,733**					$ 2,822,533.23		

Exhibit NM-14

ACEEE, Review of Performance Incentives, June 2015

Beyond Carrots for Utilities: A National Review of Performance Incentives for Energy Efficiency

Seth Nowak, Brendon Baatz, Annie Gilleo, Martin Kushler,
Maggie Molina, and Dan York

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Dan York has more than 20 years of experience in researching, analyzing, and implementing energy efficiency policies and programs. He is widely recognized for his work tracking and analyzing trends and emerging issues in utility-sector energy efficiency programs. His entire educational and professional experience has focused on energy efficiency and conservation as the foundations for a sustainable economy. He joined ACEEE in 2001.

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Executive Summary

Performance incentives for gas and electric energy efficiency play an increasing role in the expansion of energy efficiency programs in the utility sector. These mechanisms address economic disincentives to energy efficiency traditionally faced by regulated utilities. Performance incentives provide financial rewards or earnings opportunities to program administrators, utilities, and shareholders in return for energy savings.

Incentive policies are ripe for examination as major shifts reshape the natural gas and electric utility industry and its regulation, and as efficiency performance incentive policies become more prevalent. This study accordingly updates and expands ACEEE's 2011 report, *Carrots for Utilities: Providing Financial Returns for Utility Investments for Energy Efficiency* (Hayes et al. 2011).

We asked states to submit qualitative information on energy efficiency performance incentives, as well as quantitative information on incentives in the two most recent program years. We analyzed data across all of these states, and also prepared several in-depth case studies. Our findings include the following:

- Twenty-seven states have now adopted incentives based on cost-effective achievement of energy savings targets, of which 25 are currently implementing them, and 2 states' implementation is pending. In 2011, there were 20.
- Fourteen states report having modified or fundamentally changed their incentive mechanisms in recent years.
- Regulated utilities and third-party administrators have achieved savings goals and earned incentive payments in all the states currently implementing incentive mechanisms for which we obtained complete data.
- States with performance incentives in place in 2013 budgeted $23.50 per capita on average for electric energy efficiency programs, 50% more than states with no incentive policy. We found positive correlation in 2011 as well.
- Interviewees indicated that performance incentives influence utility behavior and decision making regarding energy efficiency programs.

Based on our review, we identified four types of performance incentives:

1. *Shared net benefits incentives* provide utilities the opportunity to earn an amount equivalent to some portion of the benefits of a successful energy efficiency program. The amount is usually a percentage of the positive difference between program spending and the dollar valuation of energy savings achieved. (13 states)
2. *Energy savings-based incentives* reward utilities for achieving pre-established energy savings goals measured in kWh or therms. For example, if the utility energy efficiency programs save 100% of target, they are eligible for some particular amount of an incentive payment, often expressed as a percentage of total program spending or budget in a tiered structure. (6 states)
3. *Multifactor incentives* are those in which the calculation of performance incentive amounts include multiple metrics, not only energy savings or energy savings net benefits. For example, financial incentives may be tied to demand savings, job creation, or measures of customer service quality. (5 states)

4. *Rate of return incentives* allow utilities to earn a rate of return based on efficiency spending. This creates a correspondence between demand-side (energy efficiency) spending and supply-side (generation and transmission) investments. (1 state)

As it was in 2011, the trend continues to be for states to adopt mechanisms that incentivize cost-effective achievement of energy savings targets, and to encourage more comprehensive, longer-term performance criteria. The majority of new mechanisms adopted fall into the shared net benefits category. Among states that have modified their incentive mechanism policies, several have adjusted quantitative aspects. These include incremental changes to minimum savings levels and award amount percentages. Others have changed the type of mechanism altogether. The common intention of these changes is to enhance energy efficiency program performance by having the incentive mechanism do a better job of guiding utility and program administrator leadership to meet program goals.

The industry experts we interviewed generally agreed that performance incentives influence utility behavior and decision making regarding energy efficiency programs. Their views are in close alignment with ACEEE's 2011 findings that the ability to assign a dollar value to efficiency investments significantly contributes to utility management's commitment to pursuing energy efficiency.

Since multiple economic and policy factors influence the performance of energy efficiency programs, it can be challenging to isolate and measure the specific impacts of performance incentive mechanisms. This report shows how mechanisms have been effective in various contexts by including twelve case studies providing background, policy details, and performance results on state experience with performance incentives. We conclude that performance incentives are working in combination with other supportive regulatory policies to encourage effective energy efficiency program performance.

Introduction

Utility business models and their regulatory environment are in the midst of historic change. Performance incentives for energy efficiency are part of this change in a growing number of states. These important regulatory tools give financial rewards or earnings opportunities to program administrators, utility companies, and their shareholders for meeting energy efficiency goals.

Utility investments in energy efficiency have greatly increased since the mid-2000s. Whereas utilities invested slightly less than $1.5 billion in energy efficiency programs in 2004, investments had jumped to $7.7 billion per year by 2014 (Gilleo et al. 2014). A number of policy drivers and other factors spurred this investment. Consumers wanted to reduce their utility bills, utilities were being asked to find more economical ways to meet rising demand, and states were looking for cleaner options to meet the energy needs of businesses and residents. Investments in energy efficiency can also create jobs, put more control into the hands of consumers when it comes to how and when they use energy, and help utilities build better relationships with customers.

This increased push to include energy efficiency in utility portfolios did not happen in a vacuum. Many states have adopted regulatory mechanisms to encourage utilities to establish long-term energy efficiency programs. Replacing regulatory practices that impeded the use of energy efficiency as a resource, these new mechanisms have played a crucial role in the expansion of customer energy efficiency programs.

BACKGROUND FOR THIS RESEARCH

Effective regulatory business models are increasingly important as energy savings from utility program portfolios continue to grow. Under traditional business models, cost-effective energy savings involved negative financial impacts and lost opportunities. Now states are increasingly trying to remove the disincentive for utilities to invest in efficiency. As this report will discuss, performance incentive policies have been one of their most effective tools.

This study builds on prior ACEEE research reported in *Carrots for Utilities: Providing Financial Returns for Utility Investments for Energy Efficiency* (Hayes et al. 2011). Since the publication of that report, states providing incentives have gained more experience with them, several new states and utilities have implemented incentives, and many have refined incentive structures already in place. This new report is an updated look at performance incentive mechanisms in states that have implemented or enacted them. We set out to find answers to the following questions:

- What types of performance incentives are being used, and how many states are implementing each type?
- How much money is being invested in each type of mechanism, and how does this compare to total utility energy efficiency budgets and spending?
- Do they work? Do knowledgeable experts at commissions and in the field see the incentives influencing utility behavior?
- What elements should be considered in designing energy efficiency performance incentives in various circumstances?

In answering these questions, we describe incentive structures, report recent data on the dollar amounts awarded, and examine outcomes and lessons learned.[1] We also summarize the insights of regulatory staff and other stakeholders into how performance incentives motivate utilities and other program administrators to institute high-performing energy efficiency programs.

UTILITY ECONOMIC DISINCENTIVES REGARDING CUSTOMER ENERGY EFFICIENCY PROGRAMS

The objective of reducing sales through customer energy efficiency measures is in conflict with the traditional US utility business model. Under this model, regulators set revenue requirements for a utility by aggregating all of its costs of providing service. They then calculate the rates necessary to recover that amount plus some acceptable return to the utility. As noted by the Regulatory Assistance Project (RAP 2011), regulators traditionally rely on two formulas:

Revenue requirement = Expenses + Return + Taxes
Rate = Revenue requirement / Units sold

In the first formula, "Expenses" refers to items such as fuel costs, operations, and maintenance. For the purposes of this explanation, "Return" may be thought of as the utility's profit. The utility is allowed to earn a set rate of return on its capital investments in assets including pipelines, electric generation facilities, and transmission lines.

The traditional business model linking cost recovery to volumetric sales of energy gives utilities the incentive to sell more electricity or gas, which increases revenues and associated profits. Rates are determined by a test year. If the utility can subsequently sell more units of energy than were used to calculate its rate in the test year, it can earn more than its revenue requirement.

This model has worked well for decades to meet its primary goal: to attract the enormous amount of capital needed to build the transmission, distribution, and generation infrastructure for a vast and growing system. Today, however, the model is being challenged by new realities such as slow or no growth in sales, competition from nonutility players, changing business models, and larger roles for energy efficiency and distributed generation (Nadel and Herndon 2014).

The traditional regulatory approach involves a number of disincentives to utility investment in energy efficiency (York et al. 2013). First, the costs of efficiency programs constitute financial losses to utilities unless they can recover those costs through rates or fees. Second, these programs drive down energy use and so reduce utility revenues without lowering the short-term fixed costs of providing service. This goes counter to utilities' incentive to sell more energy and earn more profits—often called the throughput incentive. Third, utilities normally realize a return on their investment when they fund capital assets like power

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[1] Some state energy efficiency programs are run by third-party administrators, which we sometimes refer to as utilities. We also call Washington, DC a state for simplicity.

plants. Although efficiency programs reduce the need for this capital spending, they do not provide a comparable return.

REGULATORY APPROACHES TO ADDRESSING DISINCENTIVES

While there are clear disincentives for utilities to invest in energy efficiency under the traditional business model, there are strategies to address these disincentives as a means of encouraging more energy efficiency. Many states have adopted some or all of the following adjustments to the utility regulatory structure, thanks in part to a diverse set of stakeholders who can all agree that energy efficiency presents opportunities to both utilities and the public.

Program cost recovery allows utilities to recover the cost of energy efficiency programs through rates. It is widely accepted and not controversial. Typically, regulators allow utilities to treat efficiency program costs as expenses and to recover them through rate increases. Investments in energy efficiency program are also sometimes capitalized rather than treated as expenses. If capitalized, then the utility may raise rates to earn a return on the funds it invested in efficiency.

Finding a solution to the throughput incentive is a more complicated task. The most straightforward solution is *decoupling*.[2] Decoupling breaks the link between the amount of energy a utility sells and the revenue it can collect (RAP 2011). Rates are adjusted upward or downward as actual sales come in below or above forecast. Thus the utility is able to recover its investment and operating costs independent of actual electricity or gas sales. Conversely, the utility cannot exceed its revenue requirement no matter how much energy it sells. Its revenue is decoupled from the amount of energy its customers use.

Decoupling is in place in 24 states for electric or natural gas utilities or both (Morgan 2012). Three states have electric-only decoupling, 11 states only gas, and there are 10 states with decoupling for both (Gilleo et al. 2014). We count a state as having decoupling if at least one electric or gas utility is decoupled.

As an alternative to decoupling, many states have opted to address the throughput incentive with a slightly different regulatory tool—a *lost revenue adjustment mechanism (LRAM)*. Unlike decoupling, an LRAM does not completely break the link between a utility's sales and its revenues. Instead, an LRAM allows a utility to recover revenues that were reduced, not just due to any cause, but specifically as a result of energy efficiency programs.

There are two other distinctions between decoupling and LRAM. First, LRAM requires a calculation of energy efficiency program energy savings over a given period of time.[3] Decoupling does not require this calculation; it simply compares the volume of total sales to forecasted levels. Second, unlike decoupling, LRAM is generally not symmetrical. As

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[2] Decoupling is recommended by ACEEE and numerous industry, nonprofit, and policy groups including the Natural Resources Defense Council, Regulatory Assistance Project, American Gas Association, and others.

[3] In practice, states estimate energy savings to varying degrees, with some putting greater focus on evaluated savings than others.

discussed above, decoupling can result in either refunds or surcharges, depending on whether actual sales are above or below forecast. With LRAM, a utility can recover lost revenues from efficiency programs (under the rationale that it is under-collecting revenues due to reduced sales). However rates are not adjusted downward if the utility experiences a higher volume of sales than predicted in the rate case forecast.[4] LRAM is addressed in detail in a companion report to this one, *Review of Lost Revenue Adjustment Mechanisms* (Gilleo et al. 2015).

While decoupling potentially removes the disincentive to pursue energy efficiency, utilities with only decoupling in place still lack a positive incentive for efficiency, something that utilities and their investors would prefer to have as well.[5] Decoupling may provide a financial benefit to utilities by reducing the risk that efficiency efforts will lower utility returns, and it may make utilities modestly safer investments and more secure borrowers. However benefits are less direct than the ones offered by the traditional model of selling electricity or natural gas for a guaranteed rate. For this reason, utilities, regulators, and other stakeholders have looked for a more direct way to incentivize efficiency investments. Performance incentives can provide that way.

Performance incentives, the subject of this report, offer a utility financial rewards for saving energy through efficiency programs. Incentives allow the utility's energy efficiency activity to be a source of earnings rather than just a pass-through expense. This puts energy efficiency investments on the same footing as other types of utility investments (e.g., in new power plants or transmission and distribution) that are allowed to earn a rate of return. Incentives help compensate the utility for the earnings opportunities it forgoes when it does not have to invest as much in its supply infrastructure because of reduced demand.

PERFORMANCE INCENTIVES

Four Ways to Calculate Incentives

While energy efficiency performance incentive mechanisms vary from state to state, they fall into four general categories of ways to calculate incentives: 1) as a share of net benefits, 2) energy savings-based incentives, 3) multifactor, and 4) rate of return.[6] Virtually all of these performance incentive mechanisms have a threshold level set as the achievement of a minimum amount of energy savings. Some incentive policies may fall under more than one category. Each incentive calculation type is described below.

Shared net benefits. Shared net benefits mechanisms provide utilities the opportunity to earn some portion of the benefits of a successful energy efficiency program that otherwise would all go to the ratepayers. The incentive payment amount is usually a percentage of the positive difference between the costs (efficiency program spending) and the benefits (the

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[4] Some states do have requirements in place meant to prevent utilities from over-earning under an LRAM.

[5] Decoupling approaches vary from state to state, and sometimes differ by utility in the same state. For more information, see RAP 2011. The relationship between a utility's cost of capital and the rate of return allowed by regulators is a determining factor concerning whether the disincentive for efficiency has been effectively removed or not. Also see Kihm 2009.

[6] There are many ways to categorize incentive mechanisms. See also the similar but not identical categorization in Cappers et al. 2009.

dollar valuation of energy savings achieved as a result the program). This category has a savings-based element, in that most of them have a threshold level set as the achievement of a minimum percentage of the energy savings performance goal for the utility. We call it shared net benefits because the incentive amounts are driven by net benefits; the greater the net benefits, the higher the incentive payment amount.

Energy savings-based. Savings-based incentives reward utilities for achieving, and sometimes for exceeding, pre-established energy savings goals, measured in kWh or therms. Often, these energy savings targets for utilities may be tied to or derived from statewide energy efficiency resource standard (EERS) policies. For example, if the utility energy efficiency programs save 100% of target, they are eligible for some particular amount of an incentive payment. Five of the six states with savings-based incentives have EERS. The amount of the financial incentive the utility earns is often calculated as a percentage of total program spending or budget in a tiered structure (e.g., achieve 100% of the savings target, receive an amount equivalent to 6% of the program spending; achieve 110% and receive 8%; and so on), but driven by the program energy savings achieved.

Multifactor mechanisms are those in which the calculation of performance incentive amounts are more complex and include multiple metrics. Energy savings are just one of several metrics that are used to determine the amount of incentive earned. This type of approach is found in a handful of states where the mechanism is used to forward the achievement of several regulatory and public policy goals at the same time. For example, financial incentives may be tied to demand savings, job creation, or measures of customer service quality.

Rate of return incentives are a fourth approach and are far less common. Rate of return incentives allow utilities to earn a rate of return based on efficiency spending. This creates a correspondence between demand-side (energy efficiency) spending and supply-side (generation and transmission) investments. For example, a utility may earn a rate of return for efficiency investments equivalent to or comparable to the rate it earns for new energy supply capacity investments.[7]

The Special Case of Non-Utility Program Administrators

An additional special category of performance incentives applies to situations where states have non-utility program administrators for their utility ratepayer-funded energy efficiency programs. These companies are contracted third parties that administer and implement energy efficiency program portfolios. Many of the concerns about utility earnings opportunities do not apply in these circumstances. As a class, the contract administrators in these cases differ from investor-owned utilities in their organizational and financial structures and the regulatory and policy frameworks in which they operate.[8] Examples include Efficiency Vermont, Wisconsin Focus on Energy, and Hawaii Energy. The common

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[7] Amortizing the recovery by the utility of the cost of programs over multiple years may also be considered a rate of return incentive in some instances, if the utility earns a return on the balance after the first year.

[8] Municipal utilities, a third category of energy efficiency program administrator in addition to investor-owned utilities and third-party administrators, will be the topic of upcoming ACEEE research.

element for the purposes of this study is the desire to incentivize good performance by whoever is administering the programs. Third-party administrators have argued that performance incentives motivate excellence and maximize savings and cost-effective performance.

Therefore we have included non-utility program administrators along with the investor-owned utilities in our discussion of the four ways of calculating incentives. As it turns out, all of the currently operating independent administrators that have incentive mechanisms also have multifactor performance incentives. However the structures and calculation methods of the incentive mechanisms vary substantially from state to state. We discuss the details later in this report.

Methodology

We sent research questionnaires to public utility commission staff in each state that our records indicated had implemented performance incentive policies or where policies were pending. We only reached out to states for which our previous research had identified energy efficiency performance incentives.[9] Commission staff were asked to submit both qualitative and quantitative data on the incentive structures in place for electric utilities, gas utilities, or both. In total, we emailed questionnaires to 43 individuals, almost all of whom are public service commission staff members, in 29 states. We found that in some states performance incentives were no longer in effect or had not yet been implemented. In those cases, we did not make any further attempts to include them in our analysis or discussion in this report.

The questionnaires requested qualitative and quantitative data. We asked respondents about the nature and structure of the performance incentive mechanism or mechanisms in their state, and requested them to provide citations and documentation. The quantitative data we asked for (on two utilities, for two program years, for up to two mechanisms) was the incentive amount, total energy efficiency program costs (spending or budget), and energy savings achieved in kWh or therms. See Appendix B for a copy of the questionnaire.

In instances where we did not obtain a completed research questionnaire, we collected some of the data through phone interviews, regulatory filings, or other documents. Some of our state contacts returned the questionnaire but indicated that at least some of the data we had requested was unavailable or unclear. In particular, some states did not have the numbers ready for recent program years due to the length of their regulatory processes. For example, procedures for estimating energy savings or conducting evaluation, measurement, and verification of those results, and then having finalizing the amounts of the performance incentive, may take years in some cases.

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[9] Our previous research includes Hayes et al. 2011 and Gilleo et al. 2014. It is possible that we missed additional states with utility incentives policies in those projects, in particular if they use a rate of return approach to amortize program costs and may not have categorized it as a performance incentive. For a recent listing of performance incentive policies by state, see IEI 2014.

Next we identified states representing a diversity of types of incentive mechanisms for additional research, making an effort to include those states leading the nation with the most extensive or exemplary energy efficiency portfolios and policies, states with geographic diversity, and a diversity of program-administrator types. For these, we conducted more extensive phone interviews with our contacts to get a deeper understanding of how the incentives function in practice, how they were intended to work in those states, and lessons learned. We then chose a group of these states to examine more closely for case studies. Case studies of Arizona, Arkansas, California, Indiana, Massachusetts, Michigan, Minnesota, Missouri, Oklahoma, Rhode Island, Texas, and Vermont are in Appendix A. The last steps in the data-gathering process were telephone interviews with other key stakeholders in this smaller subset of states, including utility representatives, consumer counsels, and advocates, and follow-up documentary research for the case studies.

Results

Our research identified 27 states with performance incentives for electric energy efficiency and 16 for natural gas energy efficiency. All states with incentives for gas efficiency also have incentives for electric efficiency. A few state respondents indicated that their states have performance incentives established for all regulated utilities. In other cases incentives for energy efficiency only apply to a subset of utilities in the state. Many energy efficiency performance incentives have been in place for a decade or more; most have been revised or reformed via legislation or new regulation in a series of iterations. Mississippi and West Virginia have not implemented their mechanisms yet.

Figure 1 shows the primary incentive mechanism type by state.

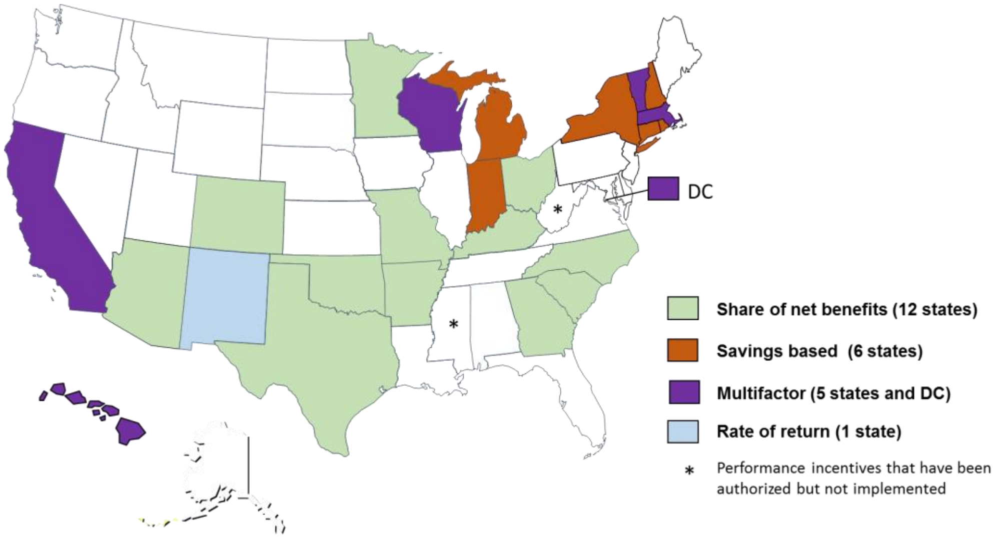

Figure 1. Primary incentive mechanism type by state. Incentive may apply to one or more regulated utilities, or to a statewide program implementer. Individual state information on performance incentives for electric and natural gas energy efficiency may be found on the ACEEE state energy efficiency policy database at http://aceee.org/sector/state-policy.

Shared net benefits energy efficiency performance incentives are the most common, seen in 13 states. We count Massachusetts in this group, although until the end of 2014 the calculation of incentives included additional performance indicators. Energy savings-based incentives are the second-most prevalent mechanism type, with six states employing this approach. Washington, DC and four states use multifactor approaches. One state, New Mexico, pays a rate-of-return incentive on energy efficiency program investments paid by the utilities.

Of the 16 states with both gas and electric energy efficiency performance incentives available, none indicated that there are significant differences between the incentive mechanisms as applied to electric versus gas utilities.

Performance Incentives: Historical Background

The historical origins of performance incentives and their rationales vary from state to state. While there are some common themes, the regulatory, policy, and economic circumstances differ enough to defy generalization, as seen in these examples.

Massachusetts' first incentives were for New England Electric in the early 1990s. The state lowered the level of performance incentives and introduced decoupling during the mid-1990s. The primary motivation for having performance incentives has been to achieve energy savings goals. The ability of the utilities to earn a return on energy efficiency spending persuades them to align their goals with public policy goals.

Since the 1980s California had decoupling in place. However, in an effort to move toward deregulation during the late 1990s, California suspended decoupling. After the 2001 electricity crisis occurred, the state then reinstated decoupling over the next three years and moved to expand energy efficiency. In 2005, the California Public Utilities Commission added performance incentives in the form of the Risk Reward Incentive Mechanism to encourage greater efficiency. Unlike many states, the regulations at that time also included financial penalties if program performance results were not sufficiently in line with energy savings goals.

Oklahoma's utility performance incentives arose from an investor-owned utility approaching the Corporation Commission in a rate case, resulting in a commission order requiring the development of quick-start energy efficiency programs. The utility came back with a proposal including programs, a rider for cost recovery, lost revenue recovery, and a 25% shared-savings performance incentive mechanism. When it came time for full compliance programs, i.e., no longer only quick-start, the utilities were still allowed to seek lost revenues attributable to energy efficiency through an LRAM. The incentive was reduced from 25% to 15%. Oklahoma has decoupling for gas, but not electric utilities.

In Rhode Island, energy efficiency programs and utility performance incentives were both instituted years prior to decoupling. Performance incentives for energy efficiency were viewed at that time as one factor that allowed the utilities to support least-cost procurement.

Vermont's statewide energy efficiency utility, Efficiency Vermont, has had quantitative performance indicators to determine the financial incentives since 2000. Vermont Energy Investment Corporation (VEIC) was hired explicitly on a performance-based three-year contract basis, so having incentives was a logical element. In 2011 VEIC was engaged as an efficiency utility via a long-term order of appointment, but the performance incentive continued.

DESCRIPTIVE RESULTS

While the circumstances in which energy efficiency performance incentive mechanisms arose vary considerably from state to state, there are common aspects to how the mechanisms themselves are structured. Almost all have a threshold, or minimum percentage of an energy savings goal, which the utility must exceed in order to be eligible for earning any incentive. Similarly, almost all incentive mechanisms have a cap, or maximum limit, on the amount. Some caps are absolute dollar amounts, such as in those states that budget a set pool of funds from which incentives may be awarded. Other caps are relative, expressed as a maximum percentage of program budgets or percentage of total net benefits. A third near-universal characteristic is that they all provide greater rewards for additional energy savings up to the level of the maximum incentive.

The following three tables summarize three aspects of the mechanisms: threshold, structure, and cap. The first table provides information on states with shared net benefits incentives, the second is for savings-based incentives, and the third is for multifactor incentives. Some of these state policies have elements of more than one type of incentive. In those cases, we list the state in the category with which it shares the main characteristics.

Reading the Tables

Threshold requirements. The left-hand column shows threshold requirements, i.e., minimum requirements for the incentive to be awarded. These are most frequently expressed as a minimum energy-savings performance measure that must be met for the utility or program administrator to be eligible, or potentially eligible, for financial incentives. For energy savings as a percentage of the utility goal or target, the minimum ranges from 50% to 100% of goal for those that have a minimum.

Overall incentive structure. The center column, overall incentive structure, briefly summarizes distinguishing elements of the incentive mechanism basis or calculation.

Cap or maximum incentive. The right-hand column, the cap or maximum incentive, indicates if there is a limit on how much a utility or administrator may earn for extraordinary energy efficiency program portfolio performance, and if so, how the limit is described or determined. Some of the caps are statewide or for all regulated utilities rather than on a by-utility basis. For example, a statewide pool of funds may be allocated to utilities based on their relative performance to each other, or their performance may be independently considered against a predetermined energy savings goal.

Shared Net Benefits

As shown in table 1, the most common thresholds for shared net benefits mechanisms are in the range of 70–85% of energy savings targets. Typically the amount of the incentive itself is calculated as percentage of the net benefits of energy savings achieved. The types of caps vary.

Table 1. Shared net benefits utility performance mechanisms overview: threshold, structure, and cap

State	Threshold requirements	Overall incentive structure	Cap or max incentive
AR	80% of net energy savings target	10% of net benefits with cap	Range from 4% to 8% program budgets
AZ	85% of gross savings goal	For 2013, 6–8 % of net benefits; capped based on percent of program costs. For 2014, $0.0125 per kWh saved.	$0.0125 per first-year kWh saved starting in 2014
CO	80% of net energy savings goal	1% net benefits for 80% of savings goals, 5% at 100%. 1% more for each 5% to max 15% at 150%. $5 million pretax disincentive offset for > 100% of electric savings goals; $3.2 million if 80-99%.	$30 million max performance incentive and disincentive offset
GA	50% of projected net energy savings	8.5% NPV actual net benefits of verified kWh savings. If annual incremental kWh savings is less than 50% of projected, will be 0.5% for demand response (DR) measures and 3% for energy efficiency (EE) measures.	No cap
KY	None	From 10% to 15% of net benefits for EE programs, excluding public education and pilot programs.	No cap
MN	Energy savings = lesser of 0.4% of retail sales or 50% of last five years' average gross savings	As energy savings levels increase to 1.5% of retail sales, utilities receive an increasing share of net benefits, up to an incentive level of and average of 7 cents per first year kWh saved. Varies by cost effectiveness of implemented projects.	Average incentive may not exceed $0.0875/first-year kWh saved or $6.875/MCF, nor exceed 20% of net benefits
MO	70% of approved three-year net savings target	Tiered or graduated scale, ranging from 70% to 130% of cumulative three-year savings target. Specifics vary by utility. For example, achieving 70% of savings goal pays 4.6% of net benefits, up to 6.19% for 130% or more, for Ameren Missouri. Others similar.	Percentage shared net benefits capped per utility; no cap on dollar amount
NC		Data not available	
OH		Data not available	
OK	2015 will be pass cost-effectiveness test and 80% of net goal savings	15% of net benefits	Previously no cap; in 2015 the cap will be 15% of net benefit
SC	Programs as a whole must pass the UCT	(6% SCE&G; 11.5% DEC) * [(net kWh and kW savings over measure life * avoided costs) -- program costs] Amortized over five years for SCE&G	No cap
TX	100% of gross savings goal	1% of the net benefits for every 2% that the demand reduction goal has been exceeded	Max of 10% of a utility's total net benefits

Source: Public utility commission staff responses to questionnaires

Savings-Based

For savings-based mechanisms, shown in table 2, all the threshold requirements include achieving a minimum percentage of energy savings goals. The most frequent method of calculating incentive amounts is a tiered percentage of energy efficiency spending that increases as energy savings performance does relative to savings targets. Caps are also typically calculated as a percentage of energy efficiency spending.

Table 2. Savings-based utility performance mechanisms overview: threshold, structure, and cap

State	Threshold requirements	Overall incentive structure	Cap or max incentive
CT[1]	75% of net savings goals for 2014; for 2015, threshold is 80%	In 2014, 2% of program spending at 75% of saving goals. At 135% or more of a goal, max is 8% of program spending. Awarded on a scale. 80% of savings goals earns 2.5%.	8% of program costs
IN	60% or 65% annual gross kWh savings target achieved	IPL, Vectren, and Duke have tiered structures tied to program costs. I&M has a shared savings mechanism. Structure ties level of kWh achieved relative to set target to a percentage of program costs that the utility may receive as performance incentive.	15% of program costs
MI[2]	Utility System Resource Cost Test (USRCT) of 1.25 and minimum 100% target savings	Sliding-scale incentive awarded when net savings exceed 100% of target, starting at 5% of spending; varies by utility. Highest rate of incentive for savings performance is 10%.	Lesser of 25% of net benefits or 15% of program costs
NH	Benefit-cost ratio of 1.0 and 55% of plan savings. Apply separately to residential and commercial and industrial sectors.	Electric utilities: 7.5% at and above 55% total lifetime energy savings; 6.0% applies below 55% total lifetime energy savings. Natural gas utilities: baseline incentive of 8%.	Electric: max 10% at 55% savings and up; 8% under 55%. 5% cap each on kWh and cost effectiveness components. Gas: 12% of costs
RI	75% of target net savings	Target incentive is 5% of spending budget.	Max incentive 6.25% of approved spending budget

State	Threshold requirements	Overall incentive structure	Cap or max incentive
NY[3]	80% of the utility's net savings goal	Linear increase from 80% to 100% of each utility's share of statewide total. Step 1 incentive: 90% of maximum possible award if utility achieves 100% of its savings goal. Step 2 incentive: remaining 10% share of statewide maximum as bonus if statewide savings goal achieved.	100% of utility share of statewide $50 million pool for gas and electric over four years based on percentage savings goals

[1] One respondent in Connecticut summarized its performance incentive mechanism type as rate of return, although many of its features are of the savings-based type. [2] Michigan performance incentives for energy efficiency vary by utility and may reward multiple performance outcomes including minimum numbers of low-income customers served, demand savings, and participation in certain multi-measure programs. While predominantly saving-based, they might also be reasonably grouped with multifactor incentives. [3] New York has expressed the maximum amount of the incentive pool both as a percentage of total program costs and in terms number of basis points of the return on equity of an investor-owned utility. *Source:* Public utility commission staff responses to questionnaires.

Multifactor

The multifactor mechanisms are more varied from state to state, as shown in table 3. Where the energy efficiency programs are run by third-party administrators, the performance incentives accrue to those companies, not the electric and gas utilities.

Table 3. Multifactor performance mechanisms overview: threshold, structure, and cap

State	Threshold requirements	Overall incentive structure	Cap or max incentive
CA	No minimum level of energy savings specified in the CPUC order. Incentive amounts are a linear function of net lifecycle savings in kWh, MW, and MMTherms multiplied by an earnings rate coefficient.	Energy savings performance award, 9% of resource program budget (minus codes and standards [C&S]) used to determine lifecycle savings coefficients; ex ante review performance award, 3% of budget times Engineering Compliance Score; C&S program management fee, 12% of C&S program budget spending; non-resource program management fee, 3% of non-resource program budget spending.	Now: up to percentages listed for each area. Was: risk/reward incentive mechanism, capped at $150 million/year for all IOUs.
DC	Reduce per-capita energy use, add renewable generating capacity, reduce peak electricity demand growth, improve low-income housing EE, reduce largest energy users' energy demand growth, add green jobs	Contractor gets 25% of at-risk compensation allocated per benchmark for electricity consumption reduction = 0.5% annual reduction in 2009 weather-normalized electricity consumption in DC. Each 0.25% beyond initial 0.5% contractor gets additional 12.5% of incentive allocated to this benchmark.	Maximum at-risk compensation in Year 1 of $300,000, increasing up to $800,000 in program years four through seven
HI	75% of target for each indicator, including first-year kWh savings, peak demand reduction, total resource benefit, inter-island equity, and others	The contract administrator proposes targets for each indicator (e.g., XX GWH in energy savings). Each target includes 75% minimum and 125% maximum achievement amount. Financial incentives are based on percentages allocated to each indicator.	Yes. Incentive amount is flat $700,000; may earn extra $133,000 for performance 25% above target.

State	Threshold requirements	Overall incentive structure	Cap or max incentive
MA *	Statewide threshold 76.72% of savings goal; adjustments for each program administrator.	Statewide incentive pool allocated to: (1) 56% savings mechanism, (2) 35% value mechanism, (3) 9% performance metrics; set payout rates for savings and value components, incentive thresholds, and caps	125% of incentive amount related to the achievement of target savings for each utility.
VT	Efficiency Vermont (EVT) has a number of quantifiable performance indicators (QPIs). Each has a different threshold. Some are minimums, where EVT loses some fraction of incentive if it fails to reach threshold. Others scale down, with no minimum.	EVT has QPIs. Some are minimums that result in reductions to EVT's compensation if not met. Others scale up with increased performance. Incentive structure was based on prior three-year performance period. QPIs for 2015–2017 period include performance indicators (PIs) and minimum performance requirements (MPRs).	For 2015–2017, cap is 4.5% of implementation budgets. Of that, split is 40% operations fee, 60% incentives. For some QPIs, cap varies by indicator.
WI	Based on annual gross life-cycle energy savings and demand reduction of 6 million MWh, 288,000 thousand therms, and 83.77 MW.	Set amounts (not sliding scale) available for performance more than 120% of annual savings goal and for customer service measures; includes penalties for under-achievement on all metrics.	$750,000 total maximum for the four-year period

* Current Massachusetts regulation has removed the 9% for performance metrics, meaning that the performance incentive mechanism going forward may no longer be best categorized as multifactor incentive. The description here applies to the mechanism as it was in 2014. *Source:* Public utility commission staff responses to questionnaires.

The diversity of incentive mechanism structures and methods of calculation in the multifactor incentive group reflects both the intended performance outcomes (i.e., those components in addition to cost-effective energy savings) and the types of organizations (i.e., not only utilities). See examples of multifactor incentives in table 4.

Table 4. Multifactor performance incentives components and type of program administrator by state

State	Administrator or program name	Multifactor mechanism components (abbreviated list, illustrative only)	Administrator organization type
DC	DC Sustainable Energy Utility	Contract includes benchmarks for per-capita energy consumption, renewable energy generating capacity, growth of peak electricity demand, energy efficiency of low-income housing, growth of the energy demand of DC's largest energy users; and the number of green-collar jobs	Third-party administrator: nonprofit energy services organization
HI	Hawaii Energy Efficiency Program	Energy savings, net benefit, demand reduction, island, and other factors	Third-party administrator: for-profit private contractor

State	Administrator or program name	Multifactor mechanism components (abbreviated list, illustrative only)	Administrator organization type
MA *	Regulated utilities	56% savings mechanism (total benefits), 35% value (net benefits) mechanism, and 9% to performance metrics. Metrics include number of correct installations, market penetration, and others.	For-profit investor-owned utilities
WI	Wisconsin Focus on Energy	Annual gross energy savings targets. Key performance indicators (KPIs), customer satisfaction measured versus baseline and days incentives outstanding (a measure of how quickly participants get financial incentive payments).	Third-party administrator: For-profit private contractor

*** Current Massachusetts regulation has removed the 9% for performance metrics, meaning that the performance incentive mechanism going forward may no longer be best categorized as multifactor incentive. The description here applies to the mechanism as it was in 2014. *Source:* Public utility commission staff responses to questionnaires.**

Rate of Return

We do not include a table displaying rate-of-return incentives, because New Mexico is the only state we surveyed to have a rate-of-return mechanism in place. We define rate-of-return mechanisms as those that provide a financial return on energy efficiency spending without tying the financial award directly to energy savings.[10] This is in marked contrast to other states that pay incentives for energy efficiency portfolio performance, whether as measured by energy savings, the net benefits of energy savings, or those metrics combined with additional quantified performance outcomes, as is the case with multifactor incentive mechanisms.

There is no minimum energy savings threshold for New Mexico's regulated investor-owned electric and gas utilities to be eligible for the financial incentive. However there is an indirect performance threshold because program spending is budgeted to be 3% of utility retail sales, evaluated programs must meet cost-effectiveness criteria, and there is a statewide energy efficiency resource standard. By stipulation, regulators have established an annual incentive for calendar years 2014–2016 that is equal to 7% of program expenditures; both efficiency spending and incentives are budgeted by utility and then trued up annually. Utilities must demonstrate that the energy efficiency programs they propose to the New Mexico Public Regulation Commission are cost effective using the total resource cost test (TRC) and the utility cost test (UCT).

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[10] Kentucky statute also allows the commission to approve a financial return on efficiency spending; in practice, they have used a shared net benefits approach. Amortizing the recovery of the cost of programs over multiple years may also be considered a rate of return incentive in cases in which the utility earns a return on the balance after the first year. This is the case in Maryland. Vermont Gas Systems (VGS) receives a return on approved energy efficiency spending and their recovery of energy efficiency costs is amortized over three years. This was not considered to be a performance incentive by those we spoke with in Vermont.

COMPARATIVE RESULTS

To provide a quantifiable basis for analysis of these types of incentives, we examined incentive amounts relative to energy efficiency program costs. We recognize that there are many differences among jurisdictions in terms of policies and performance. Comparing ratios of incentive amounts to program costs is still a useful and straightforward means of comparison. Note that the following data are not normalized by the extent to which energy savings goals were achieved or exceeded, nor are these organized into tiers by the absolute levels of energy-efficiency spending or savings.

To make these comparisons, we collected data on the dollar amounts of performance incentive financial awards by utility for the two most recent program years or program cycles for which these amounts were readily available. Most states submitted data for the largest one or two regulated investor-owned utilities, as we had requested. In most cases these were electric utilities. As one means of normalizing the data across states, we calculated the ratio of incentive amount to energy efficiency program cost by utility or program administrator. For energy efficiency cost, we used either total annual program spending or budget, as provided by regulatory staff contacts.

Next we sorted the utilities into groups by type of incentive mechanism employed in their respective states applicable to the reported utilities. This provided us with data for the ratio of performance incentive amounts to annual energy efficiency costs. For years in which both data points were available, there were 24 instances of shared net benefits, 14 of utilities with savings-based incentives, 12 of administrators or utilities with multifactor incentives, and 1 rate of return mechanism, for a total of 51 data points. These data are presented as reported by respondents and therefore may vary in their methods of calculation across states. Our aim is to provide a relative basis for comparison and contrast, not to claim a definitive measure.

In figure 2, the gray boxes indicate the inter-quartile range of data around the median. The vertical lines indicate the full range from the lowest to highest.

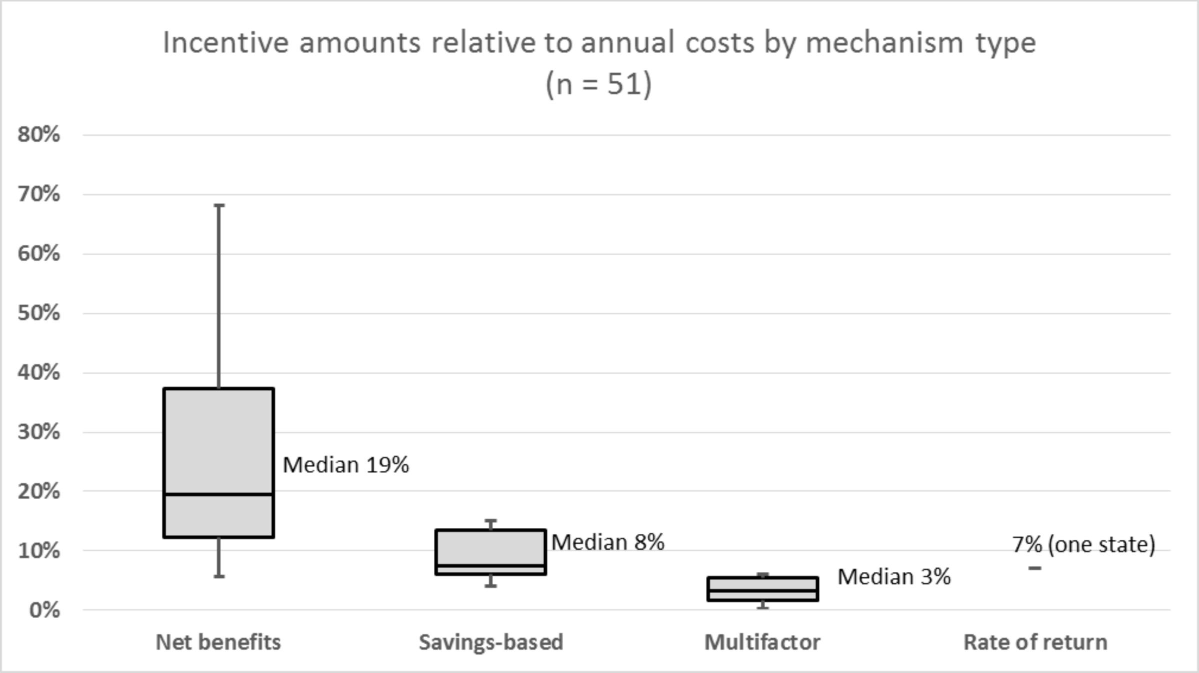

Figure 2. Incentive amounts relative to total annual energy efficiency costs by mechanism type. *Source:* Derived from public utility commission staff responses to questionnaires.

Shared Net Benefits

The eight states reporting performance incentives based on the net benefits provided by energy efficiency pay out, on average, the highest financial awards relative to annual costs. Often, the benefits are calculated over the full measure life and not just for one year. This means the incentive is front-loaded.[11] This may be one reason net benefit incentive amounts are often higher than is the case with other approaches. They are still generally lower than earnings on supply-side investments over the life of those investments, realized in net present value.[12] Of the 24 ratios reported here, the highest is 68%, the lowest is 6%, and the median is 19%. This is significantly higher than the ratios in states using other approaches to calculating incentives. Only 7 of the 26 award amounts reported from states using multifactor or energy savings-based incentive calculation methods were 8% of energy efficiency program costs or higher. The highest ratios in the data set in the chart are from 2011 and 2012 for two Minnesota electric utilities and are not representative of incentive amounts for the majority of shared net benefits mechanisms. These utilities had neither LRAM nor decoupling mechanisms in place during those years, which may partially explain the higher ratios. For further discussion, see the Minnesota case study in Appendix A.

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[11] States have a variety of approaches to how they calculate net benefits and how many years constitute the measure lives. Often measure lives are determined in a technical reference manual (TRM).

[12] See https://www.pge.com/regulation/EnergyEfficiencyRisk-RewardIncentiveMechanismOIR/Pleadings/NRDC/2010/EnergyEfficiencyRisk-RewardIncentiveMechanismOIR_Plea_NRDC_20101206_203020.pdf.

Savings-Based

The savings-based award-to-cost ratios are generally in the middle of the dataset in terms of incentives as percentage of spending, though substantially below net benefits, as seen in figure 2. Of the 14 energy savings-based award amounts included here, relative to energy efficiency costs, the ratios ranged from a low of 4.2% to a high of 15%, with a median of 8%. As defined above, savings-based incentives reward utilities for achieving pre-established energy savings goals, measured in kWh or therms. These may be tied to or derived from statewide energy efficiency resource standards (EERS). For utilities that over-comply with energy savings goals, i.e., achieve more than 100% of their targets, the maximum incentive dollar amounts impose an upper limit on how much energy savings beyond target is eligible as well, since the two are tied together.

While the amount of the financial incentive the utility may be eligible for is generally expressed as a percent of total program spending or budget in a tiered structure or a proportionate scale, we have chosen not to describe these as spending-based incentives, since eligibility is based on savings, not spending. Also, the term "savings-based" distinguishes them from those we are calling rate-of-return incentives.

Multifactor

Multifactor incentive amounts are the lowest when compared per dollar of costs budgeted or spent on efficiency programs. The median for multifactor awards is 3% as a percentage of energy efficiency spending. The highest multifactor ratio is 6.5%. The lowest ratio included here is approximately two-tenths of 1%, for Wisconsin Focus on Energy, a third-party administered portfolio. This ratio is derived from the highest incentive payout possible to the contract administrator under the contract; the actual amount for the first four-year period has yet to be calculated and paid out and is contingent on both energy savings and customer service metrics.

Most multifactor energy efficiency performance incentives are for third-party administrators. This subcategory of multifactor incentives has the lowest awards as a percentage of program costs. The incentives they receive or may be eligible for, for meeting and exceeding energy savings goals, average just 1.8%, ranging from 0.2% up to 3.5%.

Performance incentives for non-utility program administrators generally are structured and perform differently than those for utilities. This is not surprising because third-party administrators are different economic entities than investor-owned utilities. For example, they do not have the revenue-loss disincentive that utilities face with regard to customer energy efficiency. Also, program administrators that are private firms typically would already have some profit margin built into their contract for services, and a performance incentive may simply be a bonus on top of that. These factors could justify a lower performance incentive percentage than might be received by a utility. Conditions and factors that influence setting incentive levels are reviewed in the Discussion section below.

Rate of Return

Since the New Mexico incentive mechanism is relatively new, we do not have data on amounts that will be paid out. However, since it is not dependent on performance outcomes in the same manner as other states, we can predict that the payments will be 7% of actual energy efficiency spending for all the eligible regulated utilities.

In the Commission Order on case 12-00317-UT, *Final Order Partially Adopting Recommended Decision*, the commission determined the following:

> The financial incentive provided by the EUEA [Efficient Use of Energy Act] is the opportunity for a utility "to earn a profit on cost-effective energy efficiency and load management resource development that, with satisfactory program performance, is financially more attractive to the utility than developing supply-side utility resources." NMSA 1978, § 62-17-5(F) (PNM 2013)

With supply-side generation as the frame of reference, the design and description of the rate-of-return incentive follows naturally. The payment of the incentive to the utility may even be included in base rates similar to investments in supply-side resources. The commission states it plainly, citing and repeating state statute verbatim: "This incentive on energy efficiency resources—also referred to as 'demand-side resources'—may be recovered through an approved tariff rider or in base rates, or by a combination of the two."[13]

Some other states permit utilities to capitalize energy efficiency program costs. The difference is that New Mexico gives utilities the choice to recover incentive dollars through base rates, and that those fund amounts derive from spending, not energy savings. In contrast, Michigan utilities, for example, are allowed to request that energy efficiency program costs be capitalized and earn a normal rate of return, but while they may request a performance incentive for shareholders, it is only if the utilities exceed their annual energy savings targets.

HOW ARE PERFORMANCE INCENTIVES WORKING COMPARED TO FOUR YEARS AGO?

ACEEE's research in 2011 shared three key findings in the areas of state policy, utility performance, and expert opinions on the influence of incentives on utility behavior:

1. The states profiled in the report showed a strong preference for designing policy mechanisms that award incentives based on cost-effective achievement of energy savings targets, rather than other metrics such as program spending levels.
2. Where those targets had been established, utilities consistently met or exceeded target savings levels.
3. Industry experts interviewed agreed that shareholder incentives influence utility behavior and decision making. The report noted some of the industry stakeholder observations in that regard. (Hayes et al. 2011)

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[13] "A public utility that undertakes cost-effective energy efficiency and load management programs shall have the option of recovering its prudent and reasonable costs along with commission-approved incentives for demand-side resources and load management programs … through an approved tariff rider or in base rates, or by a combination of the two." NMSA 1978, § 62-17-6(A) (2008) (PNM 2013)

The report also charted the energy efficiency spending per capita for the average of the 18 profiled states, which all had performance incentive mechanisms in effect. That average was plotted relative to other states for four years, 2006 to 2009. As presented in table 5, states with incentives invested more per capita in energy efficiency than states with other policies (such as LRAM or decoupling) and more than those with no supportive regulatory policy. These results do not isolate the impact of other important policy drivers such as EERS. Later in this section we provide additional comparative analysis on states with and without performance incentives on energy efficiency impacts.

Table 5. Average per capita investment in energy efficiency programs by state, 2009 and 2013

2009 utility efficiency spending per capita	
Profiled states with energy efficiency performance incentives in effect (n =18)[1]	$15
Policies other[2]	$8
No mechanisms[3]	$5

2013 electric energy efficiency program spending per capita	
States with electric energy efficiency performance incentives in effect (n=25)	$23.5
States with no incentive policy (all other states)	$15.3

[1] Eighteen states identified in 2011 as having shareholder incentive mechanisms for IOUs active prior to 2009. Many of these states have additional mechanisms in place to align incentives such as decoupling or lost revenue recovery mechanisms. [2] These are the states that have made some effort to align utility incentives to encourage efficiency, excluding the profiled states. This group roughly approximates states that have only adopted decoupling or lost revenue recovery mechanisms for either gas or electric utilities. [3] These are the states that have been identified as having adopted no mechanisms for properly aligning incentives to encourage efficiency.

Developments since 2011 include the following:

- More states have adopted incentives based on cost-effective achievement of energy savings targets, and several have modified or fundamentally changed their mechanisms.
- Regulated utilities and third-party administrators have achieved savings goals and earned incentive payments in all states with incentive mechanisms for which we have current data.
- Industry experts continue to find that performance incentives influence utility behavior and decision making.[14]

Policy Design Trends

Over the past four years, performance incentive mechanisms have been spreading to more states. The trend continues to be for states to adopt mechanisms that incentivize cost-effective achievement of energy savings targets, and to encourage more comprehensive performance criteria. For example, five of the eight states that have authorized performance incentives in the past four years chose either multifactor mechanisms or shared net benefits.

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[14] See York et al. 2013 for additional recent examples.

ACEEE's 2011 study found 18 states that had shareholder incentive mechanisms available to investor-owned utilities for at least a full year for which there was information available regarding performance results for the incentives in the field (Hayes et al. 2011). Today, there are 21 states meeting all of those criteria (including determination of incentive amounts and verification of energy savings). There are now 25 states with incentive policies in some phase of implementation and a total of 27 states with at least one authorized incentive mechanism for gas or electric utility energy efficiency.

Relatively recent states to have authorized performance incentives are shown in table 6.

Table 6. States authorizing new performance incentive mechanisms

Type of incentive	State	Year authorized or effective
Multifactor	DC	2011 authorized
Shared net benefits	Arkansas	2010 ordered
	Missouri	2013 effective
	North Carolina	2013 authorized
	South Carolina	2010 authorized
Rate of return	New Mexico	2013 effective
Savings-based	Indiana	2009 12 by utility
	New York	2011 authorized

Three states profiled in 2011, which had incentive mechanisms for individual utilities at that time, no longer have performance incentives in place. Washington had a pilot for Puget Sound Energy, Idaho had a savings-based pilot for Idaho Power,[15] and Nevada had a rate-of-return incentive for NV Energy. Puget Sound Energy did not request a continuation when the pilot expired; since then, the Washington Utilities and Transportation Commission (UTC) issued a package of orders on three different Puget Sound Energy cases including decoupling and others. The Idaho Power pilot was ordered discontinued because of declining returns and energy impacts. The Nevada policy allowed for increased rates for efficiency investments in addition to cost recovery, calculated as the utility's authorized return on equity (ROE) plus 5% applied to the rate-based demand-side management (DSM) costs.

Mississippi and West Virginia have authorized incentives but not yet implemented them. Michigan and Vermont both had (and continue to have) performance incentive mechanisms in place but were not selected to be profiled in our previous report. For detailed information on Michigan and Vermont, please see the case studies in Appendix A.

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[15] *Performance-Based Demand-Side Management Incentive Pilot 2007 Performance Update.* Filed with the Idaho Public Utilities Commission March 14, 2008. http://www.puc.idaho.gov/internet/cases/elec/IPC/IPCE0632/company/20080317PB%20DSM%202007%20UPDATE.PDF

The majority of states that have incentive mechanisms have modified or fundamentally changed them over time. Fourteen states reported having authorized a new version more than a year after the initial incentives were established. A few examples in table 7 illustrate this evolution.

Table 7. Examples of evolving performance incentive mechanisms

State	Past practice	Today
Hawaii	Utility-administered programs Hawaiian Electric Company (HECO) eligible for earning incentives up to 5% of net benefits Received as much $4 million some years, which was over 20% of total program spending	Third-party administrator Multifactor incentive mechanism for public benefits fee administrator (PBFA) Average award 2% of total program spending
Massachusetts	From 2010 to 2012, increased percentage of incentive pool for energy savings, decreased for other metrics Total incentives averaged 8% of program costs	Continuing increase in percentage of incentive pool for energy savings and decrease for other metrics Total incentives now approximately 5% of program costs In 2014, eliminated financial incentives for meeting quantitative performance indicators
Rhode Island	2004 increased electric threshold from 45% to 60% Increased allowed incentive from 4.25% to 4.4% of eligible program costs	2012 increased electric threshold from 60% to 75% 2012 increased allowed incentive to 5%
Texas	2008 electric utilities may earn 1% of net benefits for every 2% they exceed goal with cap 20% total program costs	2011 changed cap to 10% net benefits, greatly increasing potential incentive payments
Wisconsin	For one utility only, same rate of return was earned on efficiency investments as for capital projects	Multifactor incentive for third-party administrator

Increasing Evidence Shows Savings Goals Achieved Where There Are Incentives

ACEEE research findings published in *Energy Efficiency Resource Standards: A New Progress Report on State Experience* (Downs and Cui 2014) identified 18 states with both utility performance incentives and EERS in place. A central finding of the research was that overall, states with EERS were substantially achieving their energy savings goals. One of the lessons learned was that those states hitting their targets also generally had complementary policies in place that supported the utility business model to give the utilities stronger motivation to pursue energy efficiency. These included lost revenue adjustment mechanisms (LRAM), revenue decoupling, and performance incentives such as those examined in this report.

The data we collected strongly point to the conclusion that in those states where there are incentives, utilities in each of them are meeting at least the minimum performance thresholds and earning substantial economic incentives. Of the 25 states with performance incentives being implemented, we obtained complete questionnaire responses for 21. Of those, 18 reported performance incentive amounts paid or to be paid for at least 1 utility in the most recent program period; 17 had at least 1 utility for the most recent 2 program years or cycles. The other three states are still in the midst of their processes—the Wisconsin and Missouri performance incentives, for example, are only calculated at the end of a multiyear cycle. Wisconsin just completed a cycle at the end of 2014, and Missouri will at the end of 2016.

COMPARING EFFICIENCY PERFORMANCE AMONG STATES WITH AND WITHOUT INCENTIVES

From a public policy standpoint, the fundamental purpose of a policy for energy efficiency performance incentives for utilities (or third-party administrators) is to facilitate greater energy efficiency effort and achievements. Data available from ACEEE's annual *State Energy Efficiency Scorecard* research allow us to examine whether having an energy efficiency performance incentive policy in place in a state is associated with greater energy efficiency accomplishments.

For this analysis we focused on two key indicator variables regarding electric energy efficiency performance: energy efficiency spending as a percentage of total revenues, and energy efficiency kWh savings as a percentage of retail sales. We examined the most recent year for which complete data are available, i.e., 2013. We compared states that had an energy efficiency performance incentive policy implemented in 2013 with states that had no energy efficiency incentive policy in place on these average statewide metrics. We also compared subgroups of states, including those with EERS policies and those without EERS policies.

It is important to acknowledge that many unique factors in a state or utility will influence utility behavior regarding energy efficiency programs. Therefore this analysis requires several caveats. First, the year of implementation of an efficiency incentive or EERS policy, for example, may be a significant driver of that state's 2013 efficiency commitments. That variable was not controlled in this analysis and therefore is a limitation. Second, we present statewide averages, whereas sometimes efficiency incentive policies may only be implemented for one major utility. Other unique factors across states include historical experience with efficiency policies, electricity prices, and avoided costs, all of which have an indirect impact on the level of efficiency that is deemed cost effective.

Despite these caveats, it is useful to look at how patterns of performance vary across many states under different policy conditions. The results of our analysis are presented in table 8.

Table 8. Energy efficiency spending and energy savings in states with and without electricity performance incentive policies

	Average 2013 electric EE spending as a percentage of utility revenue	Average 2013 electricity EE savings as a percentage of sales
States with EE performance incentive (n=25)	2.0%	0.9%
States without EE performance incentive (n=25)	1.4%	0.5%

We included states that had incentive policies implemented in 2013. We did not include Mississippi and West Virginia because policies are authorized but not yet implemented.

These results showed that states with incentive policies had somewhat higher spending as a percentage of revenues (2.0%) than states without incentive policies (1.4%); and substantially higher savings (0.9%) than states without incentives (0.5%).

These results are a useful comparison. However they are complicated by the fact that the presence or absence of an EERS policy is such a dominant factor in the level of energy efficiency achieved in a state.[16] We went on to control for that factor by restricting the comparison of incentives to no incentives just to EERS states, and then doing a similar analysis just in states without an EERS. There was virtually no difference between states with or without a performance incentive policy in either of those subgroups.[17]

While these findings are obviously not determinative for every state or utility, (e.g., California's savings dramatically increased following the restoration of incentives in the late 2000s) the results indicate that, in aggregate, having an energy efficiency performance incentive policy appears to be at least somewhat associated with higher levels of energy efficiency effort (program spending) and achievement (energy savings) compared to states without an energy efficiency incentive policy.

Another approach to measuring the effectiveness of efficiency performance incentives is to compare an individual state's progress on efficiency over time after adoption of the policy. To account for the impact of an EERS policy, we could examine states with performance incentives but no EERS, which include Georgia, South Carolina, South Dakota, Kentucky, Missouri, New Hampshire, and Oklahoma. Two of these states, Missouri and Oklahoma, were included in case studies and therefore are good candidates for further examination. For more information and details on Missouri and Oklahoma, see Appendix A.

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[16] See the ACEEE Blog post "IRP vs. EERS: There's one clear winner among state energy efficiency policies." December 16, 2014. http://aceee.org/blog/2014/12/irp-vs-eers-there%E2%80%99s-one-clear-winner-.

[17] By comparison, the EERS subgroup of states combined had three times the level of relative savings (savings as a percentage of sales) as the non-EERS subgroup of states, suggesting a very strong relationship between having an EERS policy and higher levels of energy efficiency spending and savings.

Prior to adoption of an incentive policy, one of Missouri's electric utilities, Ameren Missouri, had a portfolio of customer programs totaling about $70 million over a three-year period (2009–2011). A stipulation and agreement, among Ameren Missouri and parties to its 2012 efficiency plan (2013–2015) application, was approved by the commission in 2012. This agreement included both an incentive and LRAM policy. Ameren Missouri then launched a full portfolio of energy efficiency programs totaling $145 million over the three-year program period, more than twice the levels of the prior three-year plan. The story is similar for Kansas City Power & Light (KCP&L), which had limited energy efficiency programs and associated investment in place prior to establishing its own version of an incentive policy late in 2014. Once in place, KCP&L initiated a portfolio of energy efficiency programs totaling $28.6 million over 18 months; after that time the company is expected to file a full three-year plan. More recently, however, Ameren's proposed level of investment in energy efficiency program remains about the same as the existing three-year MEEIA program plan, but expected savings are about half.

In Oklahoma, the general consensus of stakeholders interviewed by ACEEE is that the incentive policy has been effective in encouraging utilities to achieve greater energy efficiency savings. Since the policy was adopted in 2008, statewide electric utility program energy savings have ramped up quickly from 0 to over 100,000 MWh per year. However some observed the utilities could be achieving much greater savings and would be doing so if the state had an energy efficiency resource standard. Others expressed concern that without the incentive policy in place, it is unlikely the utilities would offer any programs at all. Forthcoming changes will modify several aspects of gas and electric utility efficiency rules, which may have an impact on efficiency savings. For example, beginning in 2015, utilities will only be allowed to collect an incentive if the portfolio achieves 80% or more of the individual utility's goal and the portfolio has a TRC score higher than 1.0.

These state examples provide further evidence that efficiency performance incentive policies have been helpful in making the business case for utilities to invest in efficiency. They also demonstrate some key challenges when the policies are not coupled with specific energy efficiency target requirements. The Ameren example demonstrates large swings in savings from one program cycle to the next. It appears the incentive and LRAM alone were not sufficient to lead Ameren to increase its efficiency savings levels. The structure of the incentive may help by making sure its threshold aligns with a higher percentage of savings. In general, however, without clear and steady policy guidance from the commission through specific targets, energy efficiency as a cost-effective utility resource is vulnerable to large swings in commitments.

From our overall experience, we speculate that an important but less quantifiable effect of a performance incentive policy may be in influencing utility management to cooperate with state policies to require energy efficiency programs (such as an EERS) rather than to seek to block their enactment or challenge them in legal proceedings. If that is the case, that would also be an important function for a performance incentive policy.[18]

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[18] Nearly three-quarters of states with an EERS policy also have a performance incentive policy in place.

To further refine this comparison among states with performance incentives for energy efficiency in the electric sector, we reviewed the 2013 *State Scorecard* budgets and energy savings data by type of incentive mechanism.

Table 9. Energy efficiency spending and energy savings in states with various types of incentive policy mechanisms

Type	Average 2013 electric EE spending as percentage of utility revenue	Average 2013 electricity EE savings as percentage of sales
Multifactor (CA, HI, MA, VT, WI)	3.4%	1.6%
Savings-based (CT, IN, MI, NH, NY, RI)	3.2%	1.2%
Share of net benefits (AR, AZ, CO, GA, KY, MN, MO, NC, OH, OK, SC, TX)	1.1%	0.6%
Share of net benefits with EERS or similar policy (AR, AZ, CO, MN, NC, OH, TX)	1.5%	0.8%
Share of net benefits, no EERS or similar policy (GA, KY, MO, OK, SC)	0.6%	0.4%

As shown in table 9, the average energy savings achieved as a percentage of energy sales for those states with performance incentive policies based on a share of net benefits approach are significantly lower than those for states with multifactor and savings-based mechanisms. The same basic difference is observed in terms of the relative level of energy efficiency program spending. This is not surprising, since one would expect the level of programs spending and the level of savings to be highly correlated.

Overall, the results suggest that the relative level of effort for energy efficiency appears to be lower in the group of states with a share of net benefits type of incentive mechanism. One possible explanation of the observed results would be that they may also be heavily influenced by the presence or absence, and the relative level, of EERS policies in the states in the various incentive category groups. As shown in the last two rows of table 9, the existence of an EERS policy continues to appear to be an important factor.

Of those states with shared net benefits performance incentives in place, seven of them have EERS and five do not. Those with EERS have twice the energy savings relative to sales, and more than double the electric energy efficiency budgets as a percentage of utility revenue than the states with no EERS or similar policy. In comparison, 10 of the 11 states listed in table 9 with multifactor and savings-based performance incentives also have EERS or similar policies in place, which may help account for the overall higher performance of those groups.

Discussion

Performance incentive mechanism design and implementation have evolved since ACEEE's 2011 report. The high quantitative correlation between energy efficiency budgets and the presence of performance incentive policies persists. However the correlation does not prove anything conclusive about cause and effect. There are too many factors and confounding variables, including differences across states, to isolate the specific effects of performance incentive mechanisms on energy efficiency budgets and spending without significant additional analysis. Whether or not, and to what extent, it is the performance incentives driving utilities to expand programs and achieve greater cost-effective energy savings, is a research question that we discuss below and through the case studies in appendix A.

Incentives and Utility Behavior

ACEEE concluded in the 2011 report *Carrots for Utilities* that incentives influenced utility behavior, motivated utility management, and influenced energy efficiency planning. Specifically, we found the following:

> Utility industry regulators, staff, and stakeholders consistently indicated that shareholder incentives mechanisms implemented in the 18 Profiled States had influenced utility behavior. Respondents indicated that the ability to assign a dollar value to efficiency investments significantly contributed to "buy-in" by corporate management, making efficiency more appealing as an investment option and engaging senior management in efficiency planning and decision-making in a more significant way. Several utilities indicated that the incentive influenced planning at the utility, allowing treatment of efficiency as a long-term investment strategy (Hayes et al. 2011).

Similarly, in 2013, ACEEE published *Making the Business Case for Energy Efficiency: Case Studies of Supportive Utility Regulation* (York et al. 2013). The report considered six utilities that provide large customer energy efficiency programs in states with decoupling or shareholder incentives in effect. The research assessed financial and program impacts as well as organizational and managerial impacts, finding that supportive regulatory mechanisms have been critical in elevating the role of energy efficiency.

To update and expand upon our earlier research, we explored current views on the influence of incentives on utility and program administrator behavior through interviews with regulatory staff, utility program representatives, and nonprofit and environmental group contacts. There is broad consensus among those we interviewed that incentives can have a strong and positive affect on utility program performance. The degree of influence depends on the type and amount of incentive mechanism and how its influence is enhanced or restrained by other regulation, regulatory process and timing, and state policies.

Some interviewees relayed very successful experiences in which performance incentives, and the overall incentive process, directly influenced utility behavior regarding energy efficiency program planning, administration, and even measureable energy savings performance results. This is particularly the case for four leading energy efficiency states in New England. Common among each of these are that they have decoupling or LRAM for both gas and electric, have had performance incentives established for 10 years or longer, and have extensive energy efficiency investment and program portfolios.

Connecticut. Connecticut interviewees saw a correlation between incentives and electric and natural gas savings, as well as a diversification of the source of energy savings, reducing the (narrow) focus on energy savings from efficient lighting. Contacts pointed out that Connecticut officials agreed that performance incentives influence investor-owned utility behavior in a positive way. In particular, the 75% minimum energy savings threshold was not an impediment in any way, and in fact, utilities were "always shooting for the moon" in terms of hitting their energy savings targets.

Massachusetts. Our contacts in Massachusetts noted in particular that the process of negotiating the most recent round of performance incentives was instrumental in gaining utility acceptance of increases to statewide annual energy saving requirements through the EERS. The EERS goals are among the highest in the nation and directly impact savings targets of individual utilities. A utility representative emphasized that the particular design of the incentives in Massachusetts plays a big role in how resources are allocated by utilities, including within energy efficiency portfolios. For a more thorough discussion, see the case study in appendix A.

Rhode Island. Everyone we spoke with regarding Rhode Island was unambiguous in their assessment that the incentives positively influenced utility behavior. National Grid, which serves most of the state, creates projections and program tracking in advance to make sure programs achieve 100% of their targets. The mechanism serves to focus utility attention on achieving their goals. When the incentive structure was changed in 2013 to raise the threshold of savings from 60% to 75% of the energy savings goal, and the slope of the increased incentive levels became much steeper, the utility responded. Now as it gets toward the end of the program year, it assesses savings compared to target and considers pushing to complete some projects that might otherwise lag into the next period. It stays aware of its pipeline of upcoming projects to see if it can work with vendors and distributors to acquire energy savings in those programs and measures where there is strong demand. It also aims for the internal flexibility to move budget money around to promote popular projects, measures, and technologies.

An observer outside of National Grid Rhode Island said the incentives influenced the utility in a very positive way, and described their dedicated program staff as "passionate, innovative, do a good job, and have a program to be proud of. With the implementation of decoupling, it made the utility even more willing to promote energy efficiency." These favorable comments describe the last two years since the changes have been made to the incentive mechanism. Prior to that, those interviewed said the utility had not been on a path to achieving savings goals and had undergone a restructuring and changes to middle management. Subsequent to the changes, they have not had problems achieving savings goals and now regularly achieve more than 100%. For more details, see the Rhode Island case study in Appendix A.

Vermont. Vermont experts we interviewed had consistent views on how performance incentives influenced and sometimes directly guided actions of the program administration contractor, Vermont Energy Investment Corporation (VEIC). VEIC runs the "energy efficiency utility" Efficiency Vermont. One expert observed that "they take seriously and respond strongly to the details of the [performance incentive mechanism] design. They . . . reallocate resources where the incentive structure directs them." In fact, the 2015–2017 period includes more challenging targets on many metrics, because almost all the time in the past all the goals had been met or exceeded, leading to the possible interpretation that "either it is working or the goals were too easy." For a more thorough discussion, see the case study in Appendix A.

New England states are not the only examples of incentives influencing utility behavior. Michigan presents a performance incentives success story from the Midwest. Its incentive mechanism was one of several regulations set forth in 2008 in accordance with the state's energy efficiency standard to support its full implementation. The commission has modified the incentive mechanism to incentivize comprehensiveness in addition to a short-term focus on first-year savings. The incentive attracted utility management support for energy efficiency programs and clearly played a key part in the state's overall performance success: every year since inception of the EERS, Michigan has exceeded energy savings goals.

In other states, those we interviewed had generally positive things to say, along with some caveats, and identified areas for improvement where incentives could be made more effective. In Arizona, incentives were viewed as impacting utility behavior, at least in terms of utility personnel effort. Regulatory staff were reluctant to comment on the overall effect on utility performance, relative to other factors (e.g., the general inclination to want to please the commission.) Other observers said the presence of incentives clearly motivated utility program managers and staff to deliver better performance. It helps internally in the company to see their activity as something that can benefit the company financially.

In a few states, incentives were needed to persuade utilities to accept energy efficiency requirements in the first place, and their subsequent implementation has not been as fine-tuned or closely monitored by regulators as in other states. Oklahoma is an illustrative example. The state had no established energy efficiency programs to begin with, so incentives for efficiency came along with them as part of the package. One observer shared that without the incentives, "programs were nonstarters for the utilities," adding that there is a strong pro-business environment in Oklahoma and that "the incentive rules certainly kept energy efficiency going" there.

Importance of Regulatory Process

California has had performance incentives in place for multiple three-year program cycles, and there is widespread support for some form of incentive. However the implementation in reality has taken longer than originally planned to go through the regulatory processes. Viewpoints from those interviewed about California mechanisms varied quite a bit. Since 2008, incentive amounts have generally not been set out until after the efficiency programs have been implemented. The performance incentive mechanism applicable to the 2010–2012 program cycle was not established until 2012. One stakeholder said that the incentive levels for 2015 had not been laid out yet as of the end of 2014. The delays were due to the uncertainty shareholders had about whether or not the utility would get the incentive payments, and if so, how much and when. One respondent stated that "Wall Street does not see it as income." Another expert explained that all along there had been an expectation of incentives, and that did influence utility behavior and cooperation. The fact that factors related to the program evaluation process delayed the incentive decisions did not change that reality.

The experience of regulators and utilities in Missouri is another example that demonstrates the importance of the process, and in particular, of how impact evaluation plays into it. In Missouri the previous lack of an existing strong, consensus-based evaluation approach has led to a contentious process with different parties' evaluation experts providing differing views on which methods and estimates to use. Policymakers and regulators need to establish such strong evaluation frameworks and protocols that are integrated with the performance incentive mechanisms. Both savings-based incentives and shared net benefits incentives amounts are a direct function of impact evaluations, and whether net, gross, or lifetime energy savings are the basis of the amount matters. Those results, therefore, are critically important for their accuracy and acceptance.

How Should an Incentive Mechanism Be Structured?

Considerations for the effective design of performance incentives include the specific intended functions and purposes of the mechanism as well as the economic, policy, and regulatory context. Incentives are one regulatory tool among several under which utilities do business. The presence or absence of decoupling, LRAM, and EERS can have an impact on the effectiveness of the incentive mechanism in influencing utility behavior and program outcomes. Organizational structures matter, too. Vertically integrated utilities, such as an electric utility that owns electric generating plants, have a different economic and capital expense profile relative to distribution-only electric utilities. A high level of avoided costs can lead to greater net benefits of savings, which in turn could result in higher financial incentive payments, with implications for how high the incentive rate should be and whether there should be an upper limit or ceiling.

One area of priority consideration for designing energy efficiency performance incentives is the core characteristics that make them successful. In a presentation at the 2013 ACEEE National Conference on Energy Efficiency as a Resource, Toben Galvin of Navigant Consulting built upon the objectives set forth by California Public Utilities Commission in its 2013 decision adopting the Energy Savings and Performance Incentive Mechanism, highlighting the following five characteristics:

- Clear performance goals representing a short set of the most critical objectives
- Clarity with respect to how performance will be measured
- A timely and transparent process defined for independent measurement and verification of performance results
- Incentive earnings opportunities sufficient to motivate IOU performance, while providing cost-effective value to ratepayers
- Incentive structure that rewards value and results, not just spending (Galvin 2013)

With both contextual factors and these objectives in mind, another policy design choice for states considering performance incentive mechanisms is what type of mechanism to use. There are pros and cons to each. Examples are presented in table 10.

Table 10. Strengths and weaknesses of various types of performance incentive mechanisms

Type	Strengths	Weaknesses
Shared net benefits	Go further to incentivize by multiplying the financial rewards to the utility for the overall maximization of cost-effective energy savings. Higher financial incentives relative to energy efficiency spending (may also be considered a negative aspect).	Administrator could possibly allocate excessive resources to programs or customer classes with the most cost-effective savings opportunities, which could lead to "cream skimming" or potentially significant inequities among customers. May not promote deeper savings, as those tend to be more expensive and hence have fewer net benefits. May be more uncertainty in the measurements used to determine the award, such as measurement of avoided costs.
Savings-based	Ties dollar incentive amounts directly to energy savings achieved. Rewards effective program performance.	Although all states with energy efficiency programs require some minimum level of cost effectiveness, it may be argued that this approach only encourages meeting the minimum, rather than maximizing cost effectiveness for the energy efficiency portfolios as a whole. May lead to disproportionate investment in programs and technologies with largest energy savings opportunities, such as lighting.
Multifactor	Integrates the incentive mechanism more fully with policy goals beyond the bounds of energy efficiency. Can serve to focus utility and administrator attention on specific, targeted objectives.	Mechanism and process may become complicated to plan, administer, and regulate.
Rate of return	Address the fundamental economic interest of the utility to pursue energy efficiency. Conceptually mimic the basic incentive structure that appears on the supply side. Since energy efficiency program plans generally require commission approval and at least some degree of oversight and reporting, if not stringent measurement and verification of energy savings, rate-of-return mechanisms still may be considered to some degree to be performance incentives, rather than shareholder incentives.	Unless they are carefully structured to require savings performance as an eligibility requirement, they essentially reward spending rather than actual savings performance. Do not provide the same direct and focused motivation to achieve particular performance objectives as much as other options.

For a comprehensive look at designing performance incentives to encourage utility energy efficiency programs, see Whited, Woolf, and Napoleon 2015.

Issues and Potential Solutions

States have used varying approaches to address and mitigate the negative aspects of the incentive types described in table 10. One issue that can arise for any type is excessive focus on short-term savings. This may arise if the incentives are tied to first-year savings results, which is a common metric for program evaluation. The problem is that energy efficiency measure lives vary considerably, but what we really want is persistent, long-term energy savings. Some states have successfully dealt with this by incentivizing lifetime savings rather than first-year, or by including both metrics in the calculation of the incentive amounts.

The misallocation problem noted above for shared net benefits approaches, or the all eggs in one basket issue, could be addressed by regulators through the use of carve outs, requiring savings to be distributed more evenly, and by having a maximum incentive pool or amount for each subset (such as customer groups, geographic regions, or program sectors). Several incentive mechanism policies include elements that require or provide for additional incentive dollars for addressing these concerns. For example, Hawaii rewards inter-island equity. Michigan has potential financial incentives for multi-measure residential and multi-measure commercial and industrial sector performance.

A key concern for policymakers to consider is incentive amount. Incentive levels need to be high enough to motivate utility top management and address the basic economic elements of the regulatory business model, but not so high as to appear too rich and engender political opposition. States with demonstrated performance incentive success with broad support have modified the basic structures—minimum savings threshold requirements, percent incentive amounts (the slope of the increase), and caps—over multiple program cycles in order to reach consensus on a balance of the various goals. Perception is important. When Texas changed the mechanism from 20% of program cost to 10% of net benefits, although the percentage was half as much, the actual payments almost doubled. Texas utilities have been meeting and exceeding both demand and energy savings goals every year since 2008, with only one exception for a single year of energy savings.

Other considerations depend on the type of program administrator. Different approaches may be most appropriate for investor-owned utility, third-party administrator, or nonprofit program administrators. Motivations differ by organization. Investor-owned utilities have multiple financial objectives to advance the overall business interests of the company, including profitability, stock price, managing risk, and their long-term corporate strategy. A third-party administrator is likely to have a narrower concern: the contract must be profitable and achieve a high level of performance that will lead to continuation of the contract. Nonprofit administrators are motivated by financial incentives as well, though in the context of fulfilling their mission rather than only for the money. The purposes and specific objectives of the incentive mechanism also vary. For IOUs, the most basic is to persuade management to legitimately pursue energy efficiency. For third-party administrators, the mechanism may be designed to focus administrator attention on implementing programs to satisfy key performance criteria.

When asked for any suggestions they would make to another state that was thinking of adopting a utility energy efficiency performance incentive such as the mechanisms used in their state, respondents shared the points listed below. A frequent theme was the recommendation to adopt an incentive mechanism that balances motivating utilities and program administrators to achieve energy savings goals with achieving cost effectiveness.

Comments from respondents included the following:

- Keep the mechanism simple while fairly aligning the interests of ratepayers and shareholders.
- Choose a shared-benefits-type incentive that rewards the utility both for achieving higher energy savings levels and for doing so cost effectively.
- Establish clear definitions and a standard that applies to all utilities equally. Standardize the reports, how the savings are calculated and adjusted, and what embedded costs are to be included. Failing to do so may cause confusion and results that vary according to the way they are interpreted.
- Be aware of the size of the incentive. In a structure where the incentive is a function of savings or spending, the total incentive can grow quickly as the energy efficiency budget increases. This is particularly true in the current environment where more and more emphasis is being placed on energy efficiency.
- Inform all parties of what the range of potential incentive levels might be so that no one is surprised. Use incentives to encourage utilities to expand their successes beyond the status quo.
- Consider the potential for interactive effects between programs and the potential for competing priorities when implementing multiple programs with different incentive mechanisms. (This recommendation may be most relevant for multifactor performance incentive mechanisms.)

Conclusions

Over the past four years, performance incentives for utilities and administrators of energy efficiency programs have been playing a vital and growing role in supporting the expansion of energy efficiency. These incentives are a critical component of the package of regulatory policies that address and often overcome disincentives utilities face as part of the traditional regulatory model. As energy efficiency programs multiply and expand in terms of dollars invested and energy savings achieved, more states have enacted and are implementing incentive mechanisms. The supportive regulatory policies go hand-in-glove with higher energy efficiency standards and statewide goals.

States continue to favor those mechanisms that drive program administrators toward the longest-lasting and most cost-effective energy savings performance. This is shown by the number of new states adopting various incentive approaches and by the modifications regulators have been making to existing incentives. Simply rewarding IOUs for spending money on basic energy efficiency programs is only a starting point. Regulators now are aiming for the wisest possible use of ratepayer dollars to achieve maximum net benefits while maintaining equity among customer groups.

Incentive mechanisms are working in combination with other regulatory policies to encourage energy efficiency program performance. Experts agree that performance incentives are needed and that they are effective in influencing utility behavior. In states where they are eligible for financial incentives, utilities meet and frequently exceed energy savings targets.

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Appendix A. Case Studies

ARIZONA

Background

Arizona's entry into the arena of large-scale utility energy efficiency programs is relatively recent, precipitated by orders from the Arizona Corporation Commission (ACC) in 2009 and 2010 that created a utility Energy Efficiency Standard (Docket No. RE-00000C-09-0427, Decision No. 71436 and Decision No. 71819). The commission ordered that by 2020, each investor-owned utility must achieve cumulative annual electricity savings of at least 22% of its retail electric sales in calendar year 2019 through cost-effective energy efficiency programs.

Although Arizona is most noteworthy for that Energy Efficiency Standard, the state has actually allowed utility incentives for energy efficiency programs since 2005. The first approach was adopted in a settlement agreement and was designed as an incentive based on a share of net benefits, with a cap equivalent to 10% of energy efficiency program spending. Later that was modified to a sliding scale cap on program spending (up to 16%). For 2014 that was modified to a flat amount per kWh saved. The structure and timing of these changes varied somewhat for the two major investor-owned electric utilities in Arizona (Arizona Public Service and Tucson Electric Power), which accounts for some of the differences observed in the outcomes table.

Incentive Policy Details

After the policy evolution described above, the current incentive policy for each of the two major utilities is very simple. Once a threshold of 85% of the energy efficiency savings goal is reached, the utility qualifies to receive a cash incentive of $0.0125/kWh times the first-year annual kWh saved. There is no cap on the amount of incentive that could be earned based on that incentive per kWh formula.

Other Relevant Regulatory Features

Arizona currently has an EERS requiring investor-owned electric utilities to achieve cumulative annual electricity savings of at least 22% of its retail electric sales by 2020. The state also requires natural gas utilities to obtain 6% cumulative savings by 2020. Lost revenue recovery mechanisms (LRAMs) were approved for both Arizona Public Service Company (APS) in 2012 and Tucson Electric Power Company (TEP) in 2013. Southwest Gas received authorization for full revenue decoupling in 2011.[19]

Energy Savings Outcomes

Figure A1 illustrates the increase in Arizona electric energy efficiency program savings.

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[19] Analysis of Arizona Public Service data by Lawrence Berkeley National Lab considered the potential impacts of incentives combined with decoupling on utility ROE (Satchwell, Cappers, and Goldman 2011).

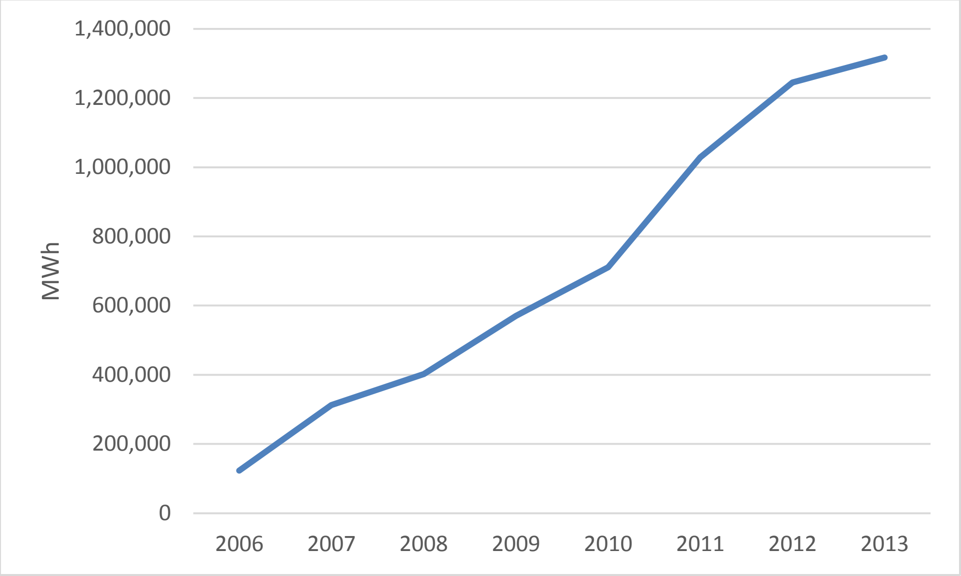

Figure A1. Arizona energy savings 2006–2013. ***Source:*** **ACEEE** ***State Scorecard*** **2007–2014.**

Financial Outcomes

Table A1 shows 2012–2013 Arizona performance incentives and savings.

Table A1. Arizona performance incentives and savings 2012–2013

Company	Incentive	Program Cost	Total annual energy savings (MWh)	PI as percentage of program cost
2013				
Arizona Public Service	$4,529,373	$50,962,754	485,791	8.89%
Tucson Electric Power	$1,879,095	$11,869,205	177,425	15.83%
2012				
Arizona Public Service	$8,631,364	$61,652,601	551,639	14.00%
Tucson Electric Power	$559,737	$6,224,345	105,655	8.99%

Source: **Arizona Corporate Commission**

Discussion

The amounts of incentives earned for the most recent two years, under the evolving incentive mechanisms, have been within the mid-range to upper mid-range of typical incentives around the nation (i.e., incentive equivalent to approximately 9–16% of program spending). It is too soon to know how the results of the recently established mechanism ($0.0125/kWh) will compare to those figures.

In general, the basic concept of having some kind of financial incentive for the utility, tied to energy efficiency program performance, has not been particularly controversial. Disagreements have focused on the mechanism and the amounts, rather than the basic principle that the utility could earn an incentive. The most recent change (to move to a flat

$0.0125 per kWh saved) was made because there was some concern that the prior mechanism (capped at a percentage of program spending) might incent the utilities to spend more money than necessary. As noted above, it is too soon to know how the incentive amounts under the new mechanism will compare to the previous approach.

Evaluation

Energy efficiency programs are evaluated by contractors hired by the individual utilities. There is no public process or collaborative oversight of the evaluations, and the ACC does not hold a contested case review of the evaluation process or outcomes. Arizona uses gross savings as the metric for estimating lost revenues.

Looking Forward

There is a docket currently open (Docket No. E-00000XX-13-0214), under which the ACC has a draft proposal that would substantially change the existing utility Energy Efficiency Standard that the ACC created in 2009 and 2010. Depending upon the outcome of this docket, the approach to utility incentives could change. The draft proposal issued by the ACC would eliminate the policy that allows the current incentive mechanism and switch to an approach of allowing the utility to earn a rate of return on energy efficiency program expenditures.

ARKANSAS

Background

Utilities in Arkansas had very little involvement in providing customer energy efficiency programs until 2007, when the Arkansas Public Service Commission (APSC) approved Rules for Conservation and Energy Efficiency Programs requiring electric and gas utilities to propose and administer energy efficiency programs (Docket No. 06-004-R, Orders No. 1, 12, 18). The state's jurisdictional utilities filed Energy Efficiency Plans in July 2007 containing proposed Quick Start efficiency programs. The utility response was still relatively small, and they expressed concern about the adverse financial impact of customer energy efficiency on the utilities. In response, in 2010 the commission took several actions to increase the energy efficiency efforts.

In 2010, the APSC adopted an EERS for both electricity and natural gas, guidelines for efficiency program cost recovery, and a shareholder performance incentive. The EERS targets set by the commission were moderate, rising from an annual reduction of 0.25% of total electric kWh sales in 2011, to 0.5% in 2012, and 0.75% in 2013. In 2013 the APSC extended the 0.75% target to 2014 and then set a target of 0.9% for 2015. The PSC deferred the ruling on 2016-2017 targets pending completion of a thorough potential study aimed at improving programs.

In December 2010 the Arkansas PSC approved a joint electric and gas utility motion to allow the awarding of lost contributions to fixed costs that result from future utility energy efficiency programs. All investor-owned utilities are approved to recover lost revenues as part of the annual energy efficiency program tariff docket (Order No. 14 Docket 08-137-U). In 2007 the APSC approved a decoupling mechanism for the three major natural gas distribution companies in the state, but no decoupling has been approved for electric utilities.

In December 2010 the APSC issued an Order approving a general policy under which the commission outlined steps to approve incentives to reward achievement in the delivery of essential energy conservation services by investor-owned utilities (Order No. 15 Docket 08-137-U). Incentives were approved for all three gas utilities in the state and the two largest electric utilities in 2012 and 2013.

Incentive Policy Details

The APSC announced the general policy for utility performance incentives for energy efficiency achievements in December 2010. The basic mechanism approved is a share of net benefits approach. A utility must first meet 80% of the energy savings target for a given year to qualify for incentives. If the annual savings are between 80% and 100% of the target, the utility can receive an amount equivalent to 10% of the net benefits, capped at 5% of the program spending amount. For savings above 100% of target, the 10% of net benefits is capped at 7% of program spending. Any incentive awards are rolled into the single energy efficiency charge to customers, along with LRAM adjustments and program costs. There are no penalties, although the commission has reserved the right to issue penalties for nonperformance.

As with the LRAM mechanism, incentives are calculated based on net savings. One distinction is that under the LRAM policy, lost revenue compensation is done contemporaneously based on projected savings, and then trued up with evaluation, measurement, and verification (EM&V), whereas incentive awards are not approved until the EM&V documentation is in hand. The process involves the utility's filing an annual report, followed by a contested case process and then a commission order.

Other Relevant Regulatory Features

Arkansas has had an EERS in place since 2010 for both gas and electric utilities. The energy savings targets are established by the Arkansas Public Service Commission in three-year cycles. The three largest natural gas distribution companies in Arkansas are decoupled, while no electric companies are decoupled in Arkansas. Electric utilities in Arkansas are able to collect lost revenues associated with declining sales resulting from energy efficiency programs, as well as earn an incentive based on energy efficiency savings results. Note that the commission issued an order inviting electric utilities to file decoupling but none has done so.

Energy Savings Outcomes

Figure A2 illustrates the increase in Arkansas electric energy efficiency program savings.

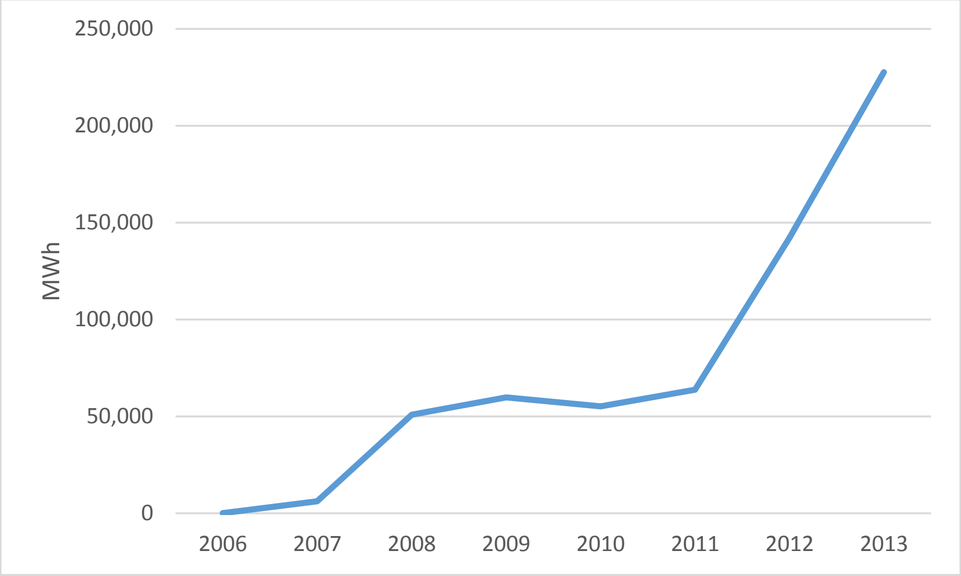

Figure A2. Arkansas energy efficiency program savings 2006–2013. *Source:* ACEEE *State Scorecard* 2007–2014.

Financial Outcomes

Table A2 shows 2012–2013 Arkansas performance incentives and savings.

Table A2. Arkansas electric utility performance incentives 2012-2013

Company	Incentive	Program cost	Total annual energy savings (MWh)	PI as percentage of program cost
		2013		
Entergy Arkansas	$3,712,268	$52,285,262	188,468	7.10%
SWEPCo	$574,225	$6,803,249	25,387	8.44%
		2012		
Entergy Arkansas	$1,743,700	$28,515,019	107,627	6.12%
SWEPCo	$413,131	$5,289,095	17,767	7.81%

Source: Arkansas Public Service Commission

Discussion

The major electric utilities in Arkansas have definitely ramped up their energy efficiency efforts and achievements in response to the various commission orders and policies that have been established since 2007. How much of that might be attributable to the incentive policy is difficult to say.

In aggregate, it does appear that the package of policies adopted in 2010 (i.e., EERS, LRAM, and performance incentives) have had a very notable effect. In the words of a commission staff person: “The commission took away every excuse, and the utilities have found it’s not so bad.” Whereas there has been some discomfort with the LRAM policy by the commission and other parties, the concept of having a shareholder incentive tied to good performance has not been particularly controversial for most parties.

Evaluation

The evaluation process is overseen by the APSC. The commission requires each utility to hire its own independent EM&V contractor to perform evaluations, and to jointly fund an Independent EM&V Monitor that provides overall oversight and guidance, and operates under the direction of the commission staff. The commission established an EM&V collaborative called Parties Working Collaboratively (PWC) to develop a technical resource manual that is updated annually and approved by the commission. Arkansas uses net savings as its evaluation metric.

Looking Forward

The incentive structure has been slightly modified to take effect for the next three-year planning cycle. Within a range of 80—120% of savings target, the 10% net benefits will be capped at a sliding scale of 4—8% of program spending. The new system will provide somewhat lower rewards for performance at the low end of the scale, and somewhat higher rewards for performance at the upper end of the scale.[20] Other aspects are expected to remain the same. Looking ahead in general, there will be substantial turnover of Commissioners during 2015, so there is understandably some uncertainty about future decisions.

CALIFORNIA

Background

California has had a long history with performance incentives for utility energy efficiency programs spanning three decades. We focus on the more recent history here that provides the most relevant context for the current issues.[21] Since 2006, there have been, broadly speaking, three main versions of incentives over this time period.

The first was the Risk Reward Incentive Mechanism (RRIM), which was in place for the energy efficiency program cycle from 2006 to 2008 and continued for the bridge year, 2009. RRIM applied to all the investor-owned gas and electric utilities: Pacific Gas and Electric, San Diego Gas and Electric, Southern California Edison, and Southern California Gas. Under the RRIM, the utilities would be eligible to earn an incentive payment of up to 12% of the net benefits of their energy efficiency programs if they achieved 100% of targeted energy savings. If they achieved between 85% and 100% of the savings goal, the highest incentive payment would be 9% of the net benefits. For the range between 65% and 85% of target, no incentives would be available. Below 65%, utilities could end up paying a financial penalty

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[20] A similar adjustment, to a steeper slope to the incentives for higher savings relative to targets, has been done in Rhode Island with apparently favorable results. See the Rhode Island case study for more details.

[21] The state had incentives for utility energy efficiency from 1990 to 2001, with modifications every four-year program cycle, including performance incentives of varying percentages and amounts that were in place from 1990 to 1997. From 1998 to 2001, there were milestone-based incentives. From 2002 to 2005, following deregulation and the electricity crisis, there were no performance incentives.

of 5 cents per kWh, 45 cents per therm and $25 per kW for each unit below the savings goal (Gold 2014). These thresholds were referred to as earnings cliffs.

Expectations for energy efficiency program performance were high at this time, with the California Public Utilities Commission (CPUC) predicting an estimated $2.7 billion in net ratepayer benefits (resource savings minus investment costs)[22] from the 2006–2008 program cycle. The statewide incentives ceiling, or maximum incentive funding available, was $450 million, or $150 million per year. This represented the low end of comparable supply-side earnings and was below the average percentage of net benefits awarded through national shared savings mechanisms, but some found it controversial that the potential incentive payments were that high.[23] The mechanism as a whole was found by the CPUC to require improvements to make the earnings process more transparent, streamlined, and less controversial while still achieving the CPUC's policy goals.[24] Ultimately, near the end of the program cycle, the CPUC changed the mechanism to be a "flat" 7% of net benefits. This was at least in part to streamline the overall process and remove the "earnings cliffs".

The second period lasted from 2010 to 2012. The CPUC described this as a reform of the RRIM, though it was substantially different. During this period, the mechanism in place was a "management fee" of 5% of energy efficiency program spending, with the potential for an additional 1%, based on how well savings were calculated. This era was still dynamic, if not as contentious as the period leading up to it. Not only were the amounts established, again, toward the end of the program cycle, in November of 2012, but so was the mechanism itself.

The third recent evolution of performance incentives began with the Efficiency Savings Performance Incentive (ESPI). ESPI applied to energy efficiency programs beginning in 2013. The primary stakeholders had been part of the process for previous performance incentives as well. In general, the investor-owned utilities supported the mechanisms and the ESPI in particular, with some supporting it very strongly. The Natural Resources Defense Council (NRDC) was another stakeholder involved in the process. NRDC supported robust and effective policies to support energy efficiency programs, including well-designed utility performance incentive mechanisms. Other organizations engaged in the process through filing comments or other means included the Division of Ratepayer Advocates (DRA) and the Utility Reform Network (TURN). DRA and TURN consistently opposed the performance incentives, but TURN ultimately did not oppose the ESPI incentive mechanism itself.[25]

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[22] CPUC (California Public Utilities Commission). 2007. Interim Opinion on Phase 1 Issues: Shareholder Risk/Reward Incentive Mechanism for Energy Efficiency Programs. Decision 07-09-043. Rulemaking 06-04-010.

[23] For comparison with California supply-side, see CPUC's "Interim Opinion on Phase 1 Issues: Shareholder Risk/Reward Incentive Mechanism for Energy Efficiency Programs." http://www.cpuc.ca.gov/NR/rdonlyres/33471B66-CCCB-4999-B727-CB02CBAB8734/0/D0709043.pdf.

[24] For specifics about the areas of the mechanism that were not working as intended, and proposed remedies, see "White Paper on Proposed Energy Efficiency Risk-Reward Incentive Mechanism and Evaluation, Measurement, and Verification Activities," CPUC Energy Division, April 1, 2009.

[25] See TURN comments filed with CPUC dated July 16, 2012, on RRIM reform and April 26, 2013, on ESPI feedback.

When the ESPI was adopted by the CPUC in September 2013, it was designed to incorporate four fundamental objectives. These principles both addressed lessons learned from experience with prior incentive mechanisms and struck a relative balance or consensus among the priorities among major stakeholders. The CPUC asserted that "an effective incentive mechanism should incorporate:

> (1) Clear performance goals;
> (2) A clear understanding of how performance will be measured in relation to those goals;
> (3) A timely and transparent process for independent measurement and verification of performance results; and
> (4) Incentive earnings opportunities sufficient to motivate IOU performance, while providing cost-effective value to ratepayers."[26]

The relative values placed on these attributes is apparent in the structure of the ESPI, described below.

Incentive Policy Details

The ESPI is a multifactor incentive. It is predominantly an energy savings-based incentive mechanism that also features management fees for non-resource efforts (see explanation below) and codes and standards programs. Specifically, there are four paths for utilities to earn financial incentives:

1. *Lifecycle savings performance award*. Potential earnings are based on the programs' energy lifecycle savings achievements. Lifecycle energy savings include the kWh or therm energy savings over the full lives of the installed energy efficiency measures. This is a fundamentally different approach than the traditional first-year savings, which in comparison leads to a shorter-term focus. This breaks out to 85% for electric program performance (kWh and kW) and 15% for natural gas (therms). Within the electric, the potential award is weighted two-thirds for kWh (energy) savings and one-third for kW (demand) reductions. The maximum incentive for the savings component is 9% of total resource program spending.[27]

2. *Ex ante review and compliance*. This component awards earnings for demonstrated compliance with CPUC-set calculation standards. Ex ante are forward-looking energy savings estimates, in contrast to ex post, which are arrived at by conducting EM&V after the programs have been implemented, with the intent to estimate actual gross and net

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[26] CPUC (California Public Utilities Commission). 2013. Order Instituting Rulemaking to Reform the Commission's Energy Efficiency Risk/Reward Incentive Mechanism. Decision Adopting Efficiency Savings and Performance Incentive Mechanism. Decision 13-09-023 Rulemaking 12-01-005

[27] "Resource programs" are what we traditionally think of as utility energy efficiency programs: those energy efficiency programs that aim to directly save energy. "Non-resource" programs, including energy efficiency research, education-only, or market transformation programs, have other primary purposes in addition to energy efficiency savings.

savings. Three percent of resource program spending, less certain administrative expenses such as EM&V, is the upper limit for this component.

3. *Non-resource management fee.* Earnings are a factor of the non-resource program spending levels for the utility. Non-resource programs include education, training, pilot programs, and new technologies. Three percent of non-resource program budget is the upper limit for this component. The fee is calculated as 3% of non-resource expenditures by utility, less administrative spending, as verified by commission audit reports.

4. *Codes and standards management fee*. This fee provides an earning opportunity for the utility based on the amount of codes and standards (C&S) program budget spent, capped at 12% of that budget. The fee is calculated as 12% of C&S spending by utility, less administrative costs.[28]

The largest of these four is the lifecycle savings performance award, which comprises 73% of the total dollar amount. The earnings amount is calculated in three steps. First, utilities must determine the ceiling, or maximum possible incentive. This is 9% of the total (statewide) resource program budget, less administrative costs. Second, utilities calculate what the dollar amount of the maximum award will be on a per-unit, lifecycle basis. This is done by multiplying the statewide first-year savings goal (such as the GWh goal) by the estimated portfolio average useful life of energy efficiency measures (for example, 12 years), and then adjusting the result by the portfolio average net-to-gross ratio and dividing the maximum possible incentive by the number of units, such as GWh. After actual energy savings achievements have been quantified, the third step is to multiply the amount of savings by the incentive award amount per unit. If, for example, the EE programs achieve 75% of that utility's savings goal, they will earn 75% of the maximum incentive.

There is no minimum savings threshold for the ESPI. The more savings, the better, in a linear progression toward the ceiling level, determined by the budget.

Other Relevant Regulatory Features

Performance incentives are one regulatory tool among many state policies that work together supporting gas and electric energy efficiency programs. While overall this is a reflection of commitment to energy efficiency achievements to meet public policy goals, it does make it difficult to isolate with much precision the specific impacts of the various performance incentive mechanisms on energy savings performance over time.

California has for many years had the largest and most extensive energy efficiency programs in the country, which is a direct result of its policy framework. In addition to performance incentive mechanisms, strong utility goals, and decoupling, California state

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[28] For the language describing these calculations as ordered by CPUC, see Decision 13-09-023 *Decision Adopting Efficiency Savings and Performance Incentive Mechanism*

laws and regulations mandate the acquisition of all cost-effective energy resources, ahead of all supply-side resources.[29]

The energy savings goals are a particularly important part of the package of policies encouraging strong utility energy efficiency program performance.[30] The CPUC established electric and natural gas goals in 2008 for years 2012 through 2020, aiming for 16,300 GWh of gross electric savings over the nine-year period (see CPUC Decision 08-07-047). (For 2010–2012 energy efficiency portfolios, see Decision 09-09-047.) More recent targets under the ESPI are included in the approved 2013–2014 program portfolios and budgets for the state's IOUs. The targets call for gross electricity savings of almost 4,000 GWh and natural gas savings of approximately 94 MMTh for those two years (see CPUC Decision 12-11-015).

All the major investor-owned utilities have had decoupling in place since 2004. As with performance incentives, California has been implementing decoupling in various forms for decades. See more in the ACEEE state policy database.

California Performance Incentive Outcomes

During the 2006–2014 period (including the RRIM, the modified RRIM, and the ESPI), California utilities have generally been increasing electric energy efficiency program budgets (see figure A3). Utilities also achieved higher levels of energy savings in 2012 compared to 2006. However, their savings results showed more fluctuation from year to year.

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[29] Assembly Bill 1890 (1996) http://www.leginfo.ca.gov/pub/95-96/bill/asm/ab_1851-1900/ab_1890_bill_960924_chaptered.html and Assembly Bill 995 (2000) http://www.energy.ca.gov/renewables/documents/ab995_bill_20000930_chap.html

30 For a history of the CPUC goal setting process by utility through 2010, see http://www.cpuc.ca.gov/NR/rdonlyres/E1E38C4A-5E56-4ACB-B0C9-AFD69656BFA0/0/goalsdecisionssummary.pdf.

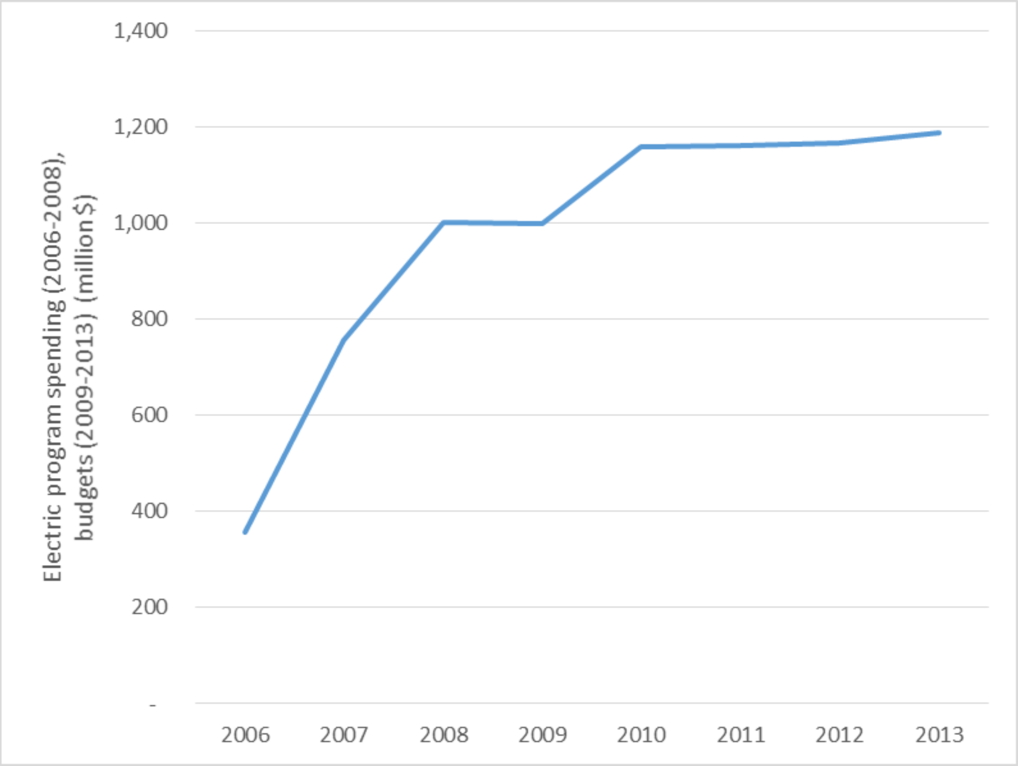

Figure A3. California electric program spending (2006–2008) and budgets (2009–2013). *Source:* ACEEE *State Scorecard* 2007–2013.

Figure A4 illustrates the increase in California electric energy efficiency program savings.

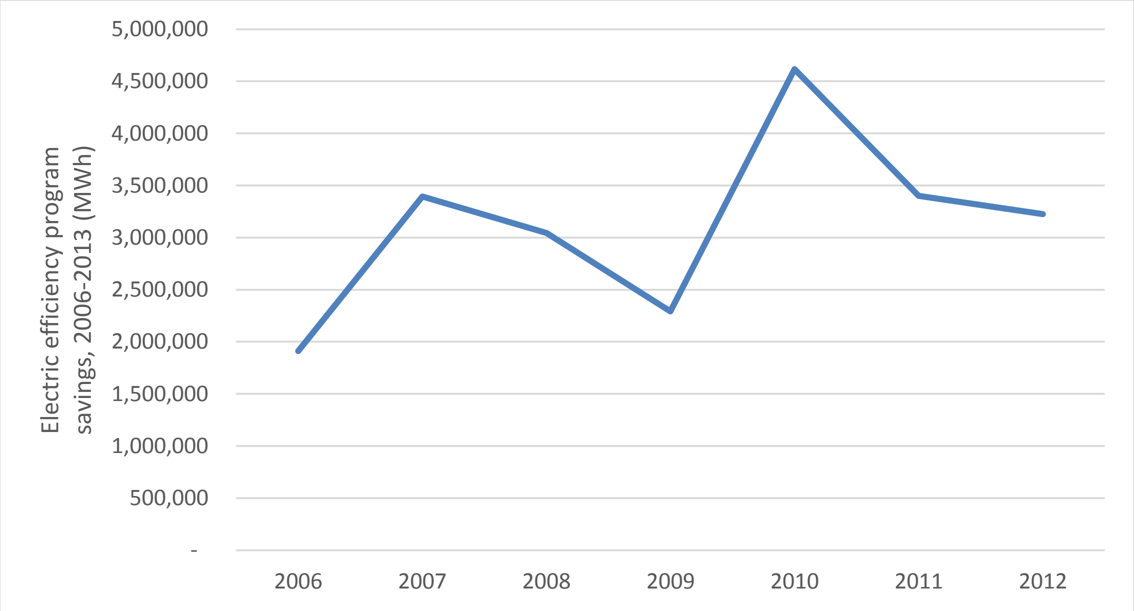

Figure A4. California energy savings 2006–2012. *Source: ACEEE State Scorecard* 2007–2013. Savings from *State Scorecard* are net incremental annual savings from Energy Information Administration Form 861 supplemented with addition data. Some year-to-year variation may be due to in part to net savings calculations methodologies and reporting. For additional data, see California Energy Statistics Portal, http://eestats.cpuc.ca.gov/Views/EEDataPortal.aspx.

Table A3. California energy savings results and performance incentive awards

Actual earnings/award (million $)	DSM total cost (million $)	Energy saved (annual)	Award as percentage of cost
Disbursed actual, 2010: 42.2	2010–2012: 2,508	2010–2012 (gross reported): 9,167 GWh, 155 MMTh 2010–2012 (net evaluated): 4,923 GWh, 94 MMTh	Actual, 2010: 6% 2010-2012, based on policy: 6%
2008 (first progress payment): 82.2 2009 (second progress payment): 61.5 2010 (final installment): 29	2006–2008: 1,929	2006–2008 (reported using ex-ante values): 9,999 GWh, 140 MMTh 2006–2008 (CPUC staff estimate based on evaluation reports): 4,097 GWh, 44 MMTh.	2006–2008: 9%

Sources: CPUC Decision 12-12-032 December 20, 2012. Alternate Decision Approving 2010-2012 Energy Efficiency Incentive Mechanism and Disbursing 2010 Incentive Awards; California Energy Statistics Portal; http://eestats.cpuc.ca.gov/Views/EEDataPortal.aspx ; CPUC staff estimate; Hayes et al. 2011.

Discussion

As a percentage of total energy efficiency spending, performance incentive award amounts for California utilities have ranged approximately from 5% to 9% during the 2006–2014 period. This is in the middle range relative to what other states' performance incentives were averaging during the latter half of this period.

To place these amounts in the context of the evolution of incentives in California, three considerations should be noted. First, the RRIM (2006–2008) started as a shared net benefits mechanism. If it had functioned as originally designed, it is reasonable to expect that actual incentive payments would have provided a substantially higher rate of earnings on EE than what happened. Second, during the 2010–2012 cycle, the amounts were calculated predominantly based on spending, which, compared to a shared net benefits approach, reduces performance risk for the utilities and therefore lower awards may be justified from that perspective. Third, the shift to the ESPI not only represents potential for increasing the incentive payments relative to EE budgets, but also the opportunity for improved regulatory certainty through greater clarity of goals, energy savings measurement, and processes. These improvements will fulfill the CPUC's criteria for an effective mechanism presented in the background section of this case study.

Those we interviewed emphasized the importance of clarity and timeliness in the process leading to EE performance incentive earnings in order for the mechanism to have the optimal, and intended, impacts on utility behavior. In particular they noted that the delays in setting out performance incentives after the efficiency programs have been run has had an adverse effect. Other than the first RRIM for the 2006–2008 program cycle, the mechanism has not been implemented on time. One observer explained that "the [incentive] dollars are not as valuable as if the mechanism and clear expectations were in place on time."

There was support for the ESPI and the current direction of the process. The 2013–2014 mechanism aligns with other CPUC policies to support long-term savings, giving IOUs more opportunity to optimize their energy efficiency portfolio to achieve the greatest returns. Another observer noted that for the utility role in supporting C&S, their investment returns 12% guaranteed, which is attractive. The incentive mechanism is viewed by some on the utility side as helping them to focus on their demand-side management efforts.

Program Evaluation and Regulatory Process

An energy efficiency expert in California summed up how the history of energy savings estimation has figured into performance incentive amounts, saying, "There have been challenges in California in terms of looking at ex ante and ex post savings values and the uncertainty that created for the utilities." There have been a variety of specific concerns over the years leading to conflicts and protracted non-resolution, a full discussion of which is beyond the scope of this case study. One of the many related issues has been how the energy savings that form the basis of the performance incentives should be counted.[31]

Looking Forward

Among those we interviewed in California, their outlook on the design and functioning of the ESPI is positive, considering it to be win-win approach. The CPUC has granted an extension to the Energy Division for complying with the schedule contained in the ESPI for when earnings awards shall be approved. While this is due to the process for evaluation contractors to be hired, get the needed data from the IOUs, and complete their work related to ex post savings—an important determinant of earnings award amounts—the extension is for 90 days only. This is a substantial improvement over the pace of past proceedings as discussed above.

Another shift that is cause for optimism is the move to rolling portfolios and evergreen programs. These create a longer-term framework for energy efficiency program planning. Energy efficiency funding was granted for 2015 and will continue unless changed for 10 years. The traditional program-year- or program-cycle-based approach, in comparison, leaves decision makers—at the utilities, program implementers, contractors, and trade allies—with an incentive to make decisions based on the short term. In conjunction with a predominantly lifecycle-savings-based performance incentive that contributes to utility earnings, the current mix of supportive regulatory policies addresses multiple concerns that impact energy efficiency performance.

INDIANA

Background

Indiana was one of the first states to enact a Certificate of Convenience and Public Necessity statute, back in 1983, requiring utilities to demonstrate need before constructing or

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[31] Under the RRIM, the combination of sharp financial penalties for failure to achieve at least 65% of the energy savings goal, with differing estimates of net savings, can make the difference between millions in penalties or millions of dollars in awards. This was the case with PG&E. For a case study of how these two elements influenced California regulation, see Gold 2014.

purchasing new generation facilities. In 1995, Indiana adopted an Integrated Resource Planning (IRP) rule (170 IAC 4-7), requiring electric utilities to develop an IRP that evaluated demand-side and supply-side resources on a comparable basis.

In spite of that framework, the fact that Indiana utilities were achieving very little energy efficiency savings led to a series of hearings and investigations by the Indiana Utility Regulatory Commission (IURC) beginning in 2004, culminating in a landmark order in 2009 (Cause 42693, December 9, 2009). The order established a two-part approach, with utilities contracting with a single independent third-party administrator for a basic set of statewide programs (core programs), and utilities individually administering additional energy efficiency programs (Core Plus programs) in their own service territories, to address aspects not covered by the Core programs. The order also established an EERS, requiring utilities to meet annual savings goals. The goals began at 0.3% of annual sales in 2010, increasing to 1.1% in 2014, and leveling off at 2.0% in 2019.

With regard to the issue of utility performance incentives for energy efficiency, Indiana had actually established a performance incentive rule in 1995 (170 IAC 4-8-6) as part of its guidelines for DSM cost recovery. However, as noted above, very little DSM was taking place. Now, subsequent to the 2009 order, four out of the five major electric utilities (Indiana Michigan Power [I&M], Indianapolis Power and Light [IPL], Vectren Indiana, and Duke Energy Indiana) have approved mechanisms. (Per the IURC 2009 order, utilities are eligible to apply for shareholder incentives relating to their Core Plus programs.) Table A5 provides summary data for three of the utilities.

In March 2014 the Indiana legislature voted (SB 340) to end many of the aspects of the IURC 2009 order, effectively eliminating both the Core program requirement and the annual savings goals that had been established by the IURC. Governor Mike Pence neither signed nor vetoed the bill, and it became law in April 2014. While the legislation did not alter the state's policy regarding utility incentives for energy efficiency, the entire framework for utility energy efficiency programs in Indiana is somewhat uncertain at this point.

Policy Details

In the first phase of incentives after the 2009 order, three utilities (IPL, Vectren, and Duke) originally had similar tiered-savings mechanisms, where the incentive is calculated as a percentage of program costs, and the percentage to apply is determined by the level of savings achieved relative to the savings goal for that year. There is also the potential for a penalty, if savings achieved are less than 50% of the goal. Vectren subsequently had its incentive modified to a share of net benefits approach (see description below), and Duke's tiered structure has been updated per settlement agreement included in an order issued under 43955 DSM-2. Duke now has additional constraints such as a higher floor, no penalty, a lower ceiling, and an overall cap on incentive earnings. We provide the most recent incentive structure for Duke Energy as an example in table A4.

Table A4. Duke incentive structure

Percentage of annual kWh target achieved	Incentive as percentage of EE program cost
0–74.99%	0%
75–79.99%	6%
80–89.99%	8%
90–99.99%	10%
100–109.99%	12%
≥ 110%	12.13%

Source: Cause No. 43955 DSM 02 Final Order

Savings for these tiered-savings mechanisms are calculated on a gross-savings basis.

For more details, see the most recent orders for each utility addressing the mechanism (IPL; Cause No. 44497; Vectren: Cause No. 44495; Duke: Cause No. 43955).

Two utilities (I&M and Vectren) now have an incentive mechanism designed as a share of net benefits. The mechanism calculates net benefits using the utility-cost approach (i.e., total utility EE program costs compared to utility system benefits in the form of avoided capacity and energy costs). The incentive that may be earned is capped at an amount equivalent to a certain percentage of program costs (Vectren 10%, I&M 15%). For those utilities with authority to receive an incentive, all must achieve some minimum percentage level of the savings goal in order to qualify for an incentive.

For more details on the I&M mechanism, see Cause No. 44486, December 3, 2014.

To illustrate the results of these mechanisms, the table provides the energy savings and incentive results for the most recent two years for two largest tiered-savings utilities and one share of net benefits utility.

Other Relevant Regulatory Features

Indiana previously had an EERS in place, but this policy was eliminated by the 2014 Indiana General Assembly. Four of the five largest IOUs in Indiana currently collect lost margins for sales lost because of efficiency programs. The fifth utility, Indianapolis Power and Light, is awaiting a commission order to recover lost margin. There are no electric companies in Indiana with decoupled rates. However, of the three largest natural gas distribution companies operating in the states, two of them have decoupled rates for most rate classes. Finally, Indiana offers companies the opportunity to participate in a voluntary renewable portfolio standard to earn a higher return on equity for rate base facilities. Energy efficiency savings are one means of a company meeting the voluntary standard. However no company has formally requested commission approval to participate in the standard.

Energy Savings Outcomes

Figure A5 illustrates the increase in Indiana's electric energy efficiency program savings.

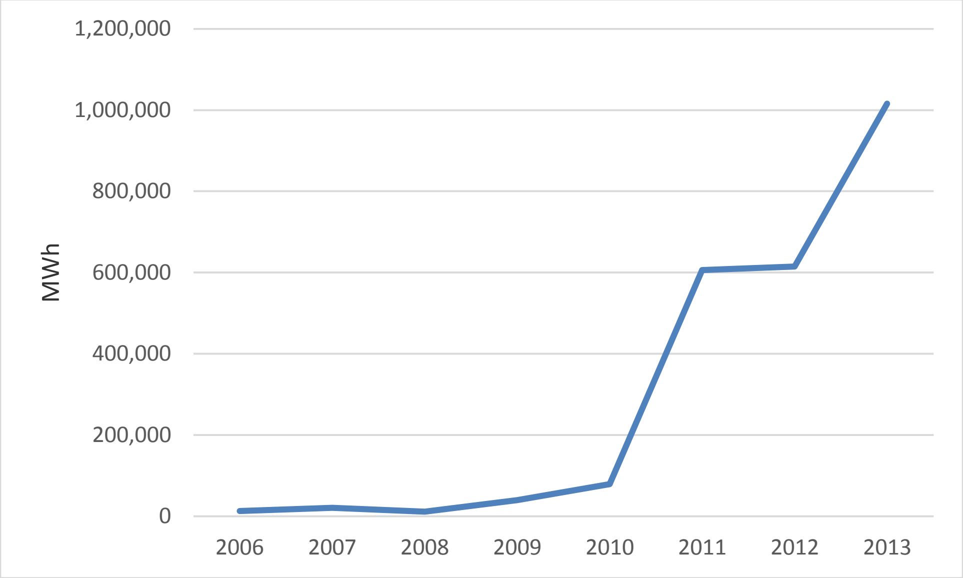

Figure A5. Indiana's energy savings 2006–2013. *Source:* ACEEE *State Scorecard* 2007–2014.

Financial Outcomes

Table A5 shows utility incentives and program costs.

Table A5. Utility energy efficiency program cost and performance incentive amounts

Company	Incentive	Program cost	Total annual energy savings (MWh)	PI as percentage of program cost
		2013		
Duke Energy	$981,232	$9,035,050	78,472	10.86%
Indianapolis Power and Light	$463,760	$5,797,000	43,902	8.00%
Indiana Michigan Power	$826,646	$8,336,021	21,981	9.92%
		2012		
Duke Energy	$757,080	$5,047,198	51,288	15.00%
Indianapolis Power and Light	$362,640	$6,521,640	18,572	5.56%
Indiana Michigan Power	$0	$949,178	3,311	0.00%

Source: Indiana Utility Regulatory Commission

Discussion

As noted above, Indiana had established the possibility of utility performance incentives (as well as lost revenue recovery) in 1995, in connection with its integrated resource planning rule and guidelines for DSM cost recovery (170 IAC 4-8-6). The utility response in terms of energy efficiency programs prior to the 2009 IURC order was very minimal and deficient in many respects (e.g., lacking evaluation plans and protocols). Therefore there was little impetus to move forward with things like performance incentives and LRAM.

Consequently, a key objective in approving the shareholder incentives mechanisms in 2009 and 2010 was to support achievement of the energy efficiency goals established in the 2009 order. The results have been fairly successful. Three out of the five utilities met their targets for 2012. Four out of five met them for 2013, and all but one met their cumulative targets for the three-year time frame 2011–2013. In the opinion of staff interviewed, the incentives did significantly affect utility behavior—in terms of both utility energy efficiency budgets and savings—but this was particularly in the context of the 2009 order requiring energy efficiency programs. In the words of one staff member,

> The primary thing that affected utility behavior is that DSM was no longer voluntary with the issuance of the 2009 order. It was mandatory. It was structured. It had compliance deadlines and oversight boards. At that point the LRAM and incentives became a huge focus for utilities.

From the Indiana experience, an overarching observation is that the existence of a policy allowing performance incentives (and also lost revenue recovery) was apparently not sufficient to generate meaningful utility energy efficiency programs in the decade preceding the 2009 IURC order. In the opinion of both Staff and advocate organizations, the key factor was the 2009 order creating the annual energy savings requirements (i.e., essentially an EERS).

It remains to be seen how utility performance will fare now that the annual savings requirement has been terminated. At this point the Indiana utilities have all filed and had approved one-year plans to continue some energy efficiency programs during 2015. Early indications suggest that while programs will continue, they will deliver lower savings than in previous years.

Evaluation

For the Core Plus programs, the programs for which a performance incentive is possible, each individual utility is responsible for hiring an independent evaluator to evaluate its programs. Although there is no formal central oversight process such as there was with the DSM Coordinating Committee for the statewide Core programs, each utility has an oversight committee with, at a minimum, representatives from the OUCC, and most also have participation from other stakeholders. The committees are involved in reviewing the work and reports prepared by the evaluator.

For the utilities using the simple tiered-incentive approach described earlier, gross savings are used as the indicator of program impact. For the utilities using a share of net benefits approach, savings are determined using net savings (i.e., adjusted for free-riders).

Process

The experience with the performance incentive mechanisms is fairly limited thus far, and it is too soon to draw conclusions about the process. Staff felt that as utilities utilize and incorporate program evaluation results into the calculations the utilities use to determine their requested incentives, important experience will be gained and the process improved. The OUCC is theoretically in a position to audit the process utilities use and their reported numbers, although the limited time and resources available to the OUCC limits their ability to audit. This need is partially offset by the participation of the OUCC in the utility-specific oversight boards.

Looking Forward

Interestingly, all three utilities that originally had a tiered incentive structure have requested a shared net benefits approach, such as the structure used for I&M. More broadly, however, the policy landscape for utility energy efficiency in Indiana is fairly uncertain at this point. In the governor's letter to the legislature after the enactment of SB 340 he stated,

> I have requested the Indiana Utility Regulatory Commission to immediately begin to develop recommendations that can inform a new legislative framework for consideration during the 2015 session of the Indiana General Assembly.

This suggests that the entire framework for utility energy efficiency programs in Indiana is up for revision. It is yet to be determined whether there will be any type of utility energy efficiency requirements at all (much less annual savings targets), and what associated policies (e.g., LRAM, decoupling, performance incentives) will remain or will be put in place.

At this point the Indiana utilities have all filed one-year plans to continue some energy efficiency programs during 2015. It is noteworthy that now that the IURC annual savings targets have been struck down by SB 340, the projected savings from the voluntary utility plans are, in aggregate, about half of what would have been required under the previous IURC standard.

MASSACHUSETTS

Background

Performance incentives for energy efficiency have existed in Massachusetts for electric companies since the early 1990s. The current performance incentive policy was established in the Green Communities Act of 2008. The act required gas and electric companies to file energy efficiency investment plans with the Department of Public Utilities (DPU). The three-year plans required detailed acquisition strategies for all cost-effective energy efficiency. The plans also were to include a proposal for a mechanism to recover a performance incentive based on meeting or exceeding goals proposed in the plan.[32] There have been two cycles of three-year plans filed since the enactment of the Green Communities Act. The first plan laid the foundation for a performance incentive based on DPU precedent and guidelines included in the Green Communities Act of 2008.

The first three-year plan was filed in 2009 for program years 2010 through 2012. The performance incentive mechanism approved with this plan was made up of three components: a savings mechanism, a value mechanism, and a performance metric mechanism. Both the savings and value mechanism incentive payments are based on benefits for the energy efficiency programs. The savings mechanism focused on total benefits, while the value mechanism focused on net benefits. The payout rate for both

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[32] Green Communities Act 2008. Sec 21 (b)(2)

incentives is applied uniformly across all program administrators including investor-owned utilities (PAs) and determines the incentive amount a PA can receive for each dollar of benefit achieved through the implementation of a program.[33] The payout rates were calculated based on projected benefits and a statewide available incentive pool of $65 million. The allocation of the incentive pool to individual PAs is based on the PA contribution to the statewide savings goals.

The performance metric incentive created both overall targets and targets for specific customer sectors. An incentive amount was allocated for individual PAs after meeting targets specific to each metric. The DPU required PAs to demonstrate annually how each metric was fulfilled. Some metrics, such as CoolSmart: Increase Percent of Correct Installations were easy to quantify.[34] Others, such as the MassSAVE/Weatherization: Increase Direct Installation (DI) bulb penetration, were more difficult to quantify. For the metrics that were more difficult to quantify, the DPU required PAs to make a showing on how necessary steps were taken to meet the specific goal.

Table A6 shows the features and details of the three components of the incentive mechanism.

Table A6. Massachusetts performance incentive structure 2010–2012 three-year plan

Component	Percentage of incentive pool	Purpose	Threshold/limit	Calculation of incentive
Savings mechanism	2010: 45% 2011: 50% 2012: 52%	Encourage maximum total benefits	75% of MWh goal, no limit	Payout equal to percentage of the statewide incentive pool allocated to the savings mechanism divided by the projected statewide benefits multiplied by actual benefits
Value mechanism	35%	Encourage maximum net benefits and cost-effectiveness	75% of MWh goal, no limit	Same as savings mechanism, but instead of total benefits, net benefits are used
Performance metrics	2010: 20% 2011: 15% 2012: 13%	Encourage benefits not included in value and savings mechanism	75% – Threshold 100% – Design 125% – Exemplary	Varies by metric

*** Performance metric incentive specifics were approved in Orders in DPU 09-116B through DPU 09-118B and DPU 09-120 through DPU 09-127B. *Source:* DPU 09-116 through DPU 120 January 28, 2010 Order.**

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[33] Order on DPU 09-116 through DPU 09-120.

[34] This performance metric required electric utilities to increase the percentage of quality installs and properly sized installs in homes that receive a CoolSmart rebate. The goal is based on the increase in percentage over the baseline.

The most recent performance incentive mechanism was approved for the 2013 through 2015 three-year plans.[35] There were several changes in the performance incentive mechanism from the 2010 through 2012 three-year plan. The total statewide performance incentive pool is $80,056,269 for electric program administrators and $16,002,485 for gas. This was an increase in the electric pool and a decrease in the gas pool. Instead of a 75% threshold for PAs to earn the savings and value incentives, each PA has a different energy savings threshold required to begin earning a performance incentive. For example, Unitil Electric must meet 76.72% of its goals before earning an incentive, while Columbia Gas only needs to meet 70.78%. The allocation of the incentive pool also changed. Instead of an annual change in the savings mechanism and performance metric allocation of the pool, fixed percentages were used for all three years. These allocations are listed below under the policy details section. Finally, the performance metric goals were updated and some metrics were eliminated.

Other Relevant Regulatory Features

The Massachusetts Green Communities Act of 2008 requires electric and gas utilities to obtain all cost-effective energy efficiency. Three-year goals are established in triennial plans filed by electric and gas utilities. Electric and gas utilities in Massachusetts have also been fully decoupled since 2008.

Policy Details

Currently, the structure of the incentive mechanism for the 2013–2015 three-year program plans includes two components: the savings and value mechanisms. The performance incentive for each utility is the sum of these two components. The calculation of the savings component payout is the adjusted statewide incentive pool divided by the projected dollar value of statewide benefits. The calculation produces a payout rate per dollar of total benefits. The payout rate for the value mechanism is determined in the same manner except net benefits are used instead of total benefits.

The approved incentive pool available for the 2013–2015 period is $80,056,269 for electric program administrators and $16,002,485 for gas. This pool is equal to approximately 5% of the statewide electric budgets and 3% of the statewide gas program budget. The allocation of the statewide incentive pool is as follows: 61.5% to savings mechanism and 38.5% to value mechanism. The thresholds for both savings and value mechanisms, shown in table A7, vary by utility.

Table A7. Massachusetts performance incentive savings and thresholds by utility 2013–2015

Program administrator	Threshold (%)
Unitil (electric)	76.72
Berkshire Gas	76.72
NEGC	76.72

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[35] *See* Massachusetts Three Year Efficiency Plans Order DPU 12-100 through DPU 12-111. 1/31/13.

Program administrator	Threshold (%)
Unitil (gas)	76.72
NSTAR Electric	76.32
NSTAR Gas	76.25
National Grid (electric)	75.65
National Grid (gas)	75.16
WMECo	72.46
Columbia Gas	70.78

Source: Massachusetts Three-Year Efficiency Plans Order DPU 12-100 through DPU 12-111, 1/31/13

Outcomes

Table A8 shows program costs, energy savings, and incentives for electric and gas. companies.

Table A8. Massachusetts statewide energy efficiency program cost and performance incentives, 2003–2013

Year	Program cost	Energy savings	Performance incentive	Percentage of program costs
		Electric (MWh)		
2003	$107,980,774	317,571	$8,313,920	7.70%
2004	$122,694,191	442,164	$9,625,058	7.84%
2005	$113,875,666	454,726	$9,607,335	8.44%
2006	$120,352,651	417,031	$10,128,897	8.42%
2007	$110,976,339	489,622	$9,181,020	8.27%
2008	$115,103,427	388,254	$9,281,413	8.06%
2009	$175,526,256	424,617	$12,904,615	7.35%
2010	$221,090,179	603,460	$17,577,689	7.95%
2011	$254,692,915	765,226	$20,478,218	8.04%
2012	$361,392,739	950,887	$24,145,526	6.68%
2013*	$466,748,563	1,026,520	$27,379,880	5.87%
		Gas (MMBtu)		
2010	$62,657,153	1,123,915	$4,075,030	6.50%
2011	$97,247,817	1,518,116	$4,213,081	4.33%
2012	$135,120,261	2,262,716	$5,165,768	3.82%
2013*	$171,403,031	2,466,798	$5,413,645	3.16%

* 2013 data not yet approved. *Source:* DPU.

The data show a consistent recovery of approximately 8% of program cost as a performance incentive since 2003. Performance incentives paid have declined in recent years as the total amount available for performance incentives has declined relative to program costs. The total dollar amounts of incentives have still been increasing and are projected to continue to increase as program costs continue to increase. While the performance incentive pool has been limited to approximately 5% of total program cost since 2010 for electric utilities, program administrators are able to earn additional incentives for exceeding planned total benefits, net benefits, and performance metric goals. This is the reason the percentage of program costs has exceeded 5% since 2010. Overall, program administrators in Massachusetts have been exceeding planned performance goals to earn performance incentives greater than 5% of program cost.

Discussion

Massachusetts' newest performance incentive structure is still being refined after going through two approval processes in 2009 and 2012. The consensus of the stakeholders interviewed by ACEEE staff for this report is that performance incentives have been successful in encouraging higher levels of performance. This may be due to the combined effect of multiple policies creating an overall environment that addresses disincentives and pulls for higher savings: all cost-effective energy efficiency, decoupling, savings goals, high program budgets, etc. The performance incentive mechanism is designed to incentivize program administrators to meet savings goals in the most cost-effective manner. The performance metric mechanism is designed to achieve other policy objectives for specific programs. The debate in Massachusetts regarding the performance incentive has focused on the total incentive pool, not the existence or nonexistence of an incentive.

Looking Forward

Currently, Massachusetts is in the middle of a three-year energy efficiency plan cycle. New three-year plans for 2016 through 2018 will be filed next year. Within those plans, it is likely program administrators and other stakeholders will file requested changes to existing performance incentives. However Massachusetts operates some of the most successful utility-sponsored programs in the country. Major changes to the incentive structure or elimination of incentives entirely is not expected in the near future.

MICHIGAN

Background

Michigan had a history of fairly aggressive energy efficiency programs until 1995, when energy efficiency programs and integrated resource planning were discontinued during the move toward electric restructuring. Michigan had essentially no utility-sector energy efficiency programs from 1996 until 2008.

Public Act 295 of 2008 (enrolled SB 213) brought energy efficiency programs back to Michigan in the form of an EERS that requires all electric utilities and all natural gas utilities to file energy optimization (efficiency) programs with the Michigan Public Service Commission (MPSC). Public Act 295 offers multiple options for utilities for energy efficiency program administration, including administration by the utility itself, or through an independent administrator selected by the MPSC. In practice, the largest utilities in the state have chosen to administer their own energy efficiency programs.

PA 295 established an EERS with annual savings requirements for electric utilities of 0.3% in 2009, 0.5% in 2010, 0.75% in 2011, and 1.0% per year for 2012 through 2015 and each year thereafter. For natural gas utilities, the EERS savings was 0.1% in 2009, 0.25% in 2010, 0.5% in 2011, and 0.75% per year for 2012 through 2015 and each year thereafter. Spending for each utility was capped at 0.75% of total retail revenues in 2009, 1.0% in 2010, 1.5% in 2011, and 2.0% in 2012 and each year thereafter.

PA 295 (2008) contains two provisions whereby utilities can receive an economic incentives for implementing energy efficiency programs. First, they are allowed to request that energy efficiency program costs be capitalized and earn a normal rate of return. Second, they are allowed to request a performance incentive for shareholders if the utilities exceed the annual energy savings target. Performance incentives cannot exceed 15% of the total cost of the energy efficiency programs, or 25% of net benefits, whichever is less.

Act 295 also authorized natural gas decoupling, which has been implemented in a series of commission orders. The MPSC subsequently approved decoupling proposals for electric utilities Consumers Energy and Detroit Edison (U-15768 and U-15751), but commission decoupling orders for electric utilities were overturned in court on the basis of lack of specific statutory authority. (See Michigan Court of Appeals *Association of Businesses Advocating Tariff Equity v. Michigan Public Service Commission*, April 10, 2012). In light of the court's determination, the commission dismissed all pending cases involving electric revenue decoupling.

Incentive Policy Details

The utility energy efficiency performance incentive mechanism in Michigan has evolved somewhat over time. Initially it was a fairly simple sliding scale of incentive (defined in terms of percentages of energy efficiency program spending), tied to meeting or exceeding the energy savings annual target. The maximum incentive that could be earned was an amount equivalent to 15% of program spending or 25% of net benefits, whichever was smaller.

The current mechanism is a performance-based incentive with multiple criteria (one of which is still the amount of savings relative to the goal, but others include things like meeting minimum levels of low-income customer participation, the percentage of participating customers that install multiple measures, etc.). The current mechanism for the two largest utilities was established in 2012 and implemented for program year 2013.

The amount of incentive is still capped at the statutory level (15% of spending or 25% of net benefits). Additional threshold requirements are an overall portfolio benefit-cost ratio (using the Utility System Resource Cost Test, i.e., a utility cost test) of 1.25, and meeting 100% of the annual energy savings goal. There are no penalties in the incentive mechanism. Savings are determined using net savings.

Other Relevant Regulatory Features

Michigan adopted an EERS in 2008 with the passage of the Clean, Renewable, and Efficient Energy Act (PA 295). The EERS has both electric and gas savings targets that increase annually. The Michigan Public Service Commission previously approved decoupling for the state's two largest investor-owned electric utilities, Consumers Energy and DTE Energy, but the ruling was overturned by the state appellate court. Natural gas companies in Michigan have implemented a decoupled rate structure as natural gas distribution companies were not affected by the appellate ruling overturning electric decoupling.

Energy Savings Outcomes

Figure A6 illustrates the increase in Michigan electric energy efficiency program savings.

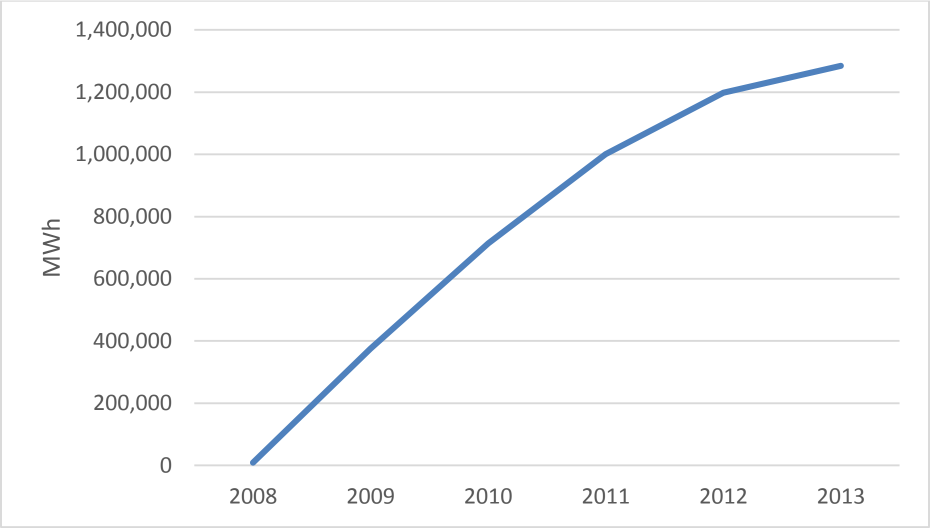

Figure A6. Michigan energy efficiency savings 2008–2013. *Source:* ACEEE *State Scorecard* 2009–2014.

Financial Outcomes

Table A9 shows 2012-2013 Michigan performance incentives and savings.

Table A9. Michigan energy efficiency performance incentives and savings, 2012–2013

Company	Incentive	Fuel	Program cost	Total annual energy savings	PI as percentage of program cost
2013					
Consumers Energy	$17,530,000	Gas	$47,776,949	2,173,124 MCF	15.00%
		Electric	$69,097,040	473,045 MWh	
DTE Energy	$15,085,266	Gas	$25,600,000	1,436,000 MCF	15.00%
		Electric	$74,900,000	614,000 MWH	
2012					
Consumers Energy	$17,327,620	Gas	$48,148,786	2,378,978 MCF	15.00%
		Electric	$67,369,007	409,353 MWh	
DTE Energy	$14,732,686	Gas	$28,600,000	1,186,000 MCF	15.00%
		Electric	$69,600,000	611,000 MWH	

Source: Michigan Public Service Commission

Discussion

The regulatory package established in Michigan in 2008 through PA 295 appears to have worked very well. Michigan utilities went from essentially no-customer energy efficiency programs prior to the legislation, to meeting and exceeding the EERS savings goals every year since the legislation. By all accounts the existence of the utility performance incentive has been a major factor in securing utility management support for the energy efficiency programs. As shown in table A9, the major utilities have generally succeeded in earning the maximum incentive each year.

One concern that has been identified is the tendency for EERS goals established in terms of annual savings to motivate the use of quick, short-term savings measures and programs rather than more comprehensive and longer-term measures. That is one reason the MPSC staff modified the incentive mechanism structure to include elements of comprehensiveness, and not just first-year annual savings.

Evaluation

Utilities are responsible for hiring independent evaluation consultants to evaluate their programs. For key assumptions and technical inputs, the evaluators must use the technical reference manual that is established and overseen by the MPSC through a multiparty energy optimization collaborative process. Utilities submit evaluation results and incentive claims that are reviewed and decided upon in a contested-case process.

Michigan uses net savings for determining any incentive awards.

Looking Forward

Michigan's legislation (PA 295) called for a review of the utility energy efficiency policy in 2015. By all accounts, the policy has been very successful to date, so one might not expect major changes. Two areas for improvement that have been discussed are eliminating the spending cap on energy efficiency programs (currently 2% of utility revenues) and clarifying that electric utilities are eligible for decoupling.

MINNESOTA

Background

Minnesota has a long history of utility energy efficiency programs, dating back well over two decades. In the mid-1990s, Minnesota tried out an LRAM policy, but the cumulative amounts of lost revenue recovery over time became excessive and controversial. The LRAM policy was ended in 1999, and the state shifted to a shareholder incentive approach. Minnesota has maintained substantial utility energy efficiency programs throughout that time period to the present.

In 2007, the Minnesota Legislature passed the Next Generation Energy Act of 2007 (Minnesota Statutes 2008 § 216B.241). Among its provisions is an EERS that sets energy-saving goals for utilities of 1.5% of retail sales each year. This act also directed the Public Utilities Commission to allow one or more rate-regulated utilities to participate in a pilot program (of up to three years) to assess the merits of a rate-decoupling strategy. Although no decoupling mechanism had yet been adopted for an electric utility as of February, 2015, two gas utilities do have decoupling in place. The commission continues to examine decoupling and has established criteria and standards to be used when considering proposals from utilities. A decoupling proposal for Xcel is before the commission.

Minnesota has had a shared benefit incentive mechanism in place since 1999. The details have been modified at various times. The current version is described below. Also, Minnesota's regulated utilities are required to file integrated resource plans with the Public Utilities Commission.

Policy Details

Minnesota's utility performance incentive for energy efficiency is based on a shared net benefits approach. The most recent version was approved on December 12, 2012. The incentive mechanism starts at a threshold of energy savings achieved equal to the lesser of 0.4% of retail sales or 50% of an average of the last five years' achievement levels. As energy savings levels increase to 1.5% of retail sales, utilities are awarded an increasing share of net benefits created. The mechanism is calibrated so that when electric utilities achieve energy savings approximating 1.5% of retail sales, the utility is rewarded with an incentive equal to an average of 7 cents per first year kWh saved. The amount of the incentive varies with the actual cost effectiveness of the implemented projects. There are two caps on the amount of incentives: the average incentive may not exceed 8.75 cents per first year kWh and may not exceed 20% of net benefits. That is the case for Xcel Energy, Interstate Power and Light, and Otter Tail Power. For Minnesota Power, the caps are 8.75 cents per first year kWh and 30% of net benefits.

Incentive payments are based on gross savings. There is no penalty component to the mechanism.

Natural gas utilities have a very similar incentive mechanism, except that the incentive structure is calibrated around a 1% annual savings target, instead of the 1.5% for electric utilities.

Other Relevant Regulatory Features

In 2007, the Minnesota legislature passed an EERS setting savings targets for electric and gas utilities. Minnesota does not allow electric companies to collect lost revenue associated with energy efficiency but has approved decoupling for two natural gas distribution companies, Minnesota Energy Resources Corporation and Center Point Energy.

Energy Savings Outcomes

Figure A7 illustrates the increase in Minnesota electric energy efficiency program savings.

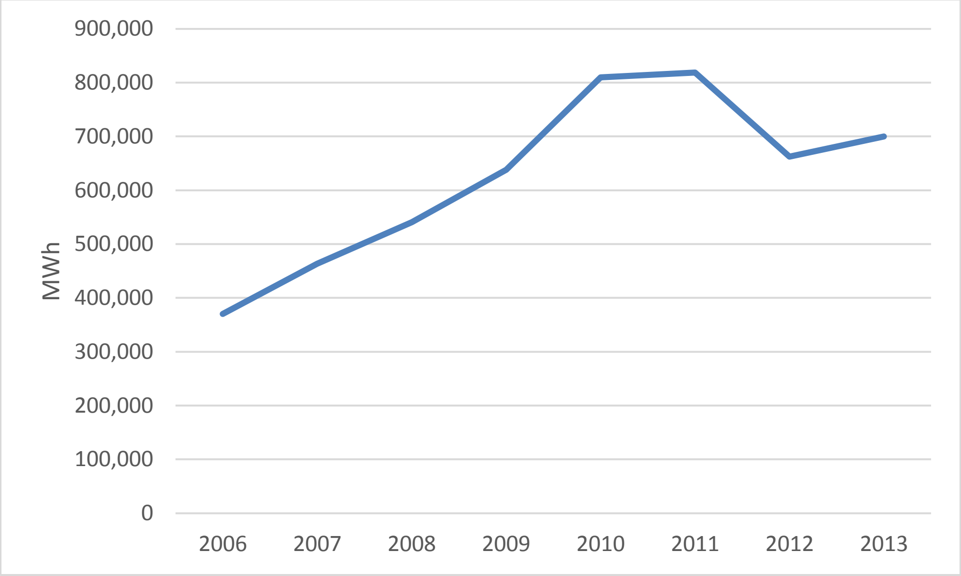

Figure A7. Minnesota energy efficiency savings 2006–2013. *Source:* ACEEE *State Scorecard* 2007–2014

Outcomes

Table A10 shows 2011–2012 Minnesota performance incentives and savings.

Table A10. Minnesota gas and electric energy efficiency program cost, savings, and performance incentives, 2011–2012

Company	Incentive	Program cost	Total annual energy savings	PI as percentage of program cost
		2012		
Xcel Electric	$53,911,925	$87,071,903	533,478 MWh	61.92%
Otter Tail Power	$2,681,575	$4,816,994	30,794 MWh	55.67%
Center Point Energy	$3,207,411	$19,226,405	13,664 Dth	16.68%
Xcel Gas	$2,682,879	$13,040,587	7,671 Dth	20.57%
		2011		
Xcel Electric	$52,004,975	$76,302,262	465,444 MWh	68.16%
Otter Tail Power	$2,608,094	$4,344,581	27,958 MWh	60.03%
Center Point Energy	$4,950,392	$18,990,010	15,284 Dth	26.07%
Xcel Gas	$2,833,202	$11,359,730	7,471 Dth	24.94%

Source: Minnesota Public Service Commission

Discussion

Minnesota's current utility performance incentive approach may well be providing the highest level of energy efficiency performance incentives as a percentage of program costs in the nation. As shown in table A10, over the most recent two years for which data are available, the incentives have been equivalent to well over half to as much as two-thirds of program costs for the electric utilities. This has been a source of concern for many parties, including the attorney general, industrial customer representatives, and the staff of the Minnesota Department of Commerce.

It should be noted that Minnesota's electric utilities had neither LRAM nor decoupling mechanisms in place during this time period. In the absence of a decoupling mechanism, it is possible that the performance incentive may have functioned in part as a way to mitigate utility concerns about the impact of energy efficiency on the recovery of its authorized revenue requirement. Natural gas utilities do have decoupling, and their incentive amounts relative to program spending are much lower. Nevertheless, the question has been raised as to whether that high level of incentive is really necessary to sustain a high level of electric energy efficiency program effort.

Evaluation

Energy savings for prescriptive rebates are based on energy savings found in the Minnesota Technical Reference Manual and customized savings algorithms approved by the Department of Commerce as part of a utility's DSM plan.[36] A measurement and verification protocol exists for larger projects, including billing analysis and submetering.

Utilities analyze their programs using the above protocols and submit the results to the commission in a docket to claim the incentive. Other parties can weigh in on the calculation of the incentive and the timing. The commission then issues an order for an approved incentive amount, and these amounts are rolled into the energy efficiency charge to customers (along with program costs).

Looking Forward

The largest electric utility in the state, Xcel Energy, has a pending proposal to adopt decoupling, and that may change the dynamics around the amount of performance incentive allowed. Also, the Department of Commerce is conducting a review and is due to release a report in July 2015, to include recommendations on these issues.

MISSOURI

Major legislation was enacted in 2009 that marked a major turning point for utility energy efficiency programs in Missouri. The Missouri Energy Efficiency Investment Act (MEEIA, SB 376), passed and signed into law in 2009, established a regulatory framework for utility energy efficiency programs to value demand-side investments equal to traditional investments in supply and delivery infrastructure. Prior to passage of MEEIA, Missouri had limited energy efficiency programs for utility customers even though utilities were required to file and implement electric utility integrated resource plans.

Key provisions of MEEIA specifically address the utility business model. Under MEEIA the Public Service Commission is to

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[36] http://mn.gov/commerce/energy/topics/conservation/Design-Resources/Technical-Reference-Manual.jsp.

- provide timely cost recovery for utilities
- ensure that utility financial incentives are aligned with helping customers use energy more efficiently
- provide timely earnings opportunities associated with cost-effective measurable and verifiable efficiency savings

MEEIA opened the door for electric utilities to propose and establish demand-side program investment cost-recovery mechanisms (DSIM) for demand-side management energy efficiency programs. Addressing the utility business model was critical for Missouri's utilities to move ahead with such programs. One of Missouri's utilities, in fact, had established a fairly large portfolio of programs at the time MEEIA was enacted. Ameren Missouri had launched a portfolio of customer programs totaling about $70 million over a three-year period (2009–2011). However the company rolled back this level of program spending and associated activity when efforts to establish cost recovery and incentive mechanisms meeting the above objectives were not approved in the company's 2011 general rate case. When the commission and utility reached an agreement that established a DSIM, the impact was significant. The stipulation and agreement was between Ameren Missouri and parties to its 2012 MEEIA (2013–2015 plan) application; the agreement was approved by the commission on August 12, 2012. Ameren soon launched a full portfolio of energy efficiency programs totaling $145 million over the three-year program period.

The story is similar for Kansas City Power & Light (KCP&L), which had limited energy efficiency programs and associated investment prior to establishing its own version of a DSIM late in 2014. Once in place KCP&L initiated a portfolio of energy efficiency programs totaling $28.6 million over 18 months, after which time the company is expected to implement a full three-year plan. KCP&L Greater Missouri Operations (GMO), a utility-operating company owned by the same corporation as KCP&L and that serves an area surrounding Kansas City, has followed a similar path as KCP&L. GMO had in place a small set of programs prior to establishing a DSIM; with this in place the company is proceeding with a greatly expanded set of programs.

Other Relevant Regulatory Features

The DSIMs in place for Missouri's utilities contain provisions both for recovery of programs' costs and lost revenues resulting from the programs and the opportunity for incentive awards. The incentive mechanisms are based on receiving a percentage of net shared benefits as determined by deemed savings for lost revenues recovery and by program evaluations for incentive awards. MEEIA's provisions supporting energy efficiency are not mandatory. MEEIA enables utilities to propose and implement such programs but does not require them. The specific language from the statute is the following:

> The Commission shall permit electric corporations to implement Commission-approved demand-side programs proposed pursuant to this section with a goal of achieving all cost-effective demand-side savings.

Decoupling requires periodic adjustments to true up rates and allowed revenues; these adjustments are viewed as rate-making outside of general rate cases. Some parties believe Missouri's existing statutes could be interpreted so as to allow decoupling. To date there have been no decoupling proposals associated with DSM programs submitted to or considered by the commission.

Policy Details

The basic structure of the demand-side incentive mechanisms (DSIMs) established for Ameren MO, KCP&L, and GMO is the same, but details differ.

Ameren Missouri's DSIM was established by a unanimous stipulation and agreement resolving Ameren Missouri's MEEIA Filing (Case No. E0-2012-142) among Ameren Missouri, the staff of the Missouri Public Service Commission, the Office of Public Counsel, the Missouri Department of Natural Resources, the Natural Resources Defense Council, Sierra Club, Renew Missouri (Earth Island Institute), the Missouri Industrial Energy Consumers, and Barnes-Jewish Hospital. The DSIM agreed to by these parties and approved by the Commission addresses program cost recovery, net shared benefits relating to the throughput disincentive, and net shared benefits relating to the performance incentive. The provision addressing net shared benefits relating to the performance incentive is structured this way:

- After the conclusion of the three-year MEEIA plan period and using final EM&V results, Ameren Missouri will be allowed to recover the performance incentive, which is a percentage of net shared benefits (NSB) according to the graduated or sliding scale (shown in the schedule below). The cumulative annual net megawatt-hours determined through EM&V to have been saved as a result of the MEEIA programs will be used to determine the amount of the performance incentive. The sliding scale established determines the amount of the performance incentive award amount for the three-year MEEIA plan.
- The savings metric used to determine the performance incentive is equal to the cumulative net MWh savings determined through EM&V divided by Ameren Missouri's total targeted 793,100 MWh, which is the cumulative annual net MWh savings in the third year of the three-year MEEIA Plan period.
- The targeted net energy savings are adjusted annually for full program-year impacts on targeted net energy savings caused by actual opt-out.
- Actual net energy savings for each program year are determined through the EM&V, including full retrospective application of net-to-gross ratios at the program level using EM&V results from each of the three program years. The sum of these three program years' annual net energy savings is used to determine the amount of the performance incentive award, following the schedule presented in table A11 and figures A8 and A9.

Table A11. Ameren Missouri performance incentive schedule

% of MWh target	Three-year total ($MM)	% of net benefits*
<70	$0.00	0.00%
70	$12.00	4.60%
80	$14.25	4.78%
90	$16.50	4.92%
100	$18.75	5.03%
110	$22.50	5.49%
120	$26.25	5.87%
130	$30.00	6.19%
>130		6.19%

* Includes income taxes (i.e., results in revenue requirement without adding income taxes). The performance incentive awarded will be based on percentage of net benefits. The percentages are interpolated linearly between the performance levels. *Source:* Missouri Public Service Commission

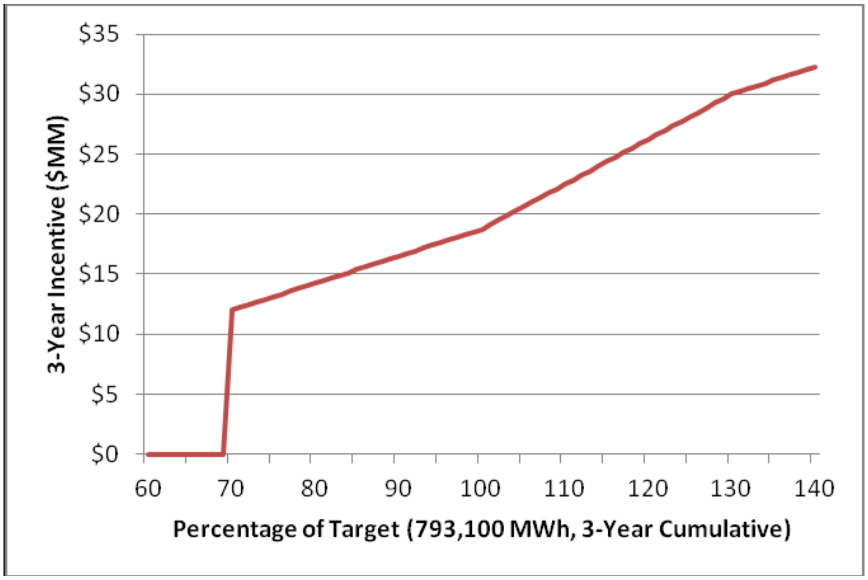

Figure A8. Ameren Missouri performance incentive schedule in dollars. *Source:* Missouri Public Service Commission.

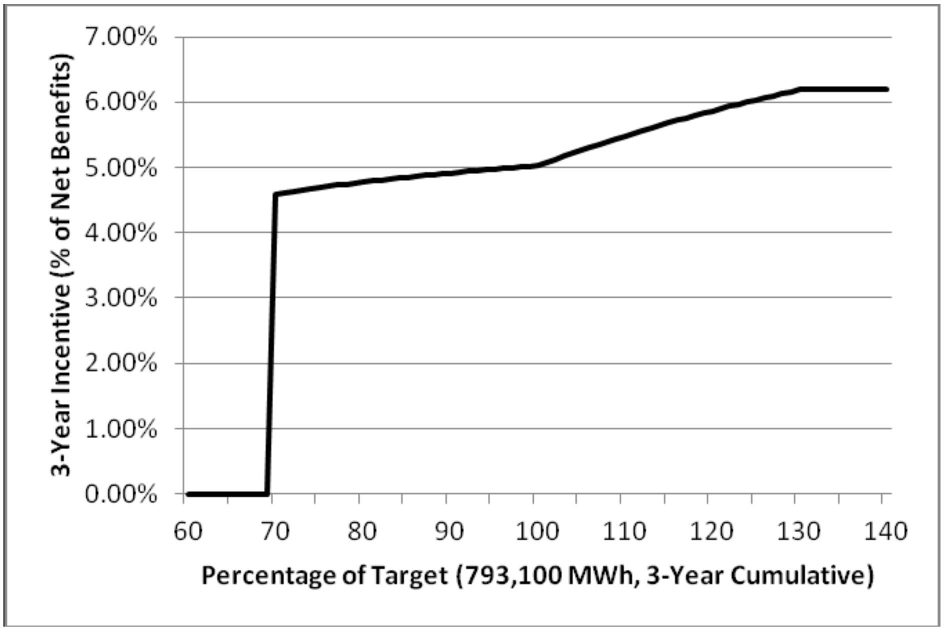

Figure A9. Ameren Missouri performance incentive schedule as percentage of net benefits. *Source:* Missouri Public Service Commission.

The agreement includes a provision for final recovery true up of any performance incentive award amount.

Outcomes

It may be too early in the initial program plan periods for the utilities with DSIMs in place to assess the full impacts and associated financial outcomes, particularly as they apply to the performance incentives, as these are not determined until full EM&V results are determined after the applicable full program plan periods (3 years for Ameren Missouri and GMO, 18 months for KCP&L's initial plan). Ameren Missouri is exceeding program savings targets and is on track to receive full incentive amounts.

Missouri's DSIMs (addressing both the throughput disincentive and shareholder performance incentive) are very new. Ameren Missouri's and GMO's mechanisms each have completed the first full program years (2013 data are complete; 2014 data are not yet final) associated with the mechanisms. KP&L's mechanism was enacted in July 2014.

While early in the process associated with determining and awarding these incentives, the impact of having these mechanisms in place is dramatic. It is clear from discussions with Missouri stakeholders that establishing these mechanisms has enabled affected utilities to initiate and fund large portfolios of customer energy efficiency programs.

Ameren Missouri's recent history with energy efficiency program funding well illustrates the dramatic impact that MEEIA and authorization of DSIMs have had. Prior to MEEIA's passage, Ameren Missouri had energy efficiency programs in place representing total utility investment of about $70 million for the three-year period of 2009–2011. During this time Ameren Missouri received only program cost recovery—no lost revenue recovery or shareholder incentive amounts. Ameren Missouri executives viewed this business model for energy efficiency as unsustainable. As a result Ameren Missouri "put on the brakes" to its programs and reduced its program funding from $30 million in 2011 to a bridge funding of $8 million in 2012. MEEIA had just passed in 2012, and Ameren Missouri sought to retain the basic foundations of its energy efficiency programs in place in anticipation of getting regulatory treatment of costs and incentives to allow it to return to a much higher level of investment. With the commission's approval of its DSIM, Ameren Missouri's planned investment did indeed jump—up to $35 million in 2013, $45 million in 2014, and as much as $65 million in 2015. As viewed by the director of Ameren Missouri's programs, accounting for all three legs of the financial stool "had a profound impact on Ameren Missouri's investments in energy efficiency." A clean energy advocate echoed this conclusion, commenting that such action "definitely changed Ameren Missouri's behavior" regarding its energy efficiency programs.

As noted earlier, MEEIA does not require utilities to fund and provide energy efficiency programs. They are voluntary. Consequently, there needed to be incentives for the utilities to engage fully and provide energy efficiency programs and services. To date, three out of four regulated electric utilities in Missouri have established energy efficiency programs in response to MEEIA. The remaining utility, Empire Electric, is developing proposals and initiated a MEEIA filing in late 2013.

Evaluation

MEEIA established guidelines and specific requirements for EM&V. Determination of the performance incentive is based on ex-post program evaluations. Consequently, annual impact evaluations are required to determine net energy and demand savings.

Process

The performance incentives are determined from the savings impacts as quantified from program evaluations completed by independent third-party contractors for the utilities. The Public Service Commission of Missouri contracts with an evaluation auditor to review the evaluations completed by the utilities' contractors in order to help ensure their accuracy. The parties filed a stipulation and agreement on February 11, 2015, to settle all issues related to final EM&V for 2013 and to put into place a process to address EM&V issues for 2014 and 2015.

Commission staff commented that the learning curve is very steep for utility energy efficiency programs; it is taking time for all parties involved to work through the processes and issues associated with the development, implementation, and evaluation of programs, including determination of utility incentives.

Looking Ahead

The rules established for MEEIA are undergoing a required review that began in 2015. Missouri's regulations requiring integrated resource planning remain in place; such proceedings occur separately from MEEIA program filings.

Ameren Missouri filed its next three-year MEEIA program plan in December 2014. The existing DSIM is part of this plan. The proposed level of investment in energy efficiency programs remains about the same as the existing three-year MEEIA program plan, but expected savings are about half.

Missouri's DSIMs in place are too new to be able to assess their full impact and effectiveness. It is clear that having these in place has been a catalyst for Missouri's electric utilities to move ahead with portfolios of customer energy efficiency programs representing significant utility investment.

While more time and analysis will be needed before a full assessment of the effectiveness of Missouri's DSIMs have been, it already is clear, in the words of one Missouri observer, that having mechanisms in place to address the utility business model "has been effective in moving the need in a positive direction in a state where there had been no incentives for utility energy efficiency."

OKLAHOMA

Background

Utility performance incentives for energy efficiency programs were first approved in Oklahoma for Public Service Company of Oklahoma (PSO) in 2008.[37] The incentive structure approved for PSO was a shared savings approach that allowed PSO to recover 25% of the net benefits for those programs that achieve measurable benefits. The total resource cost test was to be used in calculating the net benefits of the programs. The mechanism also allowed PSO to recover 15% of program costs as an incentive for programs in which savings cannot be determined. The projected savings benefit was then trued up to the actual savings benefit following completion of the program year.

Oklahoma Gas and Electric (OGE) was first approved to receive performance incentives in 2009.[38] OGE's approved performance incentive structure was similar to the PSO approved shared benefit structure. However the OGE performance incentive was limited to 15% of the net shared benefits for eligible programs with a TRC score higher than 1.0 and capped at $2.7 million in the first year. OGE's request to earn a performance incentive on education programs was denied by the Oklahoma Corporate Commission (OCC).[39] As part of the settlement agreement approved by the OCC, OGE was also allowed to earn an incentive of 15% of program costs on programs that scored less than 1.0 on the TRC test.

In 2012, the OCC approved a settlement agreement for PSO to continue offering demand response and energy efficiency programs for an additional three years. The settlement agreement contained a reduced performance incentive for PSO, allowing the company to recover 15% of shared benefits instead of the previously approved 25%. The settlement agreement also allowed PSO to recover an incentive of 15% of program costs on education programs.

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[37] Cause No. 200700449. Order No. 555302 issued June 13, 2008.

[38] Cause No. 200900200. Order No. 573419 issued January 21, 2010.

[39] Education programs represented 7.5% of the total DSM program budgets and included home energy reports.

In 2012, OGE received approval from OCC to offer programs for 2013–2015.[40] As part of the approved settlement agreement, OGE is allowed to continue the approved performance incentive structure from Cause No. 200900200. For the new three-year program cycle, OGE added two programs focused on decreasing peak demand, the SmartHours program and integrated volt var control (IVVC). These two programs are not eligible for any performance incentives.

In 2010, Oklahoma Natural Gas and CenterPoint Energy Resources received authorization to offer efficiency programs.[41] As part of this authorization, both companies received approval to collect a performance incentive of 15% of the net benefits for programs passing the TRC. The mechanism was similar to electric program performance incentives at the time. An incentive of 15% of the net benefits was awarded for programs passing the TRC and 15% of program costs for programs not passing the TRC. Program budgets for both companies were fixed for proposed three-year cycles.

Other Relevant Regulatory Features

Oklahoma does not have an energy efficiency resource standard at this time. The OCC also has yet to approve decoupling for any electric utility in the state.

Policy Details

The details of the current performance incentives for OGE and PSO are detailed in table A12 below. Both current incentive structures were approved by the OCC in 2012. Both companies collect a projected shared savings incentive and then true up the results following the end of the program year. The shared savings mechanisms for PSO and OGE are similar but have significant differences. For example, while PSO and OGE both collect 15% of the net benefits of energy efficiency programs, the net benefits are calculated in different ways. OGE calculates the incentive as 15% of the net benefits of the total resource cost test for programs with a score over 1.0. PSO calculates net benefits using the Program Administrator Cost Test. This difference allows PSO to collect a higher level of incentives because the costs included in the total resource cost test are greater than the costs included in the Program Administrator Cost Test. Both companies collect 15% of program costs for programs failing to meet a 1.0 score on the PACT or TRC. PSO also collects an incentive on demand response programs while OGE does not. Finally, PSO collects an incentive of 15% of program costs for education programs while OGE does not.

Outcomes

Table A12 outlines recent performance for electric utilities in Oklahoma and the associated incentives.

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[40] Cause No. 201200134. Order No. 605737 issued December 20, 2012.

[41] Cause Nos. 201000143 and 201000148. Order Nos. 585366 issued May 12, 2010 and 583869 issued March 25, 2011.

Table A12. OGE and PSO recent performance

Year	Program cost	Annual savings (MWh)	Performance incentive	Percentage of total program costs
Oklahoma Gas and Electric				
2011	$18,200,806	64,743	$3,105,699	17%
2012	$14,662,068	34,406	$2,609,501	18%
Public Service Company of Oklahoma				
2012	$21,963,690	75,629	$5,526,804	25%
2013	$22,335,179	67,901	$4,691,690	21%

Source: Oklahoma Corporate Commission

The data show utilities have performed well in regard to offering cost-effective programs with sizable net benefits. However it should be noted the incentives are calculated differently for OGE and PSO, thereby making direct comparisons between the two companies difficult. It is also important to note that the true-up data for companies in Oklahoma is not filed publicly, making it difficult to determine how actual results and spending compare with projected results and spending.

Figure A10 illustrates the increase in Oklahoma electric energy efficiency program savings.

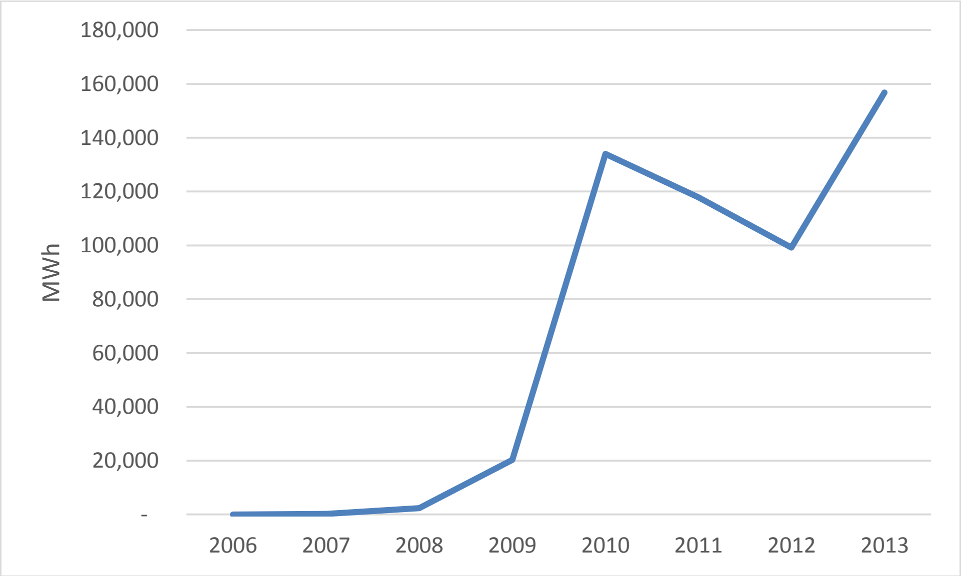

Figure A10. Oklahoma Energy Savings 2006–2013. *Source:* ACEEE 2014 *State Scorecard.*

Discussion

Oklahoma has a very favorable performance incentive policy in place for electric and gas utilities. The shared savings approach has allowed utilities in Oklahoma to earn as much as 25% of total program costs as an incentive since the inception of the policy. The general consensus of stakeholders interviewed by ACEEE is that the policy has been effective in encouraging utilities to achieve greater energy efficiency savings. Some stakeholders expressed happiness with the progress made in Oklahoma but stated that the utilities could be achieving much greater savings and would be doing so if the state had an energy efficiency resource standard. Other stakeholders expressed concern that without the incentive policy in place, it is unlikely the utilities would offer any programs at all.

Looking Forward

The performance incentive structure in Oklahoma will be modified following the current three-year program plans (2015). The changes are a result of a 2013 rulemaking proceeding to modify several aspects of gas and electric utility rules. Beginning in 2015, utilities will only be allowed to collect an incentive if the portfolio achieves 80% of the individual utility's goal and the portfolio has a TRC score higher than 1.0. Utilities will still be able to earn an incentive on programs with a TRC result of less than 1.0, but only if the portfolio as a whole passes the test. If savings beyond 100% of the utility savings goal are achieved, 15% of net benefits will be paid. The rule is not explicit in a maximum threshold for the total incentive, only the minimum. Finally, the new rule does not have explicit penalties but does have language giving the commission the ability to reduce the incentive if the utility exceeds spending targets. The new changes are expected to simplify the process and level the playing field as all utilities will have the opportunity to earn the same incentive.

RHODE ISLAND

Background

Rhode Island has had performance incentives in place for Narragansett Electric Company (National Grid) since 1990. The electric performance incentive has changed over time. Initially, the Rhode Island Public Utility Commission (RIPUC) allowed National Grid to earn a total 4.25% of the energy efficiency budget, excluding evaluation costs. The company was required to reach 45% of the targeted annual energy savings goal for a specific sector to begin earning a performance incentive. In 2004, the RIPUC approved changes to the mechanism to increase the allowed incentive from 4.25% to 4.4% of eligible program costs. [42] In addition to the energy savings goal, National Grid was also allowed to earn an incentive for achieving goals in five performance metric categories for specific programs. The threshold to earn the incentive for each sector was also increased from 45% to 60%.

In 2007, RIPUC also approved a performance incentive for National Grid's gas efficiency programs. The target incentive rate was 4.4% of eligible program costs, just as it was for electric programs. The threshold and maximum incentive structure were also the same as the electric model. The sector categories for incentives for natural gas energy efficiency performance were initially residential and commercial and industrial (C&I). The savings targets are measured in annual MMBtu.

In 2009, the sectors for which the incentive targets are measured for electric performance incentives were changed from residential, small C&I, and large C&I to low-income residential, non-low-income residential, and large C&I. The gas incentive sectors were also

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[42] See Rhode Island Public Service Commission Order 18152.

changed by splitting the residential sector into low-income residential and non-low-income residential. Also in 2009, a provision was introduced to adjust the goals for efficiency in actual spending relative to budget in the achievement of savings goals. In 2010, the performance metric incentives for five separate categories related to specific programs were eliminated to simplify awarding the incentive. In 2012, the gas and electric performance incentive underwent significant changes as the savings target incentive rate was increased to 5% and the threshold to earn the incentive was increased from 60% to 75%. In the company's settlement agreement for 2015, additional changes were made, as described in the section on looking ahead.

Other Relevant Regulatory Features

The Comprehensive Energy Conservation, Efficiency and Affordability Act of 2006 requires utilities to acquire all cost-effective energy efficiency.[43] The act also establishes requirements for strategic long-term planning and purchasing of least-cost supply and demand resources, and three-year energy saving targets. The energy savings targets are proposed by the Rhode Island Energy Efficiency and Resources Management Council. High-level strategies and illustrative budgets to reach those targets are developed in three-year plans filed by National Grid. Within the three-year plan time frame, National Grid then files annual plans containing detailed goals, budgets, and program plans for PUC approval. Revenue decoupling is also fully implemented by National Grid electric and gas in Rhode Island.

Policy Details

As of 2014, the company may earn a target-based incentive rate equal to 5% of the eligible spending budget in a program year for achieving electric and gas energy savings goals. The incentive mechanism establishes an incentive of 1.25% of the annual budget for achieving 75% of the savings goals in a sector. This increases linearly to 5% of the annual budget for achievement of 100%, and increase linearly from that point to 6.25% of the annual budget for achieving 125% of the savings goals. The company must achieve at least 75% of the targeted performance to begin earning any incentive. Figure A11 illustrates the current incentive mechanism and how it differs from the 2012 mechanism.

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[43] http://www.ripuc.org/eventsactions/docket/3759-RIAct.pdf

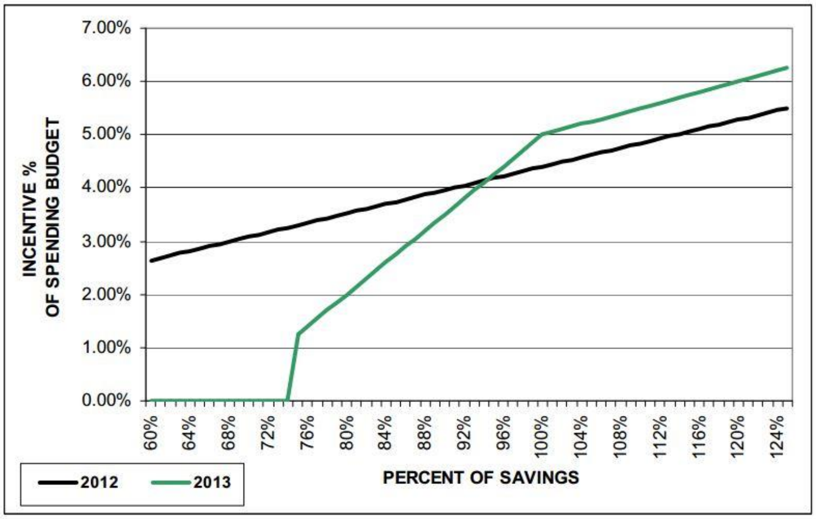

Figure A11. Shareholder incentive mechanism, 2012 and 2013. *Source:* National Grid 2013 EE Plan Docket No. 4366, page 24.

Outcomes

Table A13 details program spending, savings, and performance incentives earned since 2010 for electric and gas programs.

Table A13. Rhode Island performance incentives, 2010–2013

Year	Program cost	Annual savings	Incentive amounts	Percentage of incentive target*
		Electric (MWh)		
2010	$23,747,710	81,275	$1,333,996	107.1%
2011	$32,972,679	96,009	$1,929,273	93.5%
2012	$45,768,146	119,666	$2,469,411	93.%
2013	$62,372,290	157,121	$2,997,681	98.9%
		Gas (MMBtu)		
2010	$5,197,448	140,097	$231,310	126.8%
2011	$4,518,069	119,613	$239,863	117%
2012	$12,554,591	229,811	$586,036	99.2%
2013	$17,925,668	312,433	$968,229	108.6%

* The value in this column represents the total percentage of incentive target met. However the incentive is actually calculated at the sector level, and the company must meet sector-level thresholds to earn the incentive for each sector. *Source:* Rhode Island Public Service Commission.

The data show that the electric and gas programs have routinely performed within the bounds of 90% to 125% of the savings targets. It is also worth noting that the 2013 electric program performance increased following an increase in the target incentive rate following two years of declining performance.

Figure A12 illustrates the increase in Rhode Island electric energy efficiency program savings.

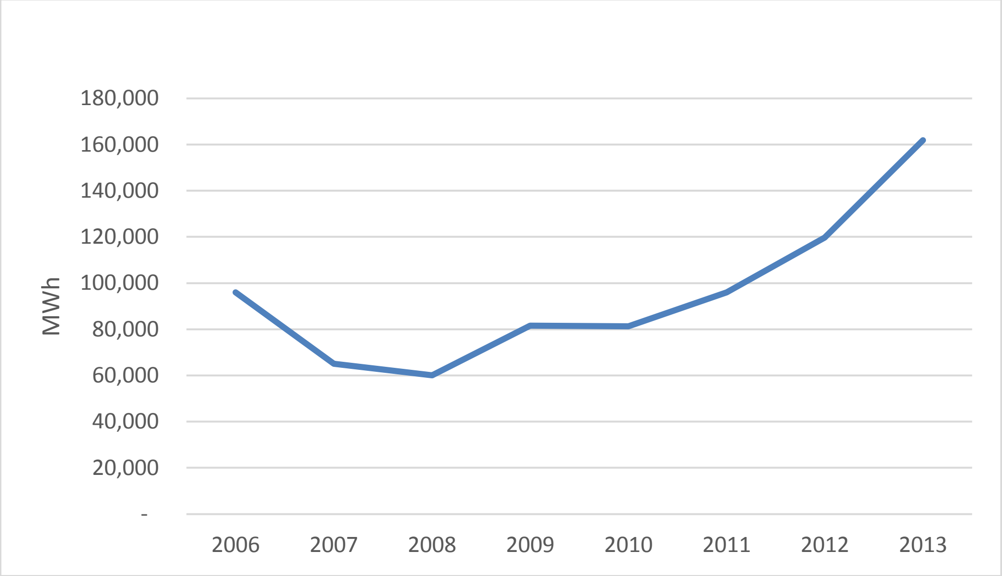

Figure A12. Rhode Island energy savings, 2006–2013. *Source:* 2014 *State Scorecard.*

Discussion

The unanimous response from the interviews conducted by ACEEE staff was that incentives have been effective in encouraging National Grid to achieve greater results with its energy efficiency programs. One of the strengths of the Rhode Island performance incentive mechanism is that the stakeholders have the opportunity to propose modifications to the incentive structure annually.[44] This allows for a nimble incentive that can change as circumstances change. For example, program performance declined in 2011 and 2012 as National Grid struggled to spend approved budgets and meet savings goals during a period of aggressive program ramping up and corporate restructuring. After the second straight year of performance below goals, the stakeholder group and National Grid agreed to increase the 4.4% award to 5% of the eligible program costs for achievement of 100% of the energy savings goals (with a maximum threshold of 125% for a 6.25% incentive). Since the change in incentive level, however, National Grid has stabilized its energy efficiency delivery efforts. At the same time, the minimum threshold was increased from 60% to 75% of performance targets to begin earning an incentive. This change has seemed to achieve the desired effect as program spending and performance increased to pre-2011 levels in 2013. The mechanism has served to focus utility attention on achieving their goals.

Looking Forward

The 2013–2014 winter was colder than average, and high natural gas demand caused significantly higher spot market prices. The result of these conditions is very high peak energy prices. To reduce peak demand and thus avoid higher prices, the stakeholder group

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[44] While the stakeholder process can propose changes to the incentive mechanism and other aspects of National Grid's program plan, ultimately any modifications must be approved by the RIPUC.

and National Grid agreed upon a demand-reduction incentive. This incentive was designed and agreed upon to increase demand reduction in the summer and provide an increased focus on demand reduction throughout the year. This proposal, introduced as part of the 2015 Energy Efficiency Program Plan, was approved by the RIPUC.

The newly designed performance incentive only applies to electric program budgets. In order to promote the achievement of demand savings goals, the company proposes to set aside 30% of the current incentive to be available for the achievement of summer annual MW savings goals. This would allow the company to earn a target-based incentive rate equal to 3.5% of the eligible annual budget for achieving MWh savings goals and 1.5% of the annual spending budget for achieving MW savings goals.

TEXAS

Background

Texas first established a performance incentive mechanism for electric utilities in 2008. The performance incentive, or bonus as it is referred to in Texas, allowed electric utilities to earn 1% of net benefits for every 2% of a company's goal that it exceeded. In an effort to limit disproportionately high bonuses, the Public Utility Commission of Texas (PUCT) capped the bonus not to exceed 20% of total program costs for each utility. The established threshold for a utility to earn a bonus was 100% of the demand and energy goals as defined in Texas law. Net benefits were calculated by subtracting the net present value of the avoided cost of energy and capacity from the program costs. Program costs included all incentives and administrative and program evaluation costs. Demand and energy savings were gross values; that is, they are not adjusted for naturally occurring savings or free riders.[45] The rule also allowed utilities to earn an additional bonus for achieving at least 120% of its demand reduction goal with at least 10% of its savings met through hard-to-reach programs. This additional bonus was equal to 10% of the first bonus. Hard-to-reach programs were designed to target residential customers with an annual household income at or below 200% of the federal poverty guidelines.

The performance bonus was modified in 2011. Previously, a utility was awarded a bonus of 1% of net benefits for every 2% a company exceeded its goals, up to 20% of total program costs. This was modified to limit the bonus to 10% of net benefits instead of 20% of total program costs. This change has created the possibility for utilities to earn much more than 20% of program cost as a performance incentive. Companies in 2012 earned between 10% and 31% of total program costs as a performance incentive. In 2013, companies were earning between 31% and 46% of program costs as a performance incentive. The change was instituted to encourage utilities to achieve savings with greater net benefits.[46] The 2011 changes eliminated the additional bonus incentive previously awarded to utilities achieving

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[45] Performance incentives first established in Order Adopting the Repeal of §25.181 and §25.184 and of new §25.181 as Approved at the March 26, 2008 Open Meeting. Project No. 33487.

[46] Modifications approved in Order Adopting Amendments to §25.181 as Approved at the September 28, 2012 Open Meeting.

120% of its demand reduction goal with at least 10% of its savings met through hard-to-reach programs.

Other Relevant Regulatory Features

Texas was the first state to adopt an Energy Efficiency Resource Standard in 1999. Currently, the annual goals mandate a 30% reduction of annual growth in demand for residential and commercial customers. However the structure of the goal allows a utility to meet the goals by reducing demand by 0.4% of its summer-weather-adjusted peak demand for the previous year. Texas does not currently allow electric utilities full decoupling or lost revenue recovery for offering energy efficiency programs.

Policy Details

Electric utilities may earn performance bonuses for achieving 100% of demand and energy savings targets prescribed in Texas law. The demand and energy goals require utilities to reduce annual growth in demand for residential and commercial customers by 30% for the previous year. If a 30% reduction is equivalent to at least 0.4% of summer-weather-adjusted peak demand for the combined residential and commercial customers for the previous year, 0.4% becomes the new goal.[47] Once a utility exceeds 100% of the approved goal and does not exceed spending limits, the utility will earn 1% of the net benefits for every 2% the goal is exceeded, with a maximum of 10% of the utility's total net benefits. Utilities must also spend at least 5% of the program budget on hard-to-reach savings to be eligible for a bonus.

Outcomes

Table A14 contains the aggregate results for energy efficiency programs and performance bonuses since 2008. Data were collected for all 10 electric utilities operating programs and receiving performance bonuses.

Table A14. Texas energy efficiency results and performance bonus, 2008–2013

Year	Total energy efficiency expenditures	Demand savings (MW)	Energy savings (GWh)	Performance bonus	Bonus as percentage of total expenditures
2008	$96,127,475	202	580	$19,238,502	20.01%
2009	$105,809,802	240	560	$21,148,220	19.99%
2010	$105,290,918	301	533	$20,432,317	19.41%
2011	$113,911,740	270	529	$21,487,140	18.86%
2012	$119,834,458	402	288	$28,736,107	23.98%
2013	$138,715,805	415	548	$53,678,151	38.70%

Source: Utility annual energy efficiency reports filed in Project Nos. 42264, 41196, 40194, 39105, and 37982

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[47] §25.181—15. The establishment of demand and energy goals is far more complicated than described in this case study. For the purpose of brevity and focus on performance incentives, a detailed discussion of energy and demand goal setting has been withheld.

Utilities in Texas have rarely failed to earn an annual performance bonus since the policy began in 2008. Demand savings have increased annually, with the only exception being a slight drop in 2011. Following the modest decline in 2011, demand savings have increased to over 415 MW in 2013, almost as big as a typical power plant. Energy savings have experienced a decline since the 2008, with a notable drop in 2012. With modest goals, however, most utilities exceed annual energy savings goals necessary to earn performance bonuses.

Figure A13 depicts the results.

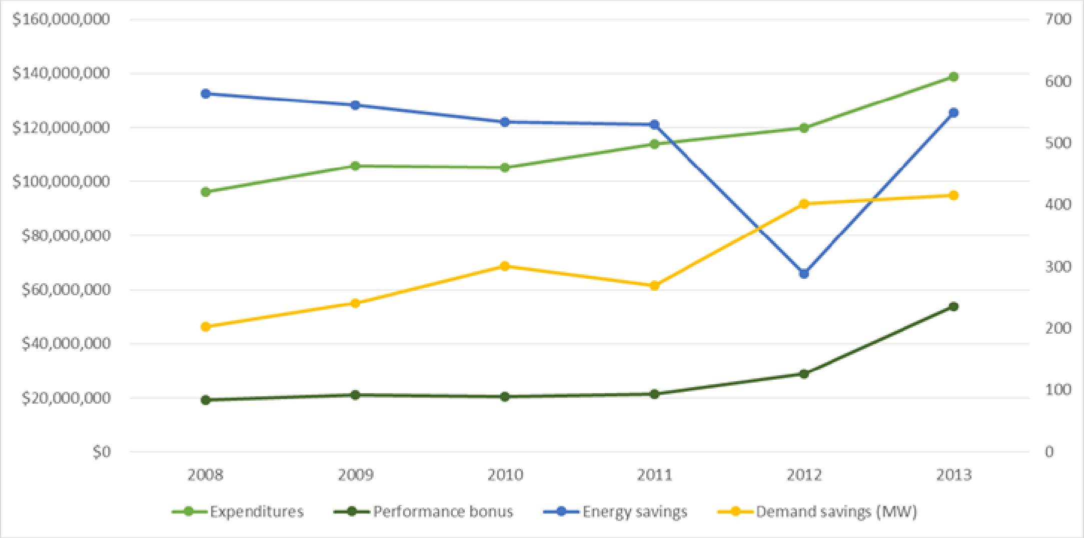

Figure A13. Texas energy efficiency results and performance bonus, 2008–2013. *Source:* Utility annual energy efficiency reports filed in Project Nos. 42264, 41196, 40194, 39105, and 37982.

Discussion

The performance bonus mechanism has been partially influential in increasing demand savings but has had a questionable effect on energy savings. Energy savings have declined since 2008, the year the performance bonus was first authorized. Demand savings have more than doubled during this same time and have increased markedly since 2011. While there were changes to the performance incentives structure at this time, the increase in demand savings can be attributed to the PUCT request to increase demand reductions from load management programs. However most utilities have exceeded energy savings targets since 2008. The spike in demand reduction performance coincided with the change in the performance incentive structure in 2011. Also in 2011, the Texas legislature adopted Senate Bill 1125 that modified the energy efficiency goal structure to include a peak demand component.

Many companies performed at levels significantly beyond goals and the maximum incentive level. As an example, Southwestern Electric Power Company met 194% of its energy goal and 238% of its demand goal in 2012. The calculated performance incentive for this level of achievement was $8,060,397. However SWEPCo only earned the maximum bonus based on 10% of net benefits, or $1,168,476. Many Texas utilities in 2012 and 2013 filed similar bonus calculations collecting a much lower bonus due to limits than what would have been potentially available. In 2013, AEP Texas Central Company calculated a performance bonus of $38,212,549 but only collected $4,459,958, the maximum allowed as 10% of net benefits.

As the data above show, the performance incentives in Texas are substantial, exceeding 38% of program cost in 2013 in aggregate. The performance incentives in Texas are based on a net benefits approach. Net benefits are results of calculations based on the avoided cost of energy. The avoided cost of energy in Texas is updated annually. The frequent updates can have significant impacts on the calculation of net benefits and the performance incentive. In 2012, the avoided cost of energy was 6.4 cents per kWh. In 2013, the value increased to 10.4 cents per kWh but then declined to 4.6 cents per kWh in 2014. Large changes in avoided cost in Texas explain part of the increase in performance incentives awarded in 2013 from 2012.

In comments filed in both Project No. 33487, the establishment of the performance bonus, and in Project No. 39674, the modifications to the limits of the performance bonus, commenters expressed concern with the level of incentives allowed. However Texas does not allow lost revenue recovery or have a decoupled rate structure. Many utilities view the incentive structure as a way to allow a company to earn part of the lost revenues associated with energy efficiency.

During PUCT rule-making proceedings to modify the performance incentives and energy efficiency goals, commenters have objected to the use of gross savings for goal attainment and performance bonus calculation.[48] The PUCT specifically requires the performance bonus to be calculated using demand or energy savings from programs implemented to obtain goals.[49] By definition, this would only include net savings, but utility filing projections and results are in gross savings terms. Evaluations in Texas do not include net-to-gross analysis, making it difficult to determine if utilities are earning incentives on savings not attributable to specific programs.

Looking Forward

Currently, there are no changes expected to the performance bonus mechanism in the near future. Changes to the mechanism have historically been initiated in the Texas legislature and worked through the PUCT rule-making process. In both of the major rule makings associated with the performance bonus, parties have actively participated in shaping the final rules. However, without legislative action, it is unlikely any changes will happen soon.

Table A15 shows energy demand goals and performance.

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[48] See comments of Cities in Project No. 39674.

[49] §25.181(h): Energy Efficiency Performance Bonus.

Table A15. Texas energy and demand goals and performance, 2008–2013

Year	Demand goal (MW)	Demand savings (MW)	Percentage of goal met	Energy savings goal (GWh)	Energy savings (GWh)	Percentage of goal met
2008	117	202	172%	375	580	155%
2009	134	240	179%	403	560	139%
2010	142	301	212%	391	533	137%
2011	147	270	183%	400	529	132%
2012	152	402	265%	366	288	79%
2013	175	415	237%	442	548	124%

Source: Utility annual energy efficiency reports filed in Project Nos. 42264, 41196, 40194, 39105, and 37982

VERMONT

Background

Performance incentives have existed in Vermont since the inception of Efficiency Vermont in 1999. Efficiency Vermont is the statewide energy efficiency program operated by Vermont Energy Investment Corporation (VEIC). VEIC was initially contracted through the Vermont Public Service Board (VPSB) to serve as the energy efficiency service provider under a contract agreement but has operated as a jurisdictional regulated utility under a long-term 12-year Order of Appointment since 2010. When VEIC first contracted with the VPSB in 1999, the contract allowed VEIC to earn a percentage of program cost for meeting performance targets in specific areas over the course of a three-year program plan. The performance targets are known as quantifiable performance indicators (QPIs). The initial contract and agreements for subsequent three-year performance periods have allowed VEIC to earn between 3.4% and 4.3% of program costs as compensation (guaranteed return and a performance incentive). Since 1999 a percentage of this compensation was guaranteed and is known as an operations fee.

The remaining compensation is the performance incentive and is at risk. The performance incentive-based compensation can only be earned if VEIC meets the QPIs. The percentage of compensation allocated to the operation fee and performance incentive has fluctuated some between three-year performance periods. In the most recent performance period, 2015–2017, the operations fee is 40% and the performance incentive is 60% of total compensation. VEIC's QPIs and compensation structure are revisited and modified prior to every three-year cycle through the Demand Resource Plan (DRP) proceeding before the VPSB, with the most recent QPIs established for the 2015–2017 performance period in 2014.

For the 2015–2017 performance period, VEIC proposed an increase in the compensation rate from 4.1% to 6% (margin rate), and to equally distribute compensation on a 50–50 basis between the operations fee and performance incentive, as opposed to the current 40–60 split as recommended by the Public Service Department (PSD). VEIC had first recommended an increase from 4.1% to 6%.[50] In addition, VEIC recommended the calculation method for the compensation rate continue to be based on a margin approach (used to set the compensation rate for the 2012–2014 performance period). The margin approach is based on the total percentage of compensation above cost, as opposed to a markup rate as a percentage of the total program cost as recommended by the PSD. The VPSB approved an increase to 4.5% on a markup basis (equating to a 4.3% margin rate) while maintaining a 40–60 split between guaranteed compensation and at-risk performance incentives.[51]

The City of Burlington Electric Department (BED) operates electric energy efficiency programs with established performance targets. BED's energy efficiency costs are recovered dollar for dollar at no additional cost to ratepayers (no operations fee or performance incentive). Vermont Gas Systems (VGS) also operates gas efficiency programs. As an incentive to operate programs, VGS is allowed to earn a rate of return on efficiency investments. The rate of return VGS earns on efficiency investments is the same rate of return approved in the company's last rate case.

Other Relevant Regulatory Features

Vermont has a nontraditional energy efficiency resource standard. Vermont law requires energy efficiency budgets to be set at a level that would realize "all reasonably available, cost-effective energy efficiency." Every 3 years the DRP produces an annual electric budget and savings 20-year forecast. Vermont law required utilities in the state to perform least-cost integrated resource planning "to identify and evaluate on an ongoing basis, resources that will meet Vermont's energy service needs in accordance with the principles of least cost integrated planning, including efficiency, conservation and load management alternatives, wise use of renewable resources, and environmentally sound energy supply."[52] Resource planning requires comprehensive energy efficiency programs designed to acquire the full amount of cost-effective savings.[53] Vermont also encourages energy efficiency through innovative rate making including inclining block rates and decoupling approved for Green Mountain Power and Vermont Gas.

Policy Details

The current electric performance incentive allows VEIC to earn a percentage of total program costs as an incentive. The incentive amount earned is determined by VEIC's ability to meet specific targets and minimum requirements for 15 electric-efficiency and 4 thermal-energy-and-process-fuels (TEPF) QPIs. Each QPI focuses on different policy objectives of the statewide efficiency program.

Electric-efficiency QPIs 1-7 are positive incentives awarded to VEIC for meeting a target for specific tasks. For example, QPI 1 targets energy savings. VEIC can begin earning an

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[50] VEIC April 6, 2014, compensation recommendation: http://psb.vermont.gov/docketsandprojects/eeu/drp2013.

[51] EEU-2013-01, Order Regarding Energy Efficiency Utility Budgets for Demand Resources Plan. Page 60. July 9, 2014.

[52] 30 VSA §202a(2).

[53] 30 VSA §218c(a)(2).

incentive when 90% of the target is reached. Reaching 100% of the target is known as a stretch goal because the targets for QPIs 1–4 are 20% higher than the expected results in these categories. VEIC is also able to earn an incentive for exceeding the target goal. For QPIs 1–4, there is no upper limit to this incentive, but it is capped at total incentive available ($4,442,682) for the three-year period.

Table A16 shows QPIs 1–7.

Table A16. Efficiency Vermont quantifiable performance indicator targets 1–7 for 2015–2017 program cycle

No.	QPI	Target	Cap	Threshold
1	Annual incremental savings	321,800 MWh	none	90%
2	Total resource benefits	$336,300,000	none	90%
3	Summer peak demand savings	41.3 MW	none	90%
4	Winter peak demand savings	53.7 MW	none	90%
5	Business comprehensiveness	11% increase in depth of savings	$196,000 or 5%	80%
6	Residential market transformation	42% of new homes above code	$117,000 or 3%	85%
7	Business market transformation	500 partners	$117,000 or 3%	80%

Source: Order in Case No. EEU-2013-01

QPIs 8-15 (table A17) set minimum performance levels for specific public policy objectives. If VEIC does not meet the minimum performance level, it can lose the opportunity to earn performance incentives earned in QPIs 1-7.

Table A17. Efficiency Vermont quantifiable performance indicator targets 8–15 for 2015–2017 program cycle

No.	QPI	Minimum requirement	Possible financial impact
8	Electric ratepayer equity	Benefit cost ratio greater than 1.2	$3,915,693
9	Residential ratepayer equity	Sector spending greater than $32,500,000	$614,825
10	Low-income ratepayer equity	Sector spending greater than $10,500,000	$614,825
11	Small business customer equity	2000 small business customers	$614,825
12	Geographic equity	Benefits goals for each geographic area	$204,942
13	Program implementation efficiency	Meet all schedule milestones	$68,314
14	Service quality	Achieve 92 or more metric points in the Service Quality and Reliability Plan	$150,000
15	Spending	103% of budgeted spending level	No limit

Source: Order in Case No. EEU-2013-01

VEIC has a total possible electric compensation of $6,526,155 for the 2015–2017 performance period. This figure includes $2,610,462 in guaranteed compensation (operations fee) and $3,915,693 at-risk. While VEIC is allowed a higher earning potential for some QPIs known as super stretch targets, the organization is not allowed to earn more than the total performance award incentive set aside.

Of the four TEPF QPIs, the first two have a positive performance award associated with target levels. The second two are minimum performance requirements, meaning if the requirements are not met, VEIC will lose the ability to lose all of the performance award associated with TEPF. VEIC has a total possible thermal compensation of $878,315 for the 2015–2017 performance period. This figure includes $351,326 in guaranteed compensation (operations fee) and $526,989 at risk.

Table A18 shows thermal efficiency initiatives.

Table A18. Vermont thermal efficiency incentives

No.	QPI	Goal	Possible award
1	Annual incremental MMBTu savings	100% = 246,000 MMBtu	$342,742
2	Residential single family comprehensiveness	Multi-component retrofit goal	$114,247
3	Residential sector spending	Greater than 62.5% of the total TEPF expenditures	If not met, opportunity to earn 10% of the 100% target level performance award is forfeited.
4	Low-income spending	Greater than 17% of the total TEPF expenditures	If not met, opportunity to earn 10% of the 100% target level performance award is forfeited.

Source: Order in Case No. EEU-2013-01

Outcomes

VEIC has been successful in earning a performance fee consistently throughout its tenure as the statewide program administrator. Table A19 shows VEIC performance for the two previous program cycles.

Table A19. VEIC performance 2006-2011

Period	Three-year budget	Three-year annual incremental net savings (MWh)	Operations fee	Performance fee	Total performance incentive
2009–2011	$95,274,004	292,406	$559,119	$2,693,748	$3,252,867
2006–2008	$66,179,500	287,442	$473,510	$2,347,510	$2,820,510

Source: End-of-cycle budget reports

In 2009–2011, VEIC outperformed expectations for some QPIs and earned a higher performance fee for these QPIs than what was originally expected. VEIC is also expected to meet targets in all QPIs for the 2012–2014 time period to earn the full performance fee allowed.

Figure A14 illustrates Vermont annual electric energy efficiency program savings.

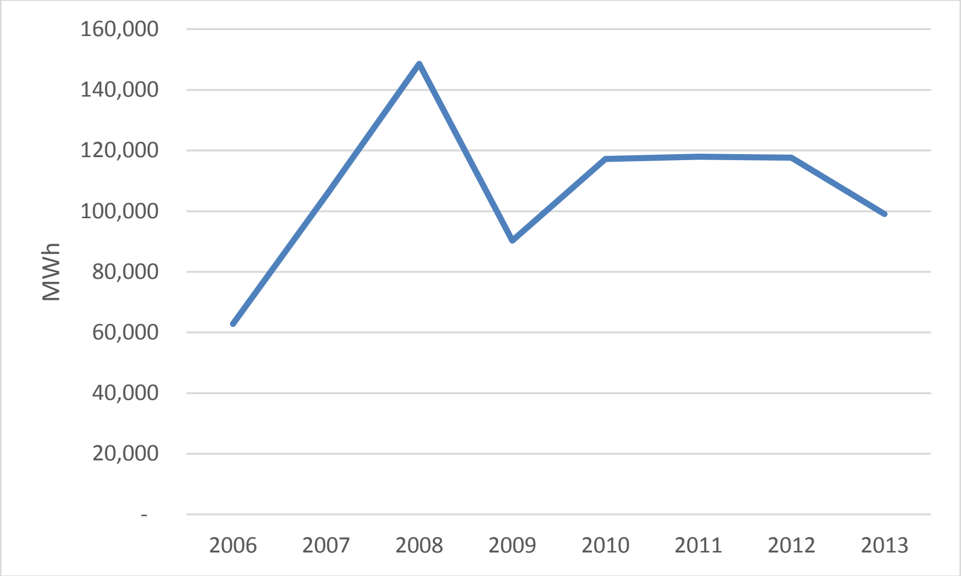

Figure A14. Vermont energy savings 2006–2013. *Source:* 2014 *State Scorecard*.

Discussion

The consensus among stakeholders interviewed in Vermont was that VEIC has done very well at balancing the goals contained in the QPI goal structure. VEIC's performance was recognized when it petitioned the VPSB to be the long-term statewide program administrator in Vermont. Subsequently, through a VPSB process, the company was awarded an 11-year order of appointment to continue working as the statewide administrator. Stakeholders also agreed the QPI structure provided a valuable mechanism to award VEIC for meeting specific policy objectives within the state. Instead of a traditional performance incentive awarding a company for meeting an energy or demand savings target, the QPI structure balances a suite of objectives and awards VEIC financially to ensure rate payer equity, spur market transformation, and achieve other state policy goals. In short, the structure is perceived as an effective mechanism for motivating performance Vermont.

Looking Forward

Under its order of appointment structure, VEIC will continue as the statewide program administrator in Vermont through 2021. Although small changes to the specific QPI and updates to the three-year performance period targets are expected, significant changes to the energy efficiency implementation structure are not expected in Vermont.

Appendix B. Questionnaire

Research Questionnaire: Financial Incentive Mechanism for Electric and Gas Utilities

The American Council for an Energy-Efficient Economy (ACEEE) is currently conducting national research on financial incentive mechanisms encouraging efficiency programs by utilities. We would greatly appreciate it if you would answer the following questions about the use of the utility-level shareholder incentive mechanism in your state. *Please note that ACEEE will report the information we gather as a general overall summary. We will not attribute specific answers or comments to specific individuals.* ACEEE will be happy to share the results of this research with the respondents to this survey.

Questions

Please answer the following questions about the financial incentive mechanism(s) in your state. Note that we leave space to answer the set of questions for up to two different incentive mechanisms. If different utilities have different types of incentive mechanisms, please answer the following items for each of two different utilities, beginning with the largest utility. If only one mechanism is used within the state, fill in all information under Mechanism One.

Mechanism One (e.g. for largest utility):

Applicable Utility(ies):

Indicate Mechanism Type (e.g. fixed incentive award, share of net benefits, performance-based incentive, increased rate of return, etc.):

1. When was it first authorized? When was the most recent version established?

2. Are there any threshold requirements that must be met to qualify for an incentive? If yes, what?

3. What is the overall incentive structure?

4. Is there a cap or ceiling on how much incentive can be earned? If yes, what?

5. Is the incentive payment based on net or gross savings?

6. Are there any related penalties? If yes, describe.

Please provide the following information for up to 2 utilities covered by Mechanism One (as described above) in your state. Please reference each of the two most recent program years for which data is available. Indicate program years and fill in information for each year in the table below.

	Utility 1: ____________	Utility 2: ____________
Program Year ______		
Actual earnings/award ($)		
Cost of energy efficiency programs to which incentive was applied ($)		
Total (1-year annual) energy savings achieved by the programs under the incentive mechanism (Please indicate kWh or therms)		
Program Year ______		
Actual earnings/award ($)		
Cost of energy efficiency programs to which incentive was applied ($)		
Total (1-year annual) energy savings achieved by the programs under the incentive mechanism (Please indicate kWh or therms)		

1. Please provide a citation or reference to the official documentation (e.g., statute, regulatory order, etc.) where this mechanism is established or described.

2. Is there a report, regulatory review, or other document that describes the mechanism and how it has worked in practice, and/or provides data on the actual award for the last two program years? If so, please provide link, contact person or reference where we may obtain a copy.

3. How are efficiency savings achieved under the incentive mechanism measured and verified?

4. Are there any significant differences between the incentive mechanisms as applied to electric versus gas utilities?

Mechanism Two:

Applicable Utility(ies):

Indicate Mechanism Type (e.g. fixed incentive award, share of net benefits, performance-based incentive, increased rate of return, etc.):

1. When was it first authorized? When was the most recent version established?

2. Are there any threshold requirements that must be met to qualify for an incentive? If yes, what?

3. What is the overall incentive structure?

4. Is there a cap or ceiling on how much incentive can be earned? If yes, what?

5. Is the incentive payment based on net or gross savings?

6. Are there any related penalties? If yes, describe.

Please provide the following information for up to 2 utilities covered by Mechanism Two (as described above) in your state. Please reference each of the two most recent program years for which data is available. Indicate program years and fill in information for each year in the table below.

	Utility 1: ____________	Utility 2: ____________
Program Year ______		
Actual earnings/award ($)		
Cost of energy efficiency programs to which incentive was applied ($)		

Total (1-year annual) energy savings achieved by the programs under the incentive mechanism (Please indicate kWh or therms)		
Program Year ______		
Actual earnings/award ($)		
Cost of energy efficiency programs to which incentive was applied ($)		
Total (1-year annual) energy savings achieved by the programs under the incentive mechanism (Please indicate kWh or therms)		

1. Please provide a citation or reference to the official documentation (e.g., statute, regulatory order, etc.) where this mechanism is established or described.

2. Is there a report, regulatory review, or other document that describes the mechanism and how it has worked in practice, and/or provides data on the actual award for the last two program years? If so, please provide link, contact person or reference where we may obtain a copy.

3. How are efficiency savings achieved under the mechanism measured and verified?

4. Are there any significant differences between the mechanisms as applied to electric versus gas utilities?

Overall Questions

We'd be interested in any thoughts you have on these last two questions. Again, we will NOT be quoting anyone by name.

1. Are there any suggestions you would make to another state who was thinking of adopting a utility energy efficiency performance incentive such as the mechanism(s) used in your state?

2. Please provide any additional insights or important information about efficiency incentives for utilities in your state that we have not covered above.

If you have any questions or comments about this survey, please contact Seth Nowak at the American Council for an Energy-Efficient Economy at (608)256-9155 or snowak@aceee.org

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Please provide your preferred contact information:

Name ________________________________

State_________________________________

Phone________________________________

Email________________________________

THANK YOU VERY MUCH FOR YOUR ASSISTANCE!

Appendix C. Incentive Amounts as Percentage of Energy Efficiency Costs

Table C1. Incentive amounts relative to total costs by mechanism type by utility/administrator, state, and year

Net benefits		Multifactor		Savings-based	
Xcel electric (MN) 2011	68%	NSTAR (MA) 2013	6%	Consumers 2012 (MI)	15%
Xcel electric (MN) 2012	62%	NGRID (MA) 2013	6%	Consumers 2013 (MI)	15%
Otter Tail Power (MN) 2011	60%	NGRID (MA) 2012	6%	DTE Energy 2012 (MI)	15%
Georgia Power 2013	58%	Efficiency VT 2008	4%	DTE Energy 2013 (MI)	15%
Otter Tail Power (MN) 2012	56%	Efficiency VT 2011	3%	IPL (IN) 2013	8%
Georgia Power 2012	42%	PBFA (HI) 2014	2%	PSNH 2013	8%
AEP Texas Central 2013	36%	PBFA (HI) 2013	2%	PSNH 2012	9%
Xcel Energy (CO) 2012	29%	DC SEU 2012	1%	CT UI 2013	6%
SWEPCO (TX) 2012	26%	DC SEU 2013	1%	CT CL&P 2013	7%
PSO (OK) 2012	25%	WI FOE 2010-14	0.2%	CT UI 2012	6%
Xcel Energy (CO) 2013	22%			CT CL&P 2012	7%
PSO (OK) 2013	21%			RI NGRID 2013	5%
DEC (SC) 2014	18%			RI NGRID 2012	5%
OGE (OK) 2012	18%			NY all IOUs	4%
DEC (SC) 2013	18%				
OGE (OK) 2011	17%				
APS (AZ) 2012	14%				
SCE&G 2013	14%				
APS (AZ) 2013	9%				
SWEPCO AR	8%				
SWEPCO AR	8%				
Entergy Arkansas 2013	7%				
Entergy Arkansas 2012	6%				
SCE&G 2014	6%				

Source: Questionnaires completed by state commission staff

Exhibit NM-15

I&M Discovery Request Response to CAC Set 1, Q2, WP 2016 EECO kWh Forecast Tab

2016 EECO Forecasted Savings

GIS Circuit id value	Station_Name	Circuit Name	Tot Custs	Tot kWh	Res custs	Res kWh	Com custs	Com kWh	Ind custs	Ind kWh	Res Lightin	Com Lightin	Com Lighting k	Ind Lighting cust	Ind Lighting k	Street Ligh	Street Lighting kWh
4050321	SOUTH BEND	NO 1	2,110	41,345,565	1,864	15,898,868	244	25,008,244	2	328,000	25,781	14	64,535	0	0	3	20,136
4050322	SOUTH BEND	NO 2	1,871	27,496,360	1,717	15,248,883	154	12,181,331	0	0	20,325	17	45,821	0	0	0	0
4050323	SOUTH BEND	NO 3	1,386	20,585,562	1,252	11,977,678	134	8,545,852	0	0	11,701	4	11,728	0	0	2	38,603
4093121	EAST SIDE	Park Jeff	1,016	9,620,876	956	8,142,559	60	1,419,368	0	0	3,211	12	55,738	0	0	0	0
4093122	EAST SIDE	Ironwood	2,366	29,092,302	2,268	18,579,789	98	10,430,783	0	0	33,512	14	29,922	0	0	3	18,296
4093123	EAST SIDE	Adams	2,109	31,257,009	1,945	18,104,939	158	10,622,145	6	2,358,755	32,029	21	42,137	0	0	7	97,004
4093124	EAST SIDE	Wilson	1,915	24,016,643	1,844	17,380,044	71	6,520,440	0	0	55,847	7	32,524	0	0	3	27,789
4093125	EAST SIDE	Hastings	2,401	24,151,770	2,210	19,127,395	188	4,815,248	3	47,508	57,710	10	11,118	2	3,036	3	89,754
4093126	EAST SIDE	IUSB	221	17,149,912	175	1,702,872	46	15,357,836	0	0	3,180	5	4,690	0	0	4	81,334
4923321	SPY RUN	Three Rivers	1,476	23,831,756	1,238	9,104,060	227	13,983,100	11	679,504	5,324	29	58,138	0	0	1	1,629
4923322	SPY RUN	Centlivre	431	54,168,068	380	2,709,161	49	4,394,059	2	47,049,236	1,348	7	7,608	2	6,656	0	0
4928821	HARPER	Tanglewood	1,399	34,963,415	1,197	11,460,267	187	5,920,475	15	17,248,659	16,880	22	38,176	0	0	10	278,958
4928822	HARPER	Minich	2,066	39,833,091	1,881	22,718,342	179	15,843,624	6	894,777	22,378	28	119,356	2	3,012	8	231,602
4933521	HACIENDA	Goeglein	1,447	18,019,642	1,380	14,606,257	65	3,346,087	2	37,986	12,505	1	476	0	0	9	16,331
4933523	HACIENDA	Maplewood	1,571	18,964,536	1,515	17,158,890	56	1,758,241	0	0	12,224	8	31,989	0	0	2	3,193
4933524	HACIENDA	Arlington	1,530	19,750,112	1,506	18,746,337	24	902,467	0	0	2,311	0	0	0	0	17	98,997
4935221	GRABILL	Sheller	504	19,695,861	394	4,167,306	85	3,882,837	25	11,613,572	3,740	10	17,509	2	7,036	1	3,861
4935222	GRABILL	Page	2,340	44,476,940	2,056	31,525,916	278	12,187,766	6	681,815	35,569	18	27,130	1	1,012	13	17,731
4938121	ELCONA	#1	69	26,400,709	0	0	27	1,495,014	42	24,784,064	0	3	3,363	6	118,268	0	0
4938122	ELCONA	#2	107	23,053,598	61	718,515	32	1,609,699	14	20,718,234	1,398	2	3,728	1	2,024	0	0
4938123	ELCONA	Country Club	1,990	48,600,092	1,753	16,798,886	191	9,302,218	46	22,276,208	12,904	10	44,751	6	28,204	7	136,920

Average Distribution Circuit Loss Factor Adjustment	Estimated CVR Factor	Target Annual Operation*	Voltage Reduction Target
1.0672	0.950	70%	2.5%

*Note: Includes VVO Off Days Required for EM&V energy and demand savings analysis

End Use (at the meter) Consumption Baseline (kWh)									Operational Status	Operational 1.1.2016
		Data								
Station_Name	Circuit Name	Res custs	Com custs	Ind custs	Res kWh	Com kWh	Ind kWh	Tot kWh		VVO Est. Savings
EAST SIDE		9,398	621	9	83,037,598	49,165,819	2,406,263	135,288,512	Operational	2,400,316
ELCONA		1,814	250	102	17,517,401	12,406,931	67,778,506	98,054,398	Operational	1,739,701
GRABILL		2,450	363	31	35,693,222	16,070,603	12,295,387	64,172,800	11.15.15	1,138,567
HACIENDA		4,401	145	2	50,511,484	6,006,794	37,986	56,734,291	Operational	1,006,591
HARPER		3,078	366	21	34,178,609	21,764,100	18,143,436	74,796,506	9.15.2015	1,327,055
SOUTH BEND		4,833	532	2	43,125,429	45,735,426	328,000	89,427,487	Operational	1,586,640
SPY RUN		1,618	276	13	11,813,221	18,377,159	47,728,740	77,999,824	10.1.2015	1,383,888
Grand Total		27,592	2553	180	275,876,964	169,526,833	148,718,318	596,473,818		10,582,758
										10,582,758

Demand Savings (kW)			
Station	Station Transformer #	Peak Demand- at the Station	Peak Demand Reduction- at the Station (kW)
East Side	#1	20,110	478
East Side	#2	19,730	469
Elcona	#1	24,200	575
Grabill	#1	16,600	394
Hacienda	#1	17,700	420
Harper	#1	17,160	408
South Bend	#4	22,130	526
Spy Run	#4	16,020	380
Hacienda	#2	23,270	582
Lincoln	#1	21,450	536
State Street	#1	19,780	495
Total			5,263

Station_Name	Total_kWh	VVO Est. Savings
HACIENDA	78,527,112	1,393,244
LINCOLN	78,011,660	1,384,098
STATE STREET	77,528,047	1,375,518
Grand Total	234,066,819	4,152,860

Station	Residential Customers	Commercial Customers	Industrial Customers	Total Customers
Hacienda	4,451	407	0	4,858
Lincoln	3,310	612	25	3,947
State Street	4,083	428	3	4,514
Total	11,844	1,447	28	13,319

1.77%

1.77%

I&M Indiana VVO 2016	
2016 Estimated kWh Savings	**2016 Estimated kW Savings**
14,735,618	**5,263**

Allocations based on # customers

90%	Residential
10%	C&I
100%	Check

Source Cause 43827 DSM 5 Attachment JLB-2

2016 Deployment I and Deployment II
Allocation--# Customers

Total 2016 Carry Charge	Total 2016 Depreciation	Total 2016 Carry Charge & Depreciation
$485,929	$161,976	$647,905

$585,436	Res	90%
$62,469	C&I	10%

Incremental O&M--See breakout below	
2016 O&M	$255,000

EM&V (% of Capital Cost)	
2016 EM&V	$75,000

Total O&M, EM&V, Staffing
$390,885

Total 2016 Pgm Cost	$1,038,790
Residential	$938,634
C&I	$100,156

I&M IN DSM Staff Fully Loaded Labor per year	$135,000
Labor Allocation to EECO	0.451
EECO DSM Labor	$60,885

2016 Benefit Cost Estimate (TRC/UCT)
1.7

O&M Detail			25 Ckts	9 Ckts		
Operations Engine	0.25	$100,000	$25,000	$9,000	AEPSC Incremental	
M&V Engineer	0.25	$100,000	$25,000	$9,000	AEPSC Incremental	
MRO Technician	0.25	$80,000	$20,000	$7,200	I&M Incremental	
IT Field Ops Techn	0.25	$80,000	$20,000	$7,200	AEPSC Incremental	
Distibution Engine	0.1	$100,000	$10,000	$3,600	AEPSC Incremental	
Line Crew	0.291666667	$300,000	$87,500	$31,500	I&M Incremental	
Total On going O&M			$187,500	$67,500		
Total Capital			$6,250,000	$2,250,000		
% On going O&M required for Capital			3.00%	3.00%		
Total Engineering & Telecommunications			$80,000	$28,800		AEPSC Incremental
Total MRO & Line			$107,500	$38,700		I&M Incremental
				$255,000		

Exhibit NM-16

I&M Discovery Request Response to CAC Set 1, Q2, 2014 Final Spend

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	**I&M Utility Operations**													
2	**2014 Actuals by Month Indiana DSM_EE Program Year 5**													
3	**Authorized / Control Budget Variance Report**													
5		**2014 Year-to-Date December / Year-End**				**ANNUAL Budget $s Remaining**								
6	**Project**	**Expense Category**	**Forecast $**	**Actual $** *(includes accruals)*					**2014 Authorized**		**January Actual $** *(includes accruals)*	**February Actual $** *(includes accruals)*	**March Actual $** *(includes accruals)*	**April Actual $** *(includes accruals)*
7	000018501 IN-DSM Staff Devlpmnt & Mbrshp	Staffing	$0.00	$12,386.04		($12,386.04)			$0.00		$3,497.11	$2,838.22	$87.97	$82.22
8		Delivery	$95,000.00	$16,224.25		$78,775.75			$95,000.00		$0.00	$0.00	$0.00	$0.00
9		Other	$0.00	$5,985.08		($5,985.08)			$0.00		$408.42	$2,706.71	$963.05	$63.24
10		**Sum:**	**$95,000.00**	**$34,595.37**		**$60,404.63**			**$95,000.00**		**$3,905.53**	**$5,544.93**	**$1,051.02**	**$145.46**
11	000018502 IN-Information & Technlgy Syst	Staffing	$0.00	$2,817.88		($2,817.88)			$0.00		$0.00	$0.00	$0.00	$1,002.87
12		Delivery	$235,000.00	$123,270.11		$111,729.89			$235,000.00		$0.00	$0.00	$53,125.00	$0.00
13		Other	$0.00	$76.23		($76.23)			$0.00		$0.00	$0.00	$0.00	$73.89
14		**Sum:**	**$235,000.00**	**$126,164.22**		**$108,835.78**			**$235,000.00**		**$0.00**	**$0.00**	**$53,125.00**	**$1,076.76**
15	000018503 IN-DSM Marketing & Cust Aware	Staffing	$0.00	$14,984.14		($14,984.14)			$0.00		$627.22	$1,748.41	$3,347.48	$1,617.21
16		Delivery	$300,000.00	$179,633.03		$120,366.97			$300,000.00		$1,316.24	$661.18	$90,093.47	$16,763.72
17		Other	$0.00	$1,051.08		($1,051.08)			$0.00		$0.00	$0.00	$189.10	$512.57
18		**Sum:**	**$300,000.00**	**$195,668.25**		**$104,331.75**			**$300,000.00**		**$1,943.46**	**$2,409.59**	**$93,630.05**	**$18,893.50**
19	000018505 IN - Res Appliance Recycling	Staffing	$43,960.00	$22,074.64		$21,885.36			$43,960.00		$843.20	$1,887.51	$1,914.33	$1,609.49
20		Incentives	$112,989.00	$155,160.00		($42,171.00)			$112,989.00		$0.00	$7,560.00	$5,240.00	$6,200.00
21		Delivery	$395,463.00	$475,177.50		($79,714.50)			$395,463.00		$34,450.00	$10,965.50	$19,297.50	$39,299.50
22		EM&V	$112,467.00	$24,025.01		$88,441.99			$112,467.00		$800.00	$1,766.57	$8,274.11	$1,875.55
23		Other	$24,993.00	$483.97		$24,509.03			$24,993.00		$3.92	$0.00	$11.25	$4.71
24		**Sum:**	**$689,872.00**	**$676,921.12**		**$12,950.88**			**$689,872.00**		**$36,097.12**	**$22,179.58**	**$34,737.19**	**$48,989.25**
25	000019206 IN - C&I Incentive Program	Staffing	$50,835.00	$59,302.23		($8,467.23)			$50,835.00		$6,242.74	$3,797.53	$5,441.04	$5,160.93
26		Incentives	$950,691.00	$646,614.98		$304,076.02			$950,691.00		$0.00	$0.00	$0.00	$11,410.55
27		Delivery	$880,062.00	$960,321.75		($80,259.75)			$880,062.00		$99,245.00	$98,290.45	$100,250.00	$39,923.87
28		EM&V	$84,331.00	$136,283.76		($51,952.76)			$84,331.00		$14,000.00	$13,397.15	$53,952.05	$12,442.85
29		Other	$21,083.00	$1,052.34		$20,030.66			$21,083.00		$9.77	$0.00	$158.02	$18.04
30		**Sum:**	**$1,987,002.00**	**$1,803,575.06**		**$183,426.94**			**$1,987,002.00**		**$119,497.51**	**$115,485.13**	**$159,801.11**	**$68,956.24**
31	000020613 IN Statewide-Res Lighting	Staffing	$34,931.00	$15,953.75		$18,977.25			$34,931.00		$1,495.10	$2,026.39	$2,285.97	$1,697.57
32		Delivery	$1,440,111.00	$808,956.32		$631,154.68			$1,440,111.00		$61,757.00	$73,360.99	$127,651.37	$176,108.83
33		EM&V	$50,000.00	$29,627.03		$20,372.97			$50,000.00		$6,000.00	$521.12	$6,500.00	$11,526.72
34		Other	$20,000.00	$695.41		$19,304.59			$20,000.00		$3.99	$351.17	$12.05	$199.40
35		**Sum:**	**$1,545,042.00**	**$855,232.51**		**$689,809.49**			**$1,545,042.00**		**$69,256.09**	**$76,259.67**	**$136,449.39**	**$189,532.52**
36	000020614 IN Statewide-Res Energy Audit	Staffing	$44,657.00	$18,102.51		$26,554.49			$44,657.00		$1,983.70	$2,244.61	$2,740.70	$1,794.23
37		Delivery	$673,670.00	$704,482.96		($30,812.96)			$673,670.00		$171,818.00	$110,577.86	$146,376.74	$248,543.30
38		EM&V	$38,067.00	$33,942.02		$4,124.98			$38,067.00		$8,000.00	$612.35	$7,499.99	$8,534.71
39		Other	$12,689.00	$452.50		$12,236.50			$12,689.00		$7.07	$233.56	$18.35	$83.20
40		**Sum:**	**$769,083.00**	**$756,979.99**		**$12,103.01**			**$769,083.00**		**$181,808.77**	**$113,668.38**	**$156,635.78**	**$258,955.44**
41	000020615 IN Statewide-Res Low Inc Weath	Staffing	$37,742.00	$17,033.30		$20,708.70			$37,742.00		$1,568.65	$1,606.00	$2,057.47	$1,556.47
42		Delivery	$1,792,799.00	$928,388.79		$864,410.21			$1,792,799.00		$166,149.00	$125,405.92	$68,986.31	$98,201.10
43		EM&V	$129,324.00	$29,069.30		$100,254.70			$129,324.00		$4,500.00	$521.13	$6,499.98	$9,539.35
44		Other	$21,554.00	$887.54		$20,666.46			$21,554.00		$8.08	$497.54	$9.54	$81.37
45		**Sum:**	**$1,981,419.00**	**$975,378.93**		**$1,006,040.07**			**$1,981,419.00**		**$172,225.73**	**$128,030.59**	**$77,553.30**	**$109,378.29**
46	000020616 IN Statewide-Energ Eff Schools	Staffing	$56,393.00	$14,793.96		$41,599.04			$56,393.00		$409.03	$1,060.42	$1,113.10	$1,173.72
47		Delivery	$333,705.00	$515,000.99		($181,295.99)			$333,705.00		$30,624.00	$25,057.69	$108,345.05	$30,891.97
48		EM&V	$162,997.00	$36,846.48		$126,150.52			$162,997.00		$3,000.00	$3,411.26	$3,000.00	$3,284.65
49		Other	$33,466.00	$1,019.92		$32,446.08			$33,466.00		$0.00	$167.80	$6.30	$79.23
50		**Sum:**	**$586,561.00**	**$567,661.35**		**$18,899.65**			**$586,561.00**		**$34,033.03**	**$29,697.17**	**$112,464.45**	**$35,429.57**
51	000020617 IN Statewide-C&I Prescriptive	Staffing	$88,202.00	$70,228.98		$17,973.02			$88,202.00		$4,580.66	$10,565.10	$13,526.14	$7,856.50
52		Incentives	$4,938,109.00	$1,881,147.70		$3,056,961.30			$4,938,109.00		$123,324.30	$166,527.00	$317,336.84	$303,915.00
53		Incentive Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$0.00
54		Delivery	$186,695.00	$566,157.23		($379,462.23)			$186,695.00		$0.00	$0.00	$0.00	$0.00
55		Delivery Accrual	$0.00	($0.00)					$0.00		$22,750.00	$25,007.41	$197,427.72	$5,553.74
56		EM&V	$97,547.00	$55,850.30		$41,696.70			$97,547.00		$0.00	$0.00	$13,231.91	$15,205.87
57		EM&V Accrual	$0.00	$0.00					$0.00		$8,000.00	$13,231.92	$268.08	$0.00
58		Other	$40,645.00	$2,634.36		$38,010.64			$40,645.00		$9.95	$270.87	$523.08	$1,107.65
59		**Sum:**	**$5,351,198.00**	**$2,576,018.57**		**$2,775,179.43**			**$5,351,198.00**		**$158,664.91**	**$215,602.30**	**$542,313.77**	**$333,638.76**
60	000020618 IN Core+ Res On-Line Audit	Staffing	$134,007.00	$38,552.97		$95,454.03			$134,007.00		$1,845.62	$1,992.80	$2,640.51	$2,341.81
61		Delivery	$119,675.00	$262,906.22		($143,231.22)			$119,675.00		$19,917.50	$49,089.84	$55,272.05	$21,657.95

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
62		EM&V	$66,036.00	$21,993.71		$44,042.29			$66,036.00		$800.00	$583.50	$9,199.64	$232.66
63		Other	$18,868.00	$93.95		$18,774.05			$18,868.00		$5.20	$0.00	$11.88	$6.61
64		**Sum:**	**$338,586.00**	**$323,546.85**		**$15,039.15**			**$338,586.00**		**$22,568.32**	**$51,666.14**	**$67,124.08**	**$24,239.03**
65	000020619 IN Core+ Res New Construction	Staffing	$34,931.00	$27,771.29		$7,159.71			$34,931.00		$1,584.38	$1,031.64	$1,256.71	$2,462.60
66		Incentives	$84,000.00	$98,940.00		($14,940.00)			$84,000.00		$0.00	$0.00	$0.00	$0.00
67		Incentive Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$0.00
68		Delivery	$154,820.00	$132,559.65		$22,260.35			$154,820.00		$0.00	$0.00	$0.00	$0.00
69		Delivery Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$8,062.00
70		EM&V	$50,000.00	$5,354.03		$44,645.97			$50,000.00		$0.00	$0.00	$0.00	$0.00
71		EM&V Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$0.00
72		Other	$10,000.00	$259.43		$9,740.57			$10,000.00		$8.08	$0.00	$6.13	$3.06
73		**Sum:**	**$333,751.00**	**$264,884.40**		**$68,866.60**			**$333,751.00**		**$1,592.46**	**$1,031.64**	**$1,262.84**	**$10,527.66**
74	000020621 IN Core+ Res Home Weatherization	Staffing	$30,238.00	$35,306.73		($5,068.73)			$30,238.00		$1,537.07	$1,782.36	$1,526.65	$1,650.59
75		Incentives	$482,386.00	$229,047.14		$253,338.86			$482,386.00		$0.00	$0.00	$0.00	$0.00
76		Incentive Accrual	$0.00	$0.00					$0.00		$2,700.00	$0.00	$0.00	$0.00
77		Delivery	$864,285.00	$364,773.37		$499,511.63			$864,285.00		$0.00	$0.00	$17,185.00	$34,370.00
78		Delivery Accrual	$0.00	$0.00					$0.00		$17,185.00	$17,185.00	$0.00	($24,549.00)
79		EM&V	$85,998.00	$20,844.40		$65,153.60			$85,998.00		$0.00	$350.10	$0.00	$3,763.01
80		EM&V Accrual	$0.00	$0.00					$0.00		$500.00	$0.00	$6,963.01	($3,608.94)
81		Other	$16,763.00	$320.10		$16,442.90			$16,763.00		$0.00	$0.00	$37.46	$12.11
82		**Sum:**	**$1,479,670.00**	**$650,291.74**		**$829,378.26**			**$1,479,670.00**		**$21,922.07**	**$19,317.46**	**$25,712.12**	**$11,637.77**
83	000020622 IN Core+ Res Home Energy Rptg	Staffing	$25,875.00	$26,306.30		($431.30)			$25,875.00		$1,748.13	$2,118.77	$3,029.57	$2,048.26
84		Delivery	$664,323.00	$664,323.00		$0.00			$664,323.00		$0.00	$491,403.00	$0.00	$0.00
85		EM&V	$40,000.00	$30,686.70		$9,313.30			$40,000.00		$500.00	$583.50	$16,206.03	$1,563.86
86		Other	$20,000.00	$68.37		$19,931.63			$20,000.00		$5.09	$0.00	$12.62	$7.48
87		**Sum:**	**$750,198.00**	**$721,384.37**		**$28,813.63**			**$750,198.00**		**$2,253.22**	**$494,105.27**	**$19,248.22**	**$3,619.60**
88	000020623 IN Core+ Res Peak Reduction	Staffing	$110,405.00	$27,195.50		$83,209.50			$110,405.00		$1,663.13	$1,473.40	$1,810.00	$852.38
89	*(Bill Credits)*	Incentives	$211,622.00	$335,752.00		($124,130.00)			$211,622.00		$0.00	$0.00	$0.00	$1,880.00
90		Delivery	$1,235,450.00	$746,036.76		$489,413.24			$1,235,450.00		$67,000.00	$58,405.05	$164,155.85	$123,695.46
91		EM&V	$105,172.00	$38,631.48		$66,540.52			$105,172.00		$1,000.00	$636.10	$20,732.87	$1,782.23
92		Other	$31,552.00	$74.22		$31,477.78			$31,552.00		$7.32	$0.00	$8.77	$4.46
93		**Sum:**	**$1,694,201.00**	**$1,147,689.96**		**$546,511.04**			**$1,694,201.00**		**$69,670.45**	**$60,514.55**	**$186,707.49**	**$128,214.53**
94	000020624 IN Core+ Renewables & Demonstr	Staffing	$46,646.00	$16,351.17		$30,294.83			$46,646.00		$1,663.67	$1,457.19	$1,413.57	$3,727.81
95		Incentives	$50,242.00	$25,625.14		$24,616.86			$50,242.00		$0.00	$0.00	$0.00	$13,596.00
96		Incentive Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$0.00
97		Delivery	$46,336.00	$0.00		$46,336.00			$46,336.00		$0.00	$0.00	$0.00	$0.00
98		EM&V	$99,292.00	$7,677.58		$91,614.42			$99,292.00		$0.00	$0.00	$933.60	$1,233.41
99		EM&V Accrual	$0.00	($0.00)					$0.00		$500.00	$350.10	$2,883.31	($1,693.06)
100		Other	$33,097.00	$245.91		$32,851.09			$33,097.00		$5.70	$0.00	$36.98	$3.34
101		**Sum:**	**$275,613.00**	**$49,899.80**		**$225,713.20**			**$275,613.00**		**$2,169.37**	**$1,807.29**	**$5,267.46**	**$16,867.50**
102	000020625 IN Core+ C&I Retro-Comm Lite	Staffing	$95,332.00	$53,523.50		$41,808.50			$95,332.00		$5,181.54	$3,670.86	$4,249.90	$3,749.86
103		Incentives	$813,623.00	$1,263,269.69		($449,646.69)			$813,623.00		$0.00	$0.00	$0.00	$214,813.92
104		Delivery	$1,046,877.00	$640,000.00		$406,877.00			$1,046,877.00		$0.00	$0.00	$0.00	$119,800.00
105		EM&V	$163,748.00	$72,526.33		$91,221.67			$163,748.00		$11,000.00	$9,251.75	$22,372.40	$3,423.82
106		Other	$68,228.00	$1,372.22		$66,855.78			$68,228.00		$7.32	$0.00	$174.63	$70.99
107		**Sum:**	**$2,187,808.00**	**$2,030,691.74**		**$157,116.26**			**$2,187,808.00**		**$16,188.86**	**$12,922.61**	**$26,796.93**	**$341,858.59**
108	000020626 IN Core+ C&I HVAC Optimization	Staffing	$69,863.00	$17,432.13		$52,430.87			$69,863.00		$1,039.17	$897.79	$1,101.08	$1,088.34
109		Incentives	$215,806.00	$875.00		$214,931.00			$215,806.00		$0.00	$0.00	$0.00	$0.00
110		Delivery	$0.00	$454.48		($454.48)			$0.00		$0.00	$0.00	$0.00	$0.00
111		EM&V	$100,000.00	$2,490.59		$97,509.41			$100,000.00		$0.00	$0.00	$1,262.58	$1,907.09
112		Other	$50,000.00	$296.46		$49,703.54			$50,000.00		$8.23	$0.00	$5.36	$77.08
113		**Sum:**	**$435,669.00**	**$21,548.66**		**$414,120.34**			**$435,669.00**		**$1,047.40**	**$897.79**	**$2,369.02**	**$3,072.51**
114	000020627 IN Core+ C&I Audit & SBDI	Staffing	$34,931.00	$24,128.89		$10,802.11			$34,931.00		$2,290.32	$1,681.28	$2,817.68	$2,151.50
115		Incentives	$292,547.00	$449,516.65		($156,969.65)			$292,547.00		$3,876.00	$0.00	$3,534.00	$5,685.00
116		Delivery	$352,073.00	$230,022.26		$122,050.74			$352,073.00		$1,720.40	$5,100.00	$2,679.40	$6,478.00
117		EM&V	$45,000.00	$62,611.62		($17,611.62)			$45,000.00		$6,000.00	$5,811.32	$16,005.13	$1,044.97
118		Other	$50,000.00	$185.96		$49,814.04			$50,000.00		$4.53	$0.00	$10.01	$73.56
119		**Sum:**	**$774,551.00**	**$766,465.38**		**$8,085.62**			**$774,551.00**		**$13,891.25**	**$12,592.60**	**$25,046.22**	**$15,433.03**
120	000023305 IN Core+ Residential EE Products	Staffing	$25,875.00	$30,053.81		($4,178.81)			$25,875.00		$265.74	$696.03	$960.77	$2,183.68
121		Incentives	$577,976.00	$110,050.00		$467,926.00			$577,976.00		$0.00	$0.00	$0.00	$0.00
122		Incentive Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$0.00
123		Delivery	$14,315.00	$111,099.01		($96,784.01)			$14,315.00		$0.00	$0.00	$0.00	$0.00
124		Delivery Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$7,304.00

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
125		EM&V	$11,250.00	$7,467.76		$3,782.24			$11,250.00		$0.00	$0.00	$0.00	$0.00
126		EM&V Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$0.00
127		Other	$1,500.00	$408.54		$1,091.46			$1,500.00		$0.00	$0.00	$4.16	$2.34
128		**Sum:**	**$630,916.00**	**$259,079.12**		**$371,836.88**			**$630,916.00**		**$265.74**	**$696.03**	**$964.93**	**$9,490.02**
129	000023306 IN-New Program Development	Staffing	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
130		Delivery	$210,000.00	$0.00		$210,000.00			$210,000.00		$0.00	$0.00	$0.00	$0.00
131		Other	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
132		**Sum:**	**$210,000.00**	**$0.00**		**$210,000.00**			**$210,000.00**		**$0.00**	**$0.00**	**$0.00**	**$0.00**
133	000023307 IN-General EE Mgmt & Collaboration	Staffing	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
134		Delivery	$105,000.00	$0.00		$105,000.00			$105,000.00		$0.00	$0.00	$0.00	$0.00
135		Other	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
136		**Sum:**	**$105,000.00**	**$0.00**		**$105,000.00**			**$105,000.00**		**$0.00**	**$0.00**	**$0.00**	**$0.00**
137	000023308 IN-Codes Work	Staffing	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
138		Delivery	$100,000.00	$0.00		$100,000.00			$100,000.00		$0.00	$0.00	$0.00	$0.00
139		Other	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
140		**Sum:**	**$100,000.00**	**$0.00**		**$100,000.00**			**$100,000.00**		**$0.00**	**$0.00**	**$0.00**	**$0.00**
141	000023309 IN-MPS & Action Plan	Staffing	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
142		Delivery	$75,000.00	$0.00		$75,000.00			$75,000.00		$0.00	$0.00	$0.00	$0.00
143		Other	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
144		**Sum:**	**$75,000.00**	**$0.00**		**$75,000.00**			**$75,000.00**		**$0.00**	**$0.00**	**$0.00**	**$0.00**
145	000023310 IN-Evaluation & Related	Staffing	$0.00	$39,170.70		($39,170.70)			$0.00		$0.00	$1,869.52	$2,441.20	$3,970.23
146		AEP Labor	$0.00	$8,644.06		($8,644.06)			$0.00		$0.00	$0.00	$0.00	$0.00
147		Delivery	$140,000.00	$0.00		$140,000.00			$140,000.00		$0.00	$0.00	$0.00	$0.00
148		Other	$0.00	$164.78		($164.78)			$0.00		$0.00	$0.00	$11.14	$5.99
149		**Sum:**	**$140,000.00**	**$47,979.54**		**$92,020.46**			**$140,000.00**		**$0.00**	**$1,869.52**	**$2,452.34**	**$3,976.22**
150	000023311 IN EECO Program	Staffing	$0.00	$4,692.68		($4,692.68)			$0.00		$0.00	$0.00	$0.00	$198.67
151		AEP Labor	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
152		Depreciation	$65,172.00	$81,584.93		($16,412.93)			$65,172.00		$5,852.40	$5,899.02	$6,136.19	$6,233.92
153		Carrying Costs	$239,362.00	$251,955.98		($12,593.98)			$239,362.00		$20,508.10	$20,528.70	$20,587.55	$20,568.75
154		Delivery	$140,953.00	$0.00		$140,953.00			$140,953.00		$0.00	$0.00	$0.00	$0.00
155		EM&V	$0.00	$38,969.46		($38,969.46)			$0.00		$0.00	$0.00	$0.00	$24,180.72
156		Other	$0.00	$9.67		($9.67)			$0.00		$0.00	$0.00	$0.00	$0.00
157		**Sum:**	**$445,487.00**	**$377,212.72**		**$68,274.28**			**$445,487.00**		**$26,360.50**	**$26,427.72**	**$26,723.74**	**$51,182.06**
158														
159		**GRAND TOTAL:**	***$23,516,627.00***	***$15,228,869.65***		***$8,287,757.35***			***$23,516,627.00***		***$955,361.79***	***$1,392,725.96***	***$1,757,436.45***	***$1,685,114.31***
160														
161	**NOTE:** Includes 06/26/2014 approved budget transfer of $196,923 from IQW to Home Energy Reporting													
162	**NOTE:** Includes the following budget transfers approved 10/28/2014:													
163		$35,000 from General EE Mgmt to IT Systems												
164		$25,000 from MPS & Action Plan to IT Systems												
165		$25,000 from Staff Development to IT Systems												
166		$126,820 from EEP to RNC												
167		$138,189 from C&I HVAC to C&I Audit / SBDI												
168		$791,046 from C&I Prescriptive to C&I Incentives												
169		$520,426 from C&I Prescriptive to C&I RCxL												
170	**NOTE:** Includes 12/17/2014 approved budget transfer of $241,650 from C&I Prescriptive to C&I RCxL													
171														
172														
173														
174														
175														

	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1													
2													
3													
5													
6	**May Actual $** *(includes accruals)*	**June Actual $** *(includes accruals)*	**July Actual $** *(includes accruals)*	**August Actual $** *(includes accruals)*	**September Actual $** *(includes accruals)*	**October Actual $** *(includes accruals)*	**November Actual $** *(includes accruals)*	**December Actual $** *(includes accruals)*	**2014 Actual $s Booked in 2015**	**2014 Year-to-Date Actual $** *(includes accruals)*	**January - June 2014**	**July - Dec 2014**	**Full Year Check**
7	$245.96	$651.54	$44.63	$32.94	$1,004.27	$3,337.69	$529.38	$34.11	$0.00	$12,386.04	$7,403.02	$4,983.02	$0.00
8	$0.00	$0.00	$0.00	$6,221.55	$1,206.00	$0.00	$5,000.00	$2,084.22	$1,712.48	$16,224.25	$0.00	$16,224.25	$0.00
9	$0.00	($0.08)	$2.81	$0.00	$36.00	$1,547.08	$255.44	$2.41	$0.00	$5,985.08	$4,141.34	$1,843.74	$0.00
10	**$245.96**	**$651.46**	**$47.44**	**$6,254.49**	**$2,246.27**	**$4,884.77**	**$5,784.82**	**$2,120.74**	**$1,712.48**	**$34,595.37**	$11,544.36	$23,051.01	$0.00
11	$1,815.01	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,817.88	$2,817.88	$0.00	$0.00
12	$53,125.00	$2,057.39	$0.00	$0.00	$0.00	$0.00	$0.00	$1,162.72	$13,800.00	$123,270.11	$108,307.39	$14,962.72	$0.00
13	$2.18	$0.16	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$76.23	$76.23	$0.00	$0.00
14	**$54,942.19**	**$2,057.55**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$1,162.72**	**$13,800.00**	**$126,164.22**	$111,201.50	$14,962.72	$0.00
15	$1,620.57	$980.56	$495.83	$634.22	$693.01	$797.08	$650.06	$1,772.49	$0.00	$14,984.14	$9,941.45	$5,042.69	$0.00
16	$2,060.83	$2,848.34	$384.03	$4,296.10	$551.67	$663.00	$20,609.56	$39,384.89	$0.00	$179,633.03	$113,743.78	$65,889.25	$0.00
17	$3.77	$0.16	$101.84	$1.25	$128.29	$110.86	$0.08	$3.16	$0.00	$1,051.08	$705.60	$345.48	$0.00
18	**$3,685.17**	**$3,829.06**	**$981.70**	**$4,931.57**	**$1,372.97**	**$1,570.94**	**$21,259.70**	**$41,160.54**	**$0.00**	**$195,668.25**	$124,390.83	$71,277.42	$0.00
19	$2,716.91	$1,759.52	$1,960.01	$1,913.93	$1,328.77	$2,106.09	$1,660.52	$2,374.36	$0.00	$22,074.64	$10,730.96	$11,343.68	$0.00
20	$9,160.00	$15,640.00	$16,480.00	$18,240.00	$18,760.00	$15,960.00	$17,000.00	$14,520.00	$10,400.00	$155,160.00	$43,800.00	$111,360.00	$0.00
21	$38,290.50	$52,934.50	$60,870.00	$55,860.00	$50,952.50	$61,065.50	$31,749.50	$30,655.50	($11,213.00)	$475,177.50	$195,237.50	$279,940.00	$0.00
22	$1,077.46	($488.73)	$966.80	$2,238.69	$1,481.08	$5,517.70	$3,990.63	($2,941.65)	($533.20)	$24,025.01	$13,304.96	$10,720.05	$0.00
23	$58.83	$0.28	$8.86	$243.41	$0.20	$144.30	$0.16	$8.05	$0.00	$483.97	$78.99	$404.98	$0.00
24	**$51,303.70**	**$69,845.57**	**$80,285.67**	**$78,496.03**	**$72,522.55**	**$84,793.59**	**$54,400.81**	**$44,616.26**	**($1,346.20)**	**$676,921.12**	$263,152.41	$413,768.71	$0.00
25	$5,563.75	$4,579.81	$2,550.42	$4,698.79	$1,417.22	$8,053.33	$4,290.16	$7,506.51	$0.00	$59,302.23	$30,785.80	$28,516.43	$0.00
26	$46,825.00	$23,580.23	$22,266.90	$35,157.78	$41,620.13	$58,854.53	$56,978.01	$360,500.07	($10,578.22)	$646,614.98	$81,815.78	$564,799.20	$0.00
27	($35,594.00)	$82,606.90	$52,961.04	$62,264.08	$63,485.99	$70,651.43	$70,686.20	$273,915.83	($18,365.04)	$960,321.75	$384,722.22	$575,599.53	$0.00
28	$3,539.13	$1,609.45	$3,184.30	$7,467.80	$8,490.47	$3,695.92	$12,996.01	$2,489.03	($980.40)	$136,283.76	$98,940.63	$37,343.13	$0.00
29	$11.98	$204.32	$23.02	$151.37	$293.84	$9.89	$0.60	$171.49	$0.00	$1,052.34	$402.13	$650.21	$0.00
30	**$20,345.86**	**$112,580.71**	**$80,985.68**	**$109,739.82**	**$115,307.65**	**$141,265.10**	**$144,950.98**	**$644,582.93**	**($29,923.66)**	**$1,803,575.06**	$596,666.56	$1,206,908.50	$0.00
31	$2,396.81	$1,316.24	$867.61	$929.02	$578.21	$948.72	$811.81	$600.30	$0.00	$15,953.75	$11,218.08	$4,735.67	$0.00
32	$202,121.54	$47,058.74	$4,761.28	$42,393.21	$34,332.02	$31,702.21	$2,318.20	$5,390.93	$0.00	$808,956.32	$688,058.47	$120,897.85	$0.00
33	$1,039.47	($675.63)	($3,607.85)	$3,501.24	$4,697.11	($1,279.05)	$577.10	$4,098.53	($3,271.73)	$29,627.03	$24,911.68	$4,715.35	$0.00
34	$111.37	$0.24	$6.62	$2.19	$0.12	$4.22	$0.08	$3.96	$0.00	$695.41	$678.22	$17.19	$0.00
35	**$205,669.19**	**$47,699.59**	**$2,027.66**	**$46,825.66**	**$39,607.46**	**$31,376.10**	**$3,707.19**	**$10,093.72**	**($3,271.73)**	**$855,232.51**	$724,866.45	$130,366.06	$0.00
36	$2,790.18	$1,520.23	$1,067.66	$1,263.91	$764.52	$798.34	$501.82	$600.30	$32.31	$18,102.51	$13,073.65	$5,028.86	$0.00
37	$11,088.72	$2,318.59	$2,397.46	$2,089.49	$2,318.20	$2,318.20	$2,318.20	$2,318.20	$0.00	$704,482.96	$690,723.21	$13,759.75	$0.00
38	($2,135.88)	($1,413.80)	($1,252.87)	$2,000.92	$5,538.84	$2,492.91	($122.90)	$3,925.53	$262.22	$33,942.02	$21,097.37	$12,844.65	$0.00
39	$89.74	$0.28	$7.66	$2.70	$0.12	$5.50	$0.08	$2.43	$1.81	$452.50	$432.20	$20.30	$0.00
40	**$11,832.76**	**$2,425.30**	**$2,219.91**	**$5,357.02**	**$8,621.68**	**$5,614.95**	**$2,697.20**	**$6,846.46**	**$296.34**	**$756,979.99**	$725,326.43	$31,653.56	$0.00
41	$2,137.89	$1,198.96	$867.82	$1,027.56	$936.27	$1,458.03	$1,110.44	$1,507.74	$0.00	$17,033.30	$10,125.44	$6,907.86	$0.00
42	$45,936.40	$48,978.71	$41,997.58	$151,440.72	$151,705.66	$21,558.20	$6,394.20	$1,634.80	$0.19	$928,388.79	$553,657.44	$374,731.35	$0.00
43	($1,066.46)	($1,561.11)	($1,277.86)	$2,999.68	$5,338.09	$1,492.91	$77.11	$4,235.91	($2,229.43)	$29,069.30	$18,432.89	$10,636.41	$0.00
44	$134.07	$0.20	$6.02	$2.19	$0.12	$6.75	$136.28	$5.38	$0.00	$887.54	$730.80	$156.74	$0.00
45	**$47,141.90**	**$48,616.76**	**$41,593.56**	**$155,470.15**	**$157,980.14**	**$24,515.89**	**$7,718.03**	**$7,383.83**	**($2,229.24)**	**$975,378.93**	$582,946.57	$392,432.36	$0.00
46	$1,584.03	$1,287.30	$1,023.22	$994.35	$1,395.20	$1,773.67	$1,704.91	$1,275.01	$0.00	$14,793.96	$6,627.60	$8,166.36	$0.00
47	$14,436.94	$35,712.60	$21,741.21	$47,621.20	$78,915.27	$83,284.34	$7,429.20	$30,511.92	$429.60	$515,000.99	$245,068.25	$269,932.74	$0.00
48	$5,709.64	$1,516.05	$936.24	$3,999.87	$4,728.05	$1,281.34	$5,722.34	$7,654.55	($7,397.51)	$36,846.48	$19,921.60	$16,924.88	$0.00
49	$142.01	$218.00	$6.49	$2.59	$0.12	$336.32	$52.80	$8.26	$0.00	$1,019.92	$613.34	$406.58	$0.00
50	**$21,872.62**	**$38,733.95**	**$23,707.16**	**$52,618.01**	**$85,038.64**	**$86,675.67**	**$14,909.25**	**$39,449.74**	**($6,967.91)**	**$567,661.35**	$272,230.79	$295,430.56	$0.00
51	$8,965.98	$5,902.85	$3,758.65	$3,666.88	$2,882.01	$5,424.71	$2,188.08	$911.42	$0.00	$70,228.98	$51,397.23	$18,831.75	$0.00
52	$100,555.06	$92,085.00	$106,222.00	$97,345.00	$237,151.90	$336,685.60	$0.00	$0.00	$0.00	$1,881,147.70	$1,103,743.20	$777,404.50	$0.00
53	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
54	$22,757.41	$60,704.70	$39,119.38	$198,171.55	$37,987.14	$33,022.98	$69,379.45	$102,696.42	$2,318.20	$566,157.23	$83,462.11	$482,695.12	$0.00
55	$32,718.54	($6,686.50)	($40,600.77)	($165,160.02)	$31,392.31	$67,355.24	($67,061.25)	($100,378.22)	($2,318.20)	($0.00)	$276,770.91	($276,770.91)	($0.00)
56	$4,456.23	$2,171.29	$1,168.16	$997.23	$2,650.15	$1,579.25	$1,115.53	$4,388.72	$8,885.96	$55,850.30	$35,065.30	$20,785.00	$0.00
57	($3,500.00)	($3,000.00)	($12,000.00)	$6,000.00	$7,000.00	($4,000.00)	$3,000.00	$5,000.00	($20,000.00)	$0.00	$15,000.00	($15,000.00)	$0.00
58	$249.75	$111.16	$29.69	$9.46	$5.40	$162.95	$0.40	$154.00	$0.00	$2,634.36	$2,272.46	$361.90	$0.00
59	**$166,202.97**	**$151,288.50**	**$97,697.11**	**$141,030.10**	**$319,068.91**	**$440,230.73**	**$8,622.21**	**$12,772.34**	**($11,114.04)**	**$2,576,018.57**	$1,567,711.21	$1,008,307.36	$0.00
60	$4,237.19	$2,996.41	$2,471.90	$3,749.30	$3,045.89	$4,443.34	$3,396.05	$5,392.15	$0.00	$38,552.97	$16,054.34	$22,498.63	$0.00
61	$17,327.63	$5,557.08	$7,544.32	$2,799.18	$5,420.51	$46,997.52	$9,417.50	$4,671.85	$17,233.29	$262,906.22	$168,822.05	$94,084.17	$0.00

	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
62	$1,668.44	$990.65	$641.18	$1,903.17	($45.10)	$1,408.45	$5,926.80	($1,000.00)	($315.68)	$21,993.71	$13,474.89	$8,518.82	$0.00
63	$5.35	$4.40	$15.08	$6.21	$0.40	$22.00	$0.36	$16.46	$0.00	$93.95	$33.44	$60.51	$0.00
64	**$23,238.61**	**$9,548.54**	**$10,672.48**	**$8,457.86**	**$8,421.70**	**$52,871.31**	**$18,740.71**	**$9,080.46**	**$16,917.61**	**$323,546.85**	$198,384.72	$125,162.13	$0.00
65	$3,132.12	$2,721.22	$1,448.11	$1,802.16	$1,645.66	$3,196.46	$3,668.07	$3,822.16	$0.00	$27,771.29	$12,188.67	$15,582.62	$0.00
66	$0.00	$5,760.00	$4,680.00	$360.00	$26,160.00	$18,960.00	$26,820.00	$14,400.00	$1,800.00	$98,940.00	$5,760.00	$93,180.00	$0.00
67	$0.00	$0.00	$360.00	$5,760.00	($1,260.00)	($4,860.00)	$0.00	$1,800.00	($1,800.00)	$0.00	$0.00	$0.00	$0.00
68	$0.00	$35,490.00	$0.00	$0.00	$27,918.30	$0.00	$35,669.02	$0.00	$33,482.33	$132,559.65	$35,490.00	$97,069.65	$0.00
69	$8,062.00	($6,188.81)	$9,921.11	$10,269.37	($9,899.54)	$15,442.89	($15,847.14)	$13,660.45	($33,482.33)	$0.00	$9,935.19	($9,935.19)	$0.00
70	$0.00	$689.64	$408.45	$730.98	$408.45	$991.95	$1,509.22	$148.54	$466.80	$5,354.03	$689.64	$4,664.39	$0.00
71	$1,000.00	($500.00)	($500.00)	$1,000.00	$0.00	$0.00	$2,000.00	($2,000.00)	($1,000.00)	$0.00	$500.00	($500.00)	$0.00
72	$5.60	$0.32	$13.68	$3.65	$0.20	$12.00	$64.64	$142.07	$0.00	$259.43	$23.19	$236.24	$0.00
73	**$12,199.72**	**$37,972.37**	**$16,331.35**	**$19,926.16**	**$44,973.07**	**$33,743.30**	**$53,883.81**	**$31,973.22**	**($533.20)**	**$264,884.40**	$64,586.69	$200,297.71	$0.00
74	$3,178.72	$3,217.88	$2,929.53	$3,291.07	$2,661.41	$3,992.58	$4,022.53	$5,516.34	$0.00	$35,306.73	$12,893.27	$22,413.46	$0.00
75	$4,373.50	$31,686.16	$0.00	$12,305.92	$25,574.47	$51,809.64	$28,419.38	$60,663.21	$14,214.86	$229,047.14	$36,059.66	$192,987.48	$0.00
76	$13,300.00	($16,000.00)	$12,305.91	$12,646.09	($20,105.00)	($4,847.00)	$0.00	$10,433.62	($10,433.62)	$0.00	$0.00	$0.00	$0.00
77	$0.00	$23,443.22	$0.00	$0.00	$62,479.79	$0.00	$97,287.65	$0.00	$130,007.71	$364,773.37	$74,998.22	$289,775.15	$0.00
78	$26,247.70	$766.19	$18,875.01	$31,863.66	($53,049.22)	$62,763.31	($47,710.81)	$76,849.80	($126,426.64)	$0.00	$36,834.89	($36,834.89)	$0.00
79	$3,983.78	$0.00	$1,310.28	$2,158.95	$1,179.63	$875.25	$6,507.56	$201.59	$514.25	$20,844.40	$8,096.89	$12,747.51	$0.00
80	($2,674.36)	$570.29	($750.00)	$1,000.00	($1,000.00)	$4,000.00	$0.00	($4,000.00)	($1,000.00)	$0.00	$1,750.00	($1,750.00)	$0.00
81	$3.84	$8.81	$16.18	$7.40	$0.36	$143.56	$49.60	$40.78	$0.00	$320.10	$62.22	$257.88	$0.00
82	**$48,413.18**	**$43,692.55**	**$34,686.91**	**$63,273.09**	**$17,741.44**	**$118,737.34**	**$88,575.91**	**$149,705.34**	**$6,876.56**	**$650,291.74**	$170,695.15	$479,596.59	$0.00
83	$2,635.59	$2,107.71	$1,306.15	$1,874.47	$1,934.49	$2,739.62	$2,035.07	$2,728.47	$0.00	$26,306.30	$13,688.03	$12,618.27	$0.00
84	$0.00	$0.00	$0.00	$0.00	$172,920.00	$0.00	$0.00	$0.00	$0.00	$664,323.00	$491,403.00	$172,920.00	$0.00
85	$1,668.42	$430.69	$1,421.03	$366.03	$1,517.19	$6,209.88	$1,525.15	($1,000.00)	($305.08)	$30,686.70	$20,952.50	$9,734.20	$0.00
86	$4.79	$0.24	$10.61	$3.31	$0.20	$13.98	$0.20	$9.85	$0.00	$68.37	$30.22	$38.15	$0.00
87	**$4,308.80**	**$2,538.64**	**$2,737.79**	**$2,243.81**	**$176,371.88**	**$8,963.48**	**$3,560.42**	**$1,738.32**	**($305.08)**	**$721,384.37**	$526,073.75	$195,310.62	$0.00
88	$1,088.52	$2,616.62	$2,302.96	$3,535.99	$2,769.98	$3,709.09	$2,449.73	$2,923.70	$0.00	$27,195.50	$9,504.05	$17,691.45	$0.00
89	$62,464.00	$63,616.00	$72,688.00	$67,008.00	$67,816.00	$16.00	$264.00	$0.00	$0.00	$335,752.00	$127,960.00	$207,792.00	$0.00
90	$78,047.22	$54,101.97	$62,432.45	$44,002.96	$39,346.87	$18,111.57	$18,368.68	$18,368.68	$0.00	$746,036.76	$545,405.55	$200,631.21	$0.00
91	$2,109.76	$92.86	$1,117.94	$2,746.57	($2,000.00)	$7,021.10	$6,593.74	($2,851.46)	($350.23)	$38,631.48	$26,353.82	$12,277.66	$0.00
92	$2.01	$0.12	$13.15	$5.79	$0.40	$20.06	$0.28	$11.86	$0.00	$74.22	$22.68	$51.54	$0.00
93	**$143,711.51**	**$120,427.57**	**$138,554.50**	**$117,299.31**	**$107,933.25**	**$28,877.82**	**$27,676.43**	**$18,452.78**	**($350.23)**	**$1,147,689.96**	$709,246.10	$438,443.86	$0.00
94	$2,519.12	$702.25	$453.87	$632.92	$309.04	$547.04	$905.28	$1,891.27	$128.14	$16,351.17	$11,483.61	$4,867.56	$0.00
95	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$381.84	$11,647.30	$0.00	$25,625.14	$13,596.00	$12,029.14	$0.00
96	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
97	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
98	$2,967.32	$0.00	$806.34	$408.45	$0.00	$350.10	$978.36	$0.00	$0.00	$7,677.58	$5,134.33	$2,543.25	$0.00
99	($613.38)	($226.97)	($700.00)	$0.00	$0.00	$0.00	$1,500.00	($2,000.00)	$0.00	($0.00)	$1,200.00	($1,200.00)	$0.00
100	$122.51	$0.24	$3.16	$0.79	$0.08	$2.25	$60.52	$4.22	$6.12	$245.91	$168.77	$77.14	$0.00
101	**$4,995.57**	**$475.52**	**$563.37**	**$1,042.16**	**$309.12**	**$899.39**	**$3,826.00**	**$11,542.79**	**$134.26**	**$49,899.80**	$31,582.71	$18,317.09	$0.00
102	$4,458.34	$3,919.88	$2,300.22	$3,842.58	$2,056.83	$7,582.18	$4,292.47	$7,150.31	$1,068.53	$53,523.50	$25,230.38	$28,293.12	$0.00
103	$96,178.48	$0.00	$11,160.73	$36,016.86	$70,008.25	$40,592.25	$70,026.79	$709,947.40	$14,525.01	$1,263,269.69	$310,992.40	$952,277.29	$0.00
104	$59,192.83	$32,000.00	$34,705.63	$40,731.37	$48,971.70	$41,840.54	$48,976.19	$221,231.38	($7,449.64)	$640,000.00	$210,992.83	$429,007.17	$0.00
105	$10,269.62	($4,774.28)	$2,847.25	$3,815.56	$5,526.07	$1,490.42	$4,699.24	$3,202.81	($598.33)	$72,526.33	$51,543.31	$20,983.02	$0.00
106	$171.08	$70.28	$19.70	$71.03	$253.36	$226.86	$0.60	$270.66	$35.71	$1,372.22	$494.30	$877.92	$0.00
107	**$170,270.35**	**$31,215.88**	**$51,033.53**	**$84,477.40**	**$126,816.21**	**$91,732.25**	**$127,995.29**	**$941,802.56**	**$7,581.28**	**$2,030,691.74**	$599,253.22	$1,431,438.52	$0.00
108	$1,784.51	$2,587.11	$1,317.17	$2,241.97	$588.75	$2,221.67	$842.67	$1,346.71	$375.19	$17,432.13	$8,498.00	$8,934.13	$0.00
109	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$875.00	$0.00	$875.00	$0.00	$875.00	$0.00
110	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$454.48	$0.00	$454.48	$0.00	$454.48	$0.00
111	($333.20)	($345.88)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,490.59	$2,490.59	$0.00	$0.00
112	$96.98	$0.16	$13.01	$3.31	$74.68	$4.23	$0.16	$4.08	$9.18	$296.46	$187.81	$108.65	$0.00
113	**$1,548.29**	**$2,241.39**	**$1,330.18**	**$2,245.28**	**$663.43**	**$2,225.90**	**$842.83**	**$2,680.27**	**$384.37**	**$21,548.66**	$11,176.40	$10,372.26	$0.00
114	$2,802.99	$2,649.55	$1,790.86	$2,679.52	$849.00	$2,258.12	$1,161.67	$996.40	$0.00	$24,128.89	$14,393.32	$9,735.57	$0.00
115	$3,591.00	$0.00	$14,578.14	$28,263.00	$44,929.09	$122,975.00	$58,649.52	$163,435.90	$0.00	$449,516.65	$16,686.00	$432,830.65	$0.00
116	$10,697.84	$69,822.01	$12,474.89	$15,308.59	$17,313.62	$30,379.93	$19,955.41	$38,092.18	($0.01)	$230,022.26	$96,497.65	$133,524.61	$0.00
117	$3,450.20	$1,311.49	$2,200.20	$3,787.55	$5,966.75	$7,290.20	$11,540.23	($446.04)	($1,350.38)	$62,611.62	$33,623.11	$28,988.51	$0.00
118	$4.98	$0.28	$13.32	$4.50	$0.28	$5.99	$62.88	$5.63	$0.00	$185.96	$93.36	$92.60	$0.00
119	**$20,547.01**	**$73,783.33**	**$31,057.41**	**$50,043.16**	**$69,058.74**	**$162,909.24**	**$91,369.71**	**$202,084.07**	**($1,350.39)**	**$766,465.38**	$161,293.44	$605,171.94	$0.00
120	$3,228.81	$2,663.45	$2,169.29	$3,850.62	$1,972.40	$4,383.55	$3,002.54	$4,676.93	$0.00	$30,053.81	$9,998.48	$20,055.33	$0.00
121	$0.00	$1,500.00	$14,600.00	$4,590.00	$24,120.00	$18,530.00	$9,910.00	$24,740.00	$12,060.00	$110,050.00	$1,500.00	$108,550.00	$0.00
122	$0.00	$0.00	$0.00	$8,530.00	($4,050.00)	($4,480.00)	$0.00	$12,287.00	($12,287.00)	$0.00	$0.00	$0.00	$0.00
123	$0.00	$28,454.00	$0.00	$0.00	$26,905.84	$0.00	$26,596.94	$0.00	$29,142.23	$111,099.01	$28,454.00	$82,645.01	$0.00
124	$7,304.00	($7,043.56)	$10,985.34	$10,208.52	($14,911.41)	$12,750.05	($16,206.36)	$18,918.20	($29,308.78)	$0.00	$7,564.44	($7,564.44)	$0.00

	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
125	$0.00	$143.23	$233.40	$116.70	$1,713.45	$2,450.70	$2,736.01	$74.27	$0.00	$7,467.76	$143.23	$7,324.53	$0.00
126	$0.00	$500.00	$0.00	$500.00	($500.00)	$3,500.00	($1,000.00)	($3,000.00)	$0.00	$0.00	$500.00	($500.00)	$0.00
127	$4.94	$0.32	$13.38	$5.48	$0.40	$99.46	$135.84	$142.22	$0.00	$408.54	$11.76	$396.78	$0.00
128	**$10,537.75**	**$26,217.44**	**$28,001.41**	**$27,801.32**	**$35,250.68**	**$37,233.76**	**$25,174.97**	**$57,838.62**	**($393.55)**	**$259,079.12**	$48,171.91	$210,907.21	$0.00
129	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
130	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
131	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
132	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	$0.00	$0.00	$0.00
133	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
134	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
135	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
136	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	$0.00	$0.00	$0.00
137	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
138	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
139	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
140	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	$0.00	$0.00	$0.00
141	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
142	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
143	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
144	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	$0.00	$0.00	$0.00
145	$7,568.46	$4,291.33	$2,326.08	$3,611.15	$2,664.53	$3,614.64	$2,654.25	$4,159.31	$0.00	$39,170.70	$20,140.74	$19,029.96	$0.00
146	$6,464.42	$2,179.64	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$8,644.06	$8,644.06	$0.00	$0.00
147	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
148	$9.12	$0.72	$21.57	$5.86	$0.40	$19.20	$0.28	$90.50	$0.00	$164.78	$26.97	$137.81	$0.00
149	**$14,042.00**	**$6,471.69**	**$2,347.65**	**$3,617.01**	**$2,664.93**	**$3,633.84**	**$2,654.53**	**$4,249.81**	**$0.00**	**$47,979.54**	$28,811.77	$19,167.77	$0.00
150	$422.15	$0.00	$0.00	$228.53	$560.92	$922.40	$1,105.71	$1,254.30	$0.00	$4,692.68	$620.82	$4,071.86	$0.00
151	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
152	$6,298.73	$6,494.73	$6,710.62	$6,969.05	$8,154.69	$8,132.89	$8,079.46	$6,429.69	$193.54	$81,584.93	$36,914.99	$44,669.94	$0.00
153	$20,583.41	$20,108.78	$19,992.27	$19,206.73	$22,313.34	$22,158.37	$22,283.30	$22,203.17	$913.51	$251,955.98	$122,885.29	$129,070.69	$0.00
154	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
155	$1,664.44	($1,432.22)	$709.36	$14.40	$0.00	$0.00	$5,500.00	$8,197.44	$135.32	$38,969.46	$24,412.94	$14,556.52	$0.00
156	$0.00	$0.04	$0.00	$0.00	$0.04	$4.15	$0.08	$5.36	$0.00	$9.67	$0.04	$9.63	$0.00
157	**$28,968.73**	**$25,171.33**	**$27,412.25**	**$26,418.71**	**$31,028.99**	**$31,217.81**	**$36,968.55**	**$38,089.96**	**$1,242.37**	**$377,212.72**	$184,834.08	$192,378.64	$0.00
158													
159	***$1,066,023.84***	***$857,484.70***	***$674,274.72***	***$1,007,568.12***	***$1,422,999.71***	***$1,393,973.18***	***$745,319.35***	***$2,279,427.48***	***($8,839.96)***	***$15,228,869.65***	$7,714,147.05	$7,514,722.60	$0.00
160													
161													
162													
163													
164													
165													
166													
167													
168													
169													
170													
171									**Internal Staff Costs**				
172									Res	$294,188.61			
173									C&I	$224,615.73			
174									Indirect	$69,358.76			
175									Total	$588,163.10			

Exhibit NM-17

I&M Discovery Request Response to CAC Set 1, Q2, 2014 Final Performance—JCW-17

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	**I&M Utility Operations**													
2	**2014 Actuals by Month Indiana DSM_EE Program Year 5**													
3	**Authorized / Control Budget Variance Report**													
5		**2014 Year-to-Date December / Year-End**				**ANNUAL Budget $s Remaining**								
6	**Project**	**Expense Category**	**Forecast $**	**Actual $** *(includes accruals)*					**2014 Authorized**		**January Actual $** *(includes accruals)*	**February Actual $** *(includes accruals)*	**March Actual $** *(includes accruals)*	**April Actual $** *(includes accruals)*
7	000018501 IN-DSM Staff Devlpmnt & Mbrshp	Staffing	$0.00	$12,386.04		($12,386.04)			$0.00		$3,497.11	$2,838.22	$87.97	$82.22
8		Delivery	$95,000.00	$16,224.25		$78,775.75			$95,000.00		$0.00	$0.00	$0.00	$0.00
9		Other	$0.00	$5,985.08		($5,985.08)			$0.00		$408.42	$2,706.71	$963.05	$63.24
10		**Sum:**	**$95,000.00**	**$34,595.37**		**$60,404.63**			**$95,000.00**		**$3,905.53**	**$5,544.93**	**$1,051.02**	**$145.46**
11	000018502 IN-Information & Technlgy Syst	Staffing	$0.00	$2,817.88		($2,817.88)			$0.00		$0.00	$0.00	$0.00	$1,002.87
12		Delivery	$235,000.00	$123,270.11		$111,729.89			$235,000.00		$0.00	$0.00	$53,125.00	$0.00
13		Other	$0.00	$76.23		($76.23)			$0.00		$0.00	$0.00	$0.00	$73.89
14		**Sum:**	**$235,000.00**	**$126,164.22**		**$108,835.78**			**$235,000.00**		**$0.00**	**$0.00**	**$53,125.00**	**$1,076.76**
15	000018503 IN-DSM Marketing & Cust Aware	Staffing	$0.00	$14,984.14		($14,984.14)			$0.00		$627.22	$1,748.41	$3,347.48	$1,617.21
16		Delivery	$300,000.00	$179,633.03		$120,366.97			$300,000.00		$1,316.24	$661.18	$90,093.47	$16,763.72
17		Other	$0.00	$1,051.08		($1,051.08)			$0.00		$0.00	$0.00	$189.10	$512.57
18		**Sum:**	**$300,000.00**	**$195,668.25**		**$104,331.75**			**$300,000.00**		**$1,943.46**	**$2,409.59**	**$93,630.05**	**$18,893.50**
19	000018505 IN - Res Appliance Recycling	Staffing	$43,960.00	$22,074.64		$21,885.36			$43,960.00		$843.20	$1,887.51	$1,914.33	$1,609.49
20		Incentives	$112,989.00	$155,160.00		($42,171.00)			$112,989.00		$0.00	$7,560.00	$5,240.00	$6,200.00
21		Delivery	$395,463.00	$475,177.50		($79,714.50)			$395,463.00		$34,450.00	$10,965.50	$19,297.50	$39,299.50
22		EM&V	$112,467.00	$24,025.01		$88,441.99			$112,467.00		$800.00	$1,766.57	$8,274.11	$1,875.55
23		Other	$24,993.00	$483.97		$24,509.03			$24,993.00		$3.92	$0.00	$11.25	$4.71
24		**Sum:**	**$689,872.00**	**$676,921.12**		**$12,950.88**			**$689,872.00**		**$36,097.12**	**$22,179.58**	**$34,737.19**	**$48,989.25**
25	000019206 IN - C&I Incentive Program	Staffing	$50,835.00	$59,302.23		($8,467.23)			$50,835.00		$6,242.74	$3,797.53	$5,441.04	$5,160.93
26		Incentives	$950,691.00	$646,614.98		$304,076.02			$950,691.00		$0.00	$0.00	$0.00	$11,410.55
27		Delivery	$880,062.00	$960,321.75		($80,259.75)			$880,062.00		$99,245.00	$98,290.45	$100,250.00	$39,923.87
28		EM&V	$84,331.00	$136,283.76		($51,952.76)			$84,331.00		$14,000.00	$13,397.15	$53,952.05	$12,442.85
29		Other	$21,083.00	$1,052.34		$20,030.66			$21,083.00		$9.77	$0.00	$158.02	$18.04
30		**Sum:**	**$1,987,002.00**	**$1,803,575.06**		**$183,426.94**			**$1,987,002.00**		**$119,497.51**	**$115,485.13**	**$159,801.11**	**$68,956.24**
31	000020613 IN Statewide-Res Lighting	Staffing	$34,931.00	$15,953.75		$18,977.25			$34,931.00		$1,495.10	$2,026.39	$2,285.97	$1,697.57
32		Delivery	$1,440,111.00	$808,956.32		$631,154.68			$1,440,111.00		$61,757.00	$73,360.99	$127,651.37	$176,108.83
33		EM&V	$50,000.00	$29,627.03		$20,372.97			$50,000.00		$6,000.00	$521.12	$6,500.00	$11,526.72
34		Other	$20,000.00	$695.41		$19,304.59			$20,000.00		$3.99	$351.17	$12.05	$199.40
35		**Sum:**	**$1,545,042.00**	**$855,232.51**		**$689,809.49**			**$1,545,042.00**		**$69,256.09**	**$76,259.67**	**$136,449.39**	**$189,532.52**
36	000020614 IN Statewide-Res Energy Audit	Staffing	$44,657.00	$18,102.51		$26,554.49			$44,657.00		$1,983.70	$2,244.61	$2,740.70	$1,794.23
37		Delivery	$673,670.00	$704,482.96		($30,812.96)			$673,670.00		$171,818.00	$110,577.86	$146,376.74	$248,543.30
38		EM&V	$38,067.00	$33,942.02		$4,124.98			$38,067.00		$8,000.00	$612.35	$7,499.99	$8,534.71
39		Other	$12,689.00	$452.50		$12,236.50			$12,689.00		$7.07	$233.56	$18.35	$83.20
40		**Sum:**	**$769,083.00**	**$756,979.99**		**$12,103.01**			**$769,083.00**		**$181,808.77**	**$113,668.38**	**$156,635.78**	**$258,955.44**
41	000020615 IN Statewide-Res Low Inc Weath	Staffing	$37,742.00	$17,033.30		$20,708.70			$37,742.00		$1,568.65	$1,606.00	$2,057.47	$1,556.47
42		Delivery	$1,792,799.00	$928,388.79		$864,410.21			$1,792,799.00		$166,149.00	$125,405.92	$68,986.31	$98,201.10
43		EM&V	$129,324.00	$29,069.30		$100,254.70			$129,324.00		$4,500.00	$521.13	$6,499.98	$9,539.35
44		Other	$21,554.00	$887.54		$20,666.46			$21,554.00		$8.08	$497.54	$9.54	$81.37
45		**Sum:**	**$1,981,419.00**	**$975,378.93**		**$1,006,040.07**			**$1,981,419.00**		**$172,225.73**	**$128,030.59**	**$77,553.30**	**$109,378.29**
46	000020616 IN Statewide-Energ Eff Schools	Staffing	$56,393.00	$14,793.96		$41,599.04			$56,393.00		$409.03	$1,060.42	$1,113.10	$1,173.72
47		Delivery	$333,705.00	$515,000.99		($181,295.99)			$333,705.00		$30,624.00	$25,057.69	$108,345.05	$30,891.97
48		EM&V	$162,997.00	$36,846.48		$126,150.52			$162,997.00		$3,000.00	$3,411.26	$3,000.00	$3,284.65
49		Other	$33,466.00	$1,019.92		$32,446.08			$33,466.00		$0.00	$167.80	$6.30	$79.23
50		**Sum:**	**$586,561.00**	**$567,661.35**		**$18,899.65**			**$586,561.00**		**$34,033.03**	**$29,697.17**	**$112,464.45**	**$35,429.57**
51	000020617 IN Statewide-C&I Prescriptive	Staffing	$88,202.00	$70,228.98		$17,973.02			$88,202.00		$4,580.66	$10,565.10	$13,526.14	$7,856.50
52		Incentives	$4,938,109.00	$1,881,147.70		$3,056,961.30			$4,938,109.00		$123,324.30	$166,527.00	$317,336.84	$303,915.00
53		Incentive Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$0.00
54		Delivery	$186,695.00	$566,157.23		($379,462.23)			$186,695.00		$0.00	$0.00	$0.00	$0.00
55		Delivery Accrual	$0.00	($0.00)					$0.00		$22,750.00	$25,007.41	$197,427.72	$5,553.74
56		EM&V	$97,547.00	$55,850.30		$41,696.70			$97,547.00		$0.00	$0.00	$13,231.91	$15,205.87
57		EM&V Accrual	$0.00	$0.00					$0.00		$8,000.00	$13,231.92	$268.08	$0.00
58		Other	$40,645.00	$2,634.36		$38,010.64			$40,645.00		$9.95	$270.87	$523.08	$1,107.65
59		**Sum:**	**$5,351,198.00**	**$2,576,018.57**		**$2,775,179.43**			**$5,351,198.00**		**$158,664.91**	**$215,602.30**	**$542,313.77**	**$333,638.76**
60	000020618 IN Core+ Res On-Line Audit	Staffing	$134,007.00	$38,552.97		$95,454.03			$134,007.00		$1,845.62	$1,992.80	$2,640.51	$2,341.81
61		Delivery	$119,675.00	$262,906.22		($143,231.22)			$119,675.00		$19,917.50	$49,089.84	$55,272.05	$21,657.95

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
62		EM&V	$66,036.00	$21,993.71		$44,042.29			$66,036.00		$800.00	$583.50	$9,199.64	$232.66
63		Other	$18,868.00	$93.95		$18,774.05			$18,868.00		$5.20	$0.00	$11.88	$6.61
64		**Sum:**	**$338,586.00**	**$323,546.85**		**$15,039.15**			**$338,586.00**		**$22,568.32**	**$51,666.14**	**$67,124.08**	**$24,239.03**
65	000020619 IN Core+ Res New Construction	Staffing	$34,931.00	$27,771.29		$7,159.71			$34,931.00		$1,584.38	$1,031.64	$1,256.71	$2,462.60
66		Incentives	$84,000.00	$98,940.00		($14,940.00)			$84,000.00		$0.00	$0.00	$0.00	$0.00
67		Incentive Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$0.00
68		Delivery	$154,820.00	$132,559.65		$22,260.35			$154,820.00		$0.00	$0.00	$0.00	$0.00
69		Delivery Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$8,062.00
70		EM&V	$50,000.00	$5,354.03		$44,645.97			$50,000.00		$0.00	$0.00	$0.00	$0.00
71		EM&V Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$0.00
72		Other	$10,000.00	$259.43		$9,740.57			$10,000.00		$8.08	$0.00	$6.13	$3.06
73		**Sum:**	**$333,751.00**	**$264,884.40**		**$68,866.60**			**$333,751.00**		**$1,592.46**	**$1,031.64**	**$1,262.84**	**$10,527.66**
74	000020621 IN Core+ Res Home Weatherization	Staffing	$30,238.00	$35,306.73		($5,068.73)			$30,238.00		$1,537.07	$1,782.36	$1,526.65	$1,650.59
75		Incentives	$482,386.00	$229,047.14		$253,338.86			$482,386.00		$0.00	$0.00	$0.00	$0.00
76		Incentive Accrual	$0.00	$0.00					$0.00		$2,700.00	$0.00	$0.00	$0.00
77		Delivery	$864,285.00	$364,773.37		$499,511.63			$864,285.00		$0.00	$0.00	$17,185.00	$34,370.00
78		Delivery Accrual	$0.00	$0.00					$0.00		$17,185.00	$17,185.00	$0.00	($24,549.00)
79		EM&V	$85,998.00	$20,844.40		$65,153.60			$85,998.00		$0.00	$350.10	$0.00	$3,763.01
80		EM&V Accrual	$0.00	$0.00					$0.00		$500.00	$0.00	$6,963.01	($3,608.94)
81		Other	$16,763.00	$320.10		$16,442.90			$16,763.00		$0.00	$0.00	$37.46	$12.11
82		**Sum:**	**$1,479,670.00**	**$650,291.74**		**$829,378.26**			**$1,479,670.00**		**$21,922.07**	**$19,317.46**	**$25,712.12**	**$11,637.77**
83	000020622 IN Core+ Res Home Energy Rptg	Staffing	$25,875.00	$26,306.30		($431.30)			$25,875.00		$1,748.13	$2,118.77	$3,029.57	$2,048.26
84		Delivery	$664,323.00	$664,323.00		$0.00			$664,323.00		$0.00	$491,403.00	$0.00	$0.00
85		EM&V	$40,000.00	$30,686.70		$9,313.30			$40,000.00		$500.00	$583.50	$16,206.03	$1,563.86
86		Other	$20,000.00	$68.37		$19,931.63			$20,000.00		$5.09	$0.00	$12.62	$7.48
87		**Sum:**	**$750,198.00**	**$721,384.37**		**$28,813.63**			**$750,198.00**		**$2,253.22**	**$494,105.27**	**$19,248.22**	**$3,619.60**
88	000020623 IN Core+ Res Peak Reduction	Staffing	$110,405.00	$27,195.50		$83,209.50			$110,405.00		$1,663.13	$1,473.40	$1,810.00	$852.38
89	*(Bill Credits)*	Incentives	$211,622.00	$335,752.00		($124,130.00)			$211,622.00		$0.00	$0.00	$0.00	$1,880.00
90		Delivery	$1,235,450.00	$746,036.76		$489,413.24			$1,235,450.00		$67,000.00	$58,405.05	$164,155.85	$123,695.46
91		EM&V	$105,172.00	$38,631.48		$66,540.52			$105,172.00		$1,000.00	$636.10	$20,732.87	$1,782.23
92		Other	$31,552.00	$74.22		$31,477.78			$31,552.00		$7.32	$0.00	$8.77	$4.46
93		**Sum:**	**$1,694,201.00**	**$1,147,689.96**		**$546,511.04**			**$1,694,201.00**		**$69,670.45**	**$60,514.55**	**$186,707.49**	**$128,214.53**
94	000020624 IN Core+ Renewables & Demonstr	Staffing	$46,646.00	$16,351.17		$30,294.83			$46,646.00		$1,663.67	$1,457.19	$1,413.57	$3,727.81
95		Incentives	$50,242.00	$25,625.14		$24,616.86			$50,242.00		$0.00	$0.00	$0.00	$13,596.00
96		Incentive Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$0.00
97		Delivery	$46,336.00	$0.00		$46,336.00			$46,336.00		$0.00	$0.00	$0.00	$0.00
98		EM&V	$99,292.00	$7,677.58		$91,614.42			$99,292.00		$0.00	$0.00	$933.60	$1,233.41
99		EM&V Accrual	$0.00	($0.00)					$0.00		$500.00	$350.10	$2,883.31	($1,693.06)
100		Other	$33,097.00	$245.91		$32,851.09			$33,097.00		$5.70	$0.00	$36.98	$3.34
101		**Sum:**	**$275,613.00**	**$49,899.80**		**$225,713.20**			**$275,613.00**		**$2,169.37**	**$1,807.29**	**$5,267.46**	**$16,867.50**
102	000020625 IN Core+ C&I Retro-Comm Lite	Staffing	$95,332.00	$53,523.50		$41,808.50			$95,332.00		$5,181.54	$3,670.86	$4,249.90	$3,749.86
103		Incentives	$813,623.00	$1,263,269.69		($449,646.69)			$813,623.00		$0.00	$0.00	$0.00	$214,813.92
104		Delivery	$1,046,877.00	$640,000.00		$406,877.00			$1,046,877.00		$0.00	$0.00	$0.00	$119,800.00
105		EM&V	$163,748.00	$72,526.33		$91,221.67			$163,748.00		$11,000.00	$9,251.75	$22,372.40	$3,423.82
106		Other	$68,228.00	$1,372.22		$66,855.78			$68,228.00		$7.32	$0.00	$174.63	$70.99
107		**Sum:**	**$2,187,808.00**	**$2,030,691.74**		**$157,116.26**			**$2,187,808.00**		**$16,188.86**	**$12,922.61**	**$26,796.93**	**$341,858.59**
108	000020626 IN Core+ C&I HVAC Optimization	Staffing	$69,863.00	$17,432.13		$52,430.87			$69,863.00		$1,039.17	$897.79	$1,101.08	$1,088.34
109		Incentives	$215,806.00	$875.00		$214,931.00			$215,806.00		$0.00	$0.00	$0.00	$0.00
110		Delivery	$0.00	$454.48		($454.48)			$0.00		$0.00	$0.00	$0.00	$0.00
111		EM&V	$100,000.00	$2,490.59		$97,509.41			$100,000.00		$0.00	$0.00	$1,262.58	$1,907.09
112		Other	$50,000.00	$296.46		$49,703.54			$50,000.00		$8.23	$0.00	$5.36	$77.08
113		**Sum:**	**$435,669.00**	**$21,548.66**		**$414,120.34**			**$435,669.00**		**$1,047.40**	**$897.79**	**$2,369.02**	**$3,072.51**
114	000020627 IN Core+ C&I Audit & SBDI	Staffing	$34,931.00	$24,128.89		$10,802.11			$34,931.00		$2,290.32	$1,681.28	$2,817.68	$2,151.50
115		Incentives	$292,547.00	$449,516.65		($156,969.65)			$292,547.00		$3,876.00	$0.00	$3,534.00	$5,685.00
116		Delivery	$352,073.00	$230,022.26		$122,050.74			$352,073.00		$1,720.40	$5,100.00	$2,679.40	$6,478.00
117		EM&V	$45,000.00	$62,611.62		($17,611.62)			$45,000.00		$6,000.00	$5,811.32	$16,005.13	$1,044.97
118		Other	$50,000.00	$185.96		$49,814.04			$50,000.00		$4.53	$0.00	$10.01	$73.56
119		**Sum:**	**$774,551.00**	**$766,465.38**		**$8,085.62**			**$774,551.00**		**$13,891.25**	**$12,592.60**	**$25,046.22**	**$15,433.03**
120	000023305 IN Core+ Residential EE Products	Staffing	$25,875.00	$30,053.81		($4,178.81)			$25,875.00		$265.74	$696.03	$960.77	$2,183.68
121		Incentives	$577,976.00	$110,050.00		$467,926.00			$577,976.00		$0.00	$0.00	$0.00	$0.00
122		Incentive Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$0.00
123		Delivery	$14,315.00	$111,099.01		($96,784.01)			$14,315.00		$0.00	$0.00	$0.00	$0.00
124		Delivery Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$7,304.00

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
125		EM&V	$11,250.00	$7,467.76		$3,782.24			$11,250.00		$0.00	$0.00	$0.00	$0.00
126		EM&V Accrual	$0.00	$0.00					$0.00		$0.00	$0.00	$0.00	$0.00
127		Other	$1,500.00	$408.54		$1,091.46			$1,500.00		$0.00	$0.00	$4.16	$2.34
128		**Sum:**	**$630,916.00**	**$259,079.12**		**$371,836.88**			**$630,916.00**		**$265.74**	**$696.03**	**$964.93**	**$9,490.02**
129	000023306 IN-New Program Development	Staffing	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
130		Delivery	$210,000.00	$0.00		$210,000.00			$210,000.00		$0.00	$0.00	$0.00	$0.00
131		Other	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
132		**Sum:**	**$210,000.00**	**$0.00**		**$210,000.00**			**$210,000.00**		**$0.00**	**$0.00**	**$0.00**	**$0.00**
133	000023307 IN-General EE Mgmt & Collaboration	Staffing	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
134		Delivery	$105,000.00	$0.00		$105,000.00			$105,000.00		$0.00	$0.00	$0.00	$0.00
135		Other	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
136		**Sum:**	**$105,000.00**	**$0.00**		**$105,000.00**			**$105,000.00**		**$0.00**	**$0.00**	**$0.00**	**$0.00**
137	000023308 IN-Codes Work	Staffing	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
138		Delivery	$100,000.00	$0.00		$100,000.00			$100,000.00		$0.00	$0.00	$0.00	$0.00
139		Other	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
140		**Sum:**	**$100,000.00**	**$0.00**		**$100,000.00**			**$100,000.00**		**$0.00**	**$0.00**	**$0.00**	**$0.00**
141	000023309 IN-MPS & Action Plan	Staffing	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
142		Delivery	$75,000.00	$0.00		$75,000.00			$75,000.00		$0.00	$0.00	$0.00	$0.00
143		Other	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
144		**Sum:**	**$75,000.00**	**$0.00**		**$75,000.00**			**$75,000.00**		**$0.00**	**$0.00**	**$0.00**	**$0.00**
145	000023310 IN-Evaluation & Related	Staffing	$0.00	$39,170.70		($39,170.70)			$0.00		$0.00	$1,869.52	$2,441.20	$3,970.23
146		AEP Labor	$0.00	$8,644.06		($8,644.06)			$0.00		$0.00	$0.00	$0.00	$0.00
147		Delivery	$140,000.00	$0.00		$140,000.00			$140,000.00		$0.00	$0.00	$0.00	$0.00
148		Other	$0.00	$164.78		($164.78)			$0.00		$0.00	$0.00	$11.14	$5.99
149		**Sum:**	**$140,000.00**	**$47,979.54**		**$92,020.46**			**$140,000.00**		**$0.00**	**$1,869.52**	**$2,452.34**	**$3,976.22**
150	000023311 IN EECO Program	Staffing	$0.00	$4,692.68		($4,692.68)			$0.00		$0.00	$0.00	$0.00	$198.67
151		AEP Labor	$0.00	$0.00		$0.00			$0.00		$0.00	$0.00	$0.00	$0.00
152		Depreciation	$65,172.00	$81,584.93		($16,412.93)			$65,172.00		$5,852.40	$5,899.02	$6,136.19	$6,233.92
153		Carrying Costs	$239,362.00	$251,955.98		($12,593.98)			$239,362.00		$20,508.10	$20,528.70	$20,587.55	$20,568.75
154		Delivery	$140,953.00	$0.00		$140,953.00			$140,953.00		$0.00	$0.00	$0.00	$0.00
155		EM&V	$0.00	$38,969.46		($38,969.46)			$0.00		$0.00	$0.00	$0.00	$24,180.72
156		Other	$0.00	$9.67		($9.67)			$0.00		$0.00	$0.00	$0.00	$0.00
157		**Sum:**	**$445,487.00**	**$377,212.72**		**$68,274.28**			**$445,487.00**		**$26,360.50**	**$26,427.72**	**$26,723.74**	**$51,182.06**
158														
159		**GRAND TOTAL:**	***$23,516,627.00***	***$15,228,869.65***		***$8,287,757.35***			***$23,516,627.00***		***$955,361.79***	***$1,392,725.96***	***$1,757,436.45***	***$1,685,114.31***
160														
161	**NOTE:** Includes 06/26/2014 approved budget transfer of $196,923 from IQW to Home Energy Reporting													
162	**NOTE:** Includes the following budget transfers approved 10/28/2014:													
163		$35,000 from General EE Mgmt to IT Systems												
164		$25,000 from MPS & Action Plan to IT Systems												
165		$25,000 from Staff Development to IT Systems												
166		$126,820 from EEP to RNC												
167		$138,189 from C&I HVAC to C&I Audit / SBDI												
168		$791,046 from C&I Prescriptive to C&I Incentives												
169		$520,426 from C&I Prescriptive to C&I RCxL												
170	**NOTE:** Includes 12/17/2014 approved budget transfer of $241,650 from C&I Prescriptive to C&I RCxL													
171														
172														
173														
174														
175														

	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1													
2													
3													
5													
6	**May Actual $** *(includes accruals)*	**June Actual $** *(includes accruals)*	**July Actual $** *(includes accruals)*	**August Actual $** *(includes accruals)*	**September Actual $** *(includes accruals)*	**October Actual $** *(includes accruals)*	**November Actual $** *(includes accruals)*	**December Actual $** *(includes accruals)*	**2014 Actual $s Booked in 2015**	**2014 Year-to-Date Actual $** *(includes accruals)*	**January - June 2014**	**July - Dec 2014**	**Full Year Check**
7	$245.96	$651.54	$44.63	$32.94	$1,004.27	$3,337.69	$529.38	$34.11	$0.00	$12,386.04	$7,403.02	$4,983.02	$0.00
8	$0.00	$0.00	$0.00	$6,221.55	$1,206.00	$0.00	$5,000.00	$2,084.22	$1,712.48	$16,224.25	$0.00	$16,224.25	$0.00
9	$0.00	($0.08)	$2.81	$0.00	$36.00	$1,547.08	$255.44	$2.41	$0.00	$5,985.08	$4,141.34	$1,843.74	$0.00
10	**$245.96**	**$651.46**	**$47.44**	**$6,254.49**	**$2,246.27**	**$4,884.77**	**$5,784.82**	**$2,120.74**	**$1,712.48**	**$34,595.37**	$11,544.36	$23,051.01	$0.00
11	$1,815.01	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,817.88	$2,817.88	$0.00	$0.00
12	$53,125.00	$2,057.39	$0.00	$0.00	$0.00	$0.00	$0.00	$1,162.72	$13,800.00	$123,270.11	$108,307.39	$14,962.72	$0.00
13	$2.18	$0.16	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$76.23	$76.23	$0.00	$0.00
14	**$54,942.19**	**$2,057.55**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$1,162.72**	**$13,800.00**	**$126,164.22**	$111,201.50	$14,962.72	$0.00
15	$1,620.57	$980.56	$495.83	$634.22	$693.01	$797.08	$650.06	$1,772.49	$0.00	$14,984.14	$9,941.45	$5,042.69	$0.00
16	$2,060.83	$2,848.34	$384.03	$4,296.10	$551.67	$663.00	$20,609.56	$39,384.89	$0.00	$179,633.03	$113,743.78	$65,889.25	$0.00
17	$3.77	$0.16	$101.84	$1.25	$128.29	$110.86	$0.08	$3.16	$0.00	$1,051.08	$705.60	$345.48	$0.00
18	**$3,685.17**	**$3,829.06**	**$981.70**	**$4,931.57**	**$1,372.97**	**$1,570.94**	**$21,259.70**	**$41,160.54**	**$0.00**	**$195,668.25**	$124,390.83	$71,277.42	$0.00
19	$2,716.91	$1,759.52	$1,960.01	$1,913.93	$1,328.77	$2,106.09	$1,660.52	$2,374.36	$0.00	$22,074.64	$10,730.96	$11,343.68	$0.00
20	$9,160.00	$15,640.00	$16,480.00	$18,240.00	$18,760.00	$15,960.00	$17,000.00	$14,520.00	$10,400.00	$155,160.00	$43,800.00	$111,360.00	$0.00
21	$38,290.50	$52,934.50	$60,870.00	$55,860.00	$50,952.50	$61,065.50	$31,749.50	$30,655.50	($11,213.00)	$475,177.50	$195,237.50	$279,940.00	$0.00
22	$1,077.46	($488.73)	$966.80	$2,238.69	$1,481.08	$5,517.70	$3,990.63	($2,941.65)	($533.20)	$24,025.01	$13,304.96	$10,720.05	$0.00
23	$58.83	$0.28	$8.86	$243.41	$0.20	$144.30	$0.16	$8.05	$0.00	$483.97	$78.99	$404.98	$0.00
24	**$51,303.70**	**$69,845.57**	**$80,285.67**	**$78,496.03**	**$72,522.55**	**$84,793.59**	**$54,400.81**	**$44,616.26**	**($1,346.20)**	**$676,921.12**	$263,152.41	$413,768.71	$0.00
25	$5,563.75	$4,579.81	$2,550.42	$4,698.79	$1,417.22	$8,053.33	$4,290.16	$7,506.51	$0.00	$59,302.23	$30,785.80	$28,516.43	$0.00
26	$46,825.00	$23,580.23	$22,266.90	$35,157.78	$41,620.13	$58,854.53	$56,978.01	$360,500.07	($10,578.22)	$646,614.98	$81,815.78	$564,799.20	$0.00
27	($35,594.00)	$82,606.90	$52,961.04	$62,264.08	$63,485.99	$70,651.43	$70,686.20	$273,915.83	($18,365.04)	$960,321.75	$384,722.22	$575,599.53	$0.00
28	$3,539.13	$1,609.45	$3,184.30	$7,467.80	$8,490.47	$3,695.92	$12,996.01	$2,489.03	($980.40)	$136,283.76	$98,940.63	$37,343.13	$0.00
29	$11.98	$204.32	$23.02	$151.37	$293.84	$9.89	$0.60	$171.49	$0.00	$1,052.34	$402.13	$650.21	$0.00
30	**$20,345.86**	**$112,580.71**	**$80,985.68**	**$109,739.82**	**$115,307.65**	**$141,265.10**	**$144,950.98**	**$644,582.93**	**($29,923.66)**	**$1,803,575.06**	$596,666.56	$1,206,908.50	$0.00
31	$2,396.81	$1,316.24	$867.61	$929.02	$578.21	$948.72	$811.81	$600.30	$0.00	$15,953.75	$11,218.08	$4,735.67	$0.00
32	$202,121.54	$47,058.74	$4,761.28	$42,393.21	$34,332.02	$31,702.21	$2,318.20	$5,390.93	$0.00	$808,956.32	$688,058.47	$120,897.85	$0.00
33	$1,039.47	($675.63)	($3,607.85)	$3,501.24	$4,697.11	($1,279.05)	$577.10	$4,098.53	($3,271.73)	$29,627.03	$24,911.68	$4,715.35	$0.00
34	$111.37	$0.24	$6.62	$2.19	$0.12	$4.22	$0.08	$3.96	$0.00	$695.41	$678.22	$17.19	$0.00
35	**$205,669.19**	**$47,699.59**	**$2,027.66**	**$46,825.66**	**$39,607.46**	**$31,376.10**	**$3,707.19**	**$10,093.72**	**($3,271.73)**	**$855,232.51**	$724,866.45	$130,366.06	$0.00
36	$2,790.18	$1,520.23	$1,067.66	$1,263.91	$764.52	$798.34	$501.82	$600.30	$32.31	$18,102.51	$13,073.65	$5,028.86	$0.00
37	$11,088.72	$2,318.59	$2,397.46	$2,089.49	$2,318.20	$2,318.20	$2,318.20	$2,318.20	$0.00	$704,482.96	$690,723.21	$13,759.75	$0.00
38	($2,135.88)	($1,413.80)	($1,252.87)	$2,000.92	$5,538.84	$2,492.91	($122.90)	$3,925.53	$262.22	$33,942.02	$21,097.37	$12,844.65	$0.00
39	$89.74	$0.28	$7.66	$2.70	$0.12	$5.50	$0.08	$2.43	$1.81	$452.50	$432.20	$20.30	$0.00
40	**$11,832.76**	**$2,425.30**	**$2,219.91**	**$5,357.02**	**$8,621.68**	**$5,614.95**	**$2,697.20**	**$6,846.46**	**$296.34**	**$756,979.99**	$725,326.43	$31,653.56	$0.00
41	$2,137.89	$1,198.96	$867.82	$1,027.56	$936.27	$1,458.03	$1,110.44	$1,507.74	$0.00	$17,033.30	$10,125.44	$6,907.86	$0.00
42	$45,936.40	$48,978.71	$41,997.58	$151,440.72	$151,705.66	$21,558.20	$6,394.20	$1,634.80	$0.19	$928,388.79	$553,657.44	$374,731.35	$0.00
43	($1,066.46)	($1,561.11)	($1,277.86)	$2,999.68	$5,338.09	$1,492.91	$77.11	$4,235.91	($2,229.43)	$29,069.30	$18,432.89	$10,636.41	$0.00
44	$134.07	$0.20	$6.02	$2.19	$0.12	$6.75	$136.28	$5.38	$0.00	$887.54	$730.80	$156.74	$0.00
45	**$47,141.90**	**$48,616.76**	**$41,593.56**	**$155,470.15**	**$157,980.14**	**$24,515.89**	**$7,718.03**	**$7,383.83**	**($2,229.24)**	**$975,378.93**	$582,946.57	$392,432.36	$0.00
46	$1,584.03	$1,287.30	$1,023.22	$994.35	$1,395.20	$1,773.67	$1,704.91	$1,275.01	$0.00	$14,793.96	$6,627.60	$8,166.36	$0.00
47	$14,436.94	$35,712.60	$21,741.21	$47,621.20	$78,915.27	$83,284.34	$7,429.20	$30,511.92	$429.60	$515,000.99	$245,068.25	$269,932.74	$0.00
48	$5,709.64	$1,516.05	$936.24	$3,999.87	$4,728.05	$1,281.34	$5,722.34	$7,654.55	($7,397.51)	$36,846.48	$19,921.60	$16,924.88	$0.00
49	$142.01	$218.00	$6.49	$2.59	$0.12	$336.32	$52.80	$8.26	$0.00	$1,019.92	$613.34	$406.58	$0.00
50	**$21,872.62**	**$38,733.95**	**$23,707.16**	**$52,618.01**	**$85,038.64**	**$86,675.67**	**$14,909.25**	**$39,449.74**	**($6,967.91)**	**$567,661.35**	$272,230.79	$295,430.56	$0.00
51	$8,965.98	$5,902.85	$3,758.65	$3,666.88	$2,882.01	$5,424.71	$2,188.08	$911.42	$0.00	$70,228.98	$51,397.23	$18,831.75	$0.00
52	$100,555.06	$92,085.00	$106,222.00	$97,345.00	$237,151.90	$336,685.60	$0.00	$0.00	$0.00	$1,881,147.70	$1,103,743.20	$777,404.50	$0.00
53	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
54	$22,757.41	$60,704.70	$39,119.38	$198,171.55	$37,987.14	$33,022.98	$69,379.45	$102,696.42	$2,318.20	$566,157.23	$83,462.11	$482,695.12	$0.00
55	$32,718.54	($6,686.50)	($40,600.77)	($165,160.02)	$31,392.31	$67,355.24	($67,061.25)	($100,378.22)	($2,318.20)	($0.00)	$276,770.91	($276,770.91)	($0.00)
56	$4,456.23	$2,171.29	$1,168.16	$997.23	$2,650.15	$1,579.25	$1,115.53	$4,388.72	$8,885.96	$55,850.30	$35,065.30	$20,785.00	$0.00
57	($3,500.00)	($3,000.00)	($12,000.00)	$6,000.00	$7,000.00	($4,000.00)	$3,000.00	$5,000.00	($20,000.00)	$0.00	$15,000.00	($15,000.00)	$0.00
58	$249.75	$111.16	$29.69	$9.46	$5.40	$162.95	$0.40	$154.00	$0.00	$2,634.36	$2,272.46	$361.90	$0.00
59	**$166,202.97**	**$151,288.50**	**$97,697.11**	**$141,030.10**	**$319,068.91**	**$440,230.73**	**$8,622.21**	**$12,772.34**	**($11,114.04)**	**$2,576,018.57**	$1,567,711.21	$1,008,307.36	$0.00
60	$4,237.19	$2,996.41	$2,471.90	$3,749.30	$3,045.89	$4,443.34	$3,396.05	$5,392.15	$0.00	$38,552.97	$16,054.34	$22,498.63	$0.00
61	$17,327.63	$5,557.08	$7,544.32	$2,799.18	$5,420.51	$46,997.52	$9,417.50	$4,671.85	$17,233.29	$262,906.22	$168,822.05	$94,084.17	$0.00

	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
62	$1,668.44	$990.65	$641.18	$1,903.17	($45.10)	$1,408.45	$5,926.80	($1,000.00)	($315.68)	$21,993.71	$13,474.89	$8,518.82	$0.00
63	$5.35	$4.40	$15.08	$6.21	$0.40	$22.00	$0.36	$16.46	$0.00	$93.95	$33.44	$60.51	$0.00
64	**$23,238.61**	**$9,548.54**	**$10,672.48**	**$8,457.86**	**$8,421.70**	**$52,871.31**	**$18,740.71**	**$9,080.46**	**$16,917.61**	**$323,546.85**	$198,384.72	$125,162.13	$0.00
65	$3,132.12	$2,721.22	$1,448.11	$1,802.16	$1,645.66	$3,196.46	$3,668.07	$3,822.16	$0.00	$27,771.29	$12,188.67	$15,582.62	$0.00
66	$0.00	$5,760.00	$4,680.00	$360.00	$26,160.00	$18,960.00	$26,820.00	$14,400.00	$1,800.00	$98,940.00	$5,760.00	$93,180.00	$0.00
67	$0.00	$0.00	$360.00	$5,760.00	($1,260.00)	($4,860.00)	$0.00	$1,800.00	($1,800.00)	$0.00	$0.00	$0.00	$0.00
68	$0.00	$35,490.00	$0.00	$0.00	$27,918.30	$0.00	$35,669.02	$0.00	$33,482.33	$132,559.65	$35,490.00	$97,069.65	$0.00
69	$8,062.00	($6,188.81)	$9,921.11	$10,269.37	($9,899.54)	$15,442.89	($15,847.14)	$13,660.45	($33,482.33)	$0.00	$9,935.19	($9,935.19)	$0.00
70	$0.00	$689.64	$408.45	$730.98	$408.45	$991.95	$1,509.22	$148.54	$466.80	$5,354.03	$689.64	$4,664.39	$0.00
71	$1,000.00	($500.00)	($500.00)	$1,000.00	$0.00	$0.00	$2,000.00	($2,000.00)	($1,000.00)	$0.00	$500.00	($500.00)	$0.00
72	$5.60	$0.32	$13.68	$3.65	$0.20	$12.00	$64.64	$142.07	$0.00	$259.43	$23.19	$236.24	$0.00
73	**$12,199.72**	**$37,972.37**	**$16,331.35**	**$19,926.16**	**$44,973.07**	**$33,743.30**	**$53,883.81**	**$31,973.22**	**($533.20)**	**$264,884.40**	$64,586.69	$200,297.71	$0.00
74	$3,178.72	$3,217.88	$2,929.53	$3,291.07	$2,661.41	$3,992.58	$4,022.53	$5,516.34	$0.00	$35,306.73	$12,893.27	$22,413.46	$0.00
75	$4,373.50	$31,686.16	$0.00	$12,305.92	$25,574.47	$51,809.64	$28,419.38	$60,663.21	$14,214.86	$229,047.14	$36,059.66	$192,987.48	$0.00
76	$13,300.00	($16,000.00)	$12,305.91	$12,646.09	($20,105.00)	($4,847.00)	$0.00	$10,433.62	($10,433.62)	$0.00	$0.00	$0.00	$0.00
77	$0.00	$23,443.22	$0.00	$0.00	$62,479.79	$0.00	$97,287.65	$0.00	$130,007.71	$364,773.37	$74,998.22	$289,775.15	$0.00
78	$26,247.70	$766.19	$18,875.01	$31,863.66	($53,049.22)	$62,763.31	($47,710.81)	$76,849.80	($126,426.64)	$0.00	$36,834.89	($36,834.89)	$0.00
79	$3,983.78	$0.00	$1,310.28	$2,158.95	$1,179.63	$875.25	$6,507.56	$201.59	$514.25	$20,844.40	$8,096.89	$12,747.51	$0.00
80	($2,674.36)	$570.29	($750.00)	$1,000.00	($1,000.00)	$4,000.00	$0.00	($4,000.00)	($1,000.00)	$0.00	$1,750.00	($1,750.00)	$0.00
81	$3.84	$8.81	$16.18	$7.40	$0.36	$143.56	$49.60	$40.78	$0.00	$320.10	$62.22	$257.88	$0.00
82	**$48,413.18**	**$43,692.55**	**$34,686.91**	**$63,273.09**	**$17,741.44**	**$118,737.34**	**$88,575.91**	**$149,705.34**	**$6,876.56**	**$650,291.74**	$170,695.15	$479,596.59	$0.00
83	$2,635.59	$2,107.71	$1,306.15	$1,874.47	$1,934.49	$2,739.62	$2,035.07	$2,728.47	$0.00	$26,306.30	$13,688.03	$12,618.27	$0.00
84	$0.00	$0.00	$0.00	$0.00	$172,920.00	$0.00	$0.00	$0.00	$0.00	$664,323.00	$491,403.00	$172,920.00	$0.00
85	$1,668.42	$430.69	$1,421.03	$366.03	$1,517.19	$6,209.88	$1,525.15	($1,000.00)	($305.08)	$30,686.70	$20,952.50	$9,734.20	$0.00
86	$4.79	$0.24	$10.61	$3.31	$0.20	$13.98	$0.20	$9.85	$0.00	$68.37	$30.22	$38.15	$0.00
87	**$4,308.80**	**$2,538.64**	**$2,737.79**	**$2,243.81**	**$176,371.88**	**$8,963.48**	**$3,560.42**	**$1,738.32**	**($305.08)**	**$721,384.37**	$526,073.75	$195,310.62	$0.00
88	$1,088.52	$2,616.62	$2,302.96	$3,535.99	$2,769.98	$3,709.09	$2,449.73	$2,923.70	$0.00	$27,195.50	$9,504.05	$17,691.45	$0.00
89	$62,464.00	$63,616.00	$72,688.00	$67,008.00	$67,816.00	$16.00	$264.00	$0.00	$0.00	$335,752.00	$127,960.00	$207,792.00	$0.00
90	$78,047.22	$54,101.97	$62,432.45	$44,002.96	$39,346.87	$18,111.57	$18,368.68	$18,368.68	$0.00	$746,036.76	$545,405.55	$200,631.21	$0.00
91	$2,109.76	$92.86	$1,117.94	$2,746.57	($2,000.00)	$7,021.10	$6,593.74	($2,851.46)	($350.23)	$38,631.48	$26,353.82	$12,277.66	$0.00
92	$2.01	$0.12	$13.15	$5.79	$0.40	$20.06	$0.28	$11.86	$0.00	$74.22	$22.68	$51.54	$0.00
93	**$143,711.51**	**$120,427.57**	**$138,554.50**	**$117,299.31**	**$107,933.25**	**$28,877.82**	**$27,676.43**	**$18,452.78**	**($350.23)**	**$1,147,689.96**	$709,246.10	$438,443.86	$0.00
94	$2,519.12	$702.25	$453.87	$632.92	$309.04	$547.04	$905.28	$1,891.27	$128.14	$16,351.17	$11,483.61	$4,867.56	$0.00
95	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$381.84	$11,647.30	$0.00	$25,625.14	$13,596.00	$12,029.14	$0.00
96	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
97	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
98	$2,967.32	$0.00	$806.34	$408.45	$0.00	$350.10	$978.36	$0.00	$0.00	$7,677.58	$5,134.33	$2,543.25	$0.00
99	($613.38)	($226.97)	($700.00)	$0.00	$0.00	$0.00	$1,500.00	($2,000.00)	$0.00	($0.00)	$1,200.00	($1,200.00)	$0.00
100	$122.51	$0.24	$3.16	$0.79	$0.08	$2.25	$60.52	$4.22	$6.12	$245.91	$168.77	$77.14	$0.00
101	**$4,995.57**	**$475.52**	**$563.37**	**$1,042.16**	**$309.12**	**$899.39**	**$3,826.00**	**$11,542.79**	**$134.26**	**$49,899.80**	$31,582.71	$18,317.09	$0.00
102	$4,458.34	$3,919.88	$2,300.22	$3,842.58	$2,056.83	$7,582.18	$4,292.47	$7,150.31	$1,068.53	$53,523.50	$25,230.38	$28,293.12	$0.00
103	$96,178.48	$0.00	$11,160.73	$36,016.86	$70,008.25	$40,592.25	$70,026.79	$709,947.40	$14,525.01	$1,263,269.69	$310,992.40	$952,277.29	$0.00
104	$59,192.83	$32,000.00	$34,705.63	$40,731.37	$48,971.70	$41,840.54	$48,976.19	$221,231.38	($7,449.64)	$640,000.00	$210,992.83	$429,007.17	$0.00
105	$10,269.62	($4,774.28)	$2,847.25	$3,815.56	$5,526.07	$1,490.42	$4,699.24	$3,202.81	($598.33)	$72,526.33	$51,543.31	$20,983.02	$0.00
106	$171.08	$70.28	$19.70	$71.03	$253.36	$226.86	$0.60	$270.66	$35.71	$1,372.22	$494.30	$877.92	$0.00
107	**$170,270.35**	**$31,215.88**	**$51,033.53**	**$84,477.40**	**$126,816.21**	**$91,732.25**	**$127,995.29**	**$941,802.56**	**$7,581.28**	**$2,030,691.74**	$599,253.22	$1,431,438.52	$0.00
108	$1,784.51	$2,587.11	$1,317.17	$2,241.97	$588.75	$2,221.67	$842.67	$1,346.71	$375.19	$17,432.13	$8,498.00	$8,934.13	$0.00
109	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$875.00	$0.00	$875.00	$0.00	$875.00	$0.00
110	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$454.48	$0.00	$454.48	$0.00	$454.48	$0.00
111	($333.20)	($345.88)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,490.59	$2,490.59	$0.00	$0.00
112	$96.98	$0.16	$13.01	$3.31	$74.68	$4.23	$0.16	$4.08	$9.18	$296.46	$187.81	$108.65	$0.00
113	**$1,548.29**	**$2,241.39**	**$1,330.18**	**$2,245.28**	**$663.43**	**$2,225.90**	**$842.83**	**$2,680.27**	**$384.37**	**$21,548.66**	$11,176.40	$10,372.26	$0.00
114	$2,802.99	$2,649.55	$1,790.86	$2,679.52	$849.00	$2,258.12	$1,161.67	$996.40	$0.00	$24,128.89	$14,393.32	$9,735.57	$0.00
115	$3,591.00	$0.00	$14,578.14	$28,263.00	$44,929.09	$122,975.00	$58,649.52	$163,435.90	$0.00	$449,516.65	$16,686.00	$432,830.65	$0.00
116	$10,697.84	$69,822.01	$12,474.89	$15,308.59	$17,313.62	$30,379.93	$19,955.41	$38,092.18	($0.01)	$230,022.26	$96,497.65	$133,524.61	$0.00
117	$3,450.20	$1,311.49	$2,200.20	$3,787.55	$5,966.75	$7,290.20	$11,540.23	($446.04)	($1,350.38)	$62,611.62	$33,623.11	$28,988.51	$0.00
118	$4.98	$0.28	$13.32	$4.50	$0.28	$5.99	$62.88	$5.63	$0.00	$185.96	$93.36	$92.60	$0.00
119	**$20,547.01**	**$73,783.33**	**$31,057.41**	**$50,043.16**	**$69,058.74**	**$162,909.24**	**$91,369.71**	**$202,084.07**	**($1,350.39)**	**$766,465.38**	$161,293.44	$605,171.94	$0.00
120	$3,228.81	$2,663.45	$2,169.29	$3,850.62	$1,972.40	$4,383.55	$3,002.54	$4,676.93	$0.00	$30,053.81	$9,998.48	$20,055.33	$0.00
121	$0.00	$1,500.00	$14,600.00	$4,590.00	$24,120.00	$18,530.00	$9,910.00	$24,740.00	$12,060.00	$110,050.00	$1,500.00	$108,550.00	$0.00
122	$0.00	$0.00	$0.00	$8,530.00	($4,050.00)	($4,480.00)	$0.00	$12,287.00	($12,287.00)	$0.00	$0.00	$0.00	$0.00
123	$0.00	$28,454.00	$0.00	$0.00	$26,905.84	$0.00	$26,596.94	$0.00	$29,142.23	$111,099.01	$28,454.00	$82,645.01	$0.00
124	$7,304.00	($7,043.56)	$10,985.34	$10,208.52	($14,911.41)	$12,750.05	($16,206.36)	$18,918.20	($29,308.78)	$0.00	$7,564.44	($7,564.44)	$0.00

	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
125	$0.00	$143.23	$233.40	$116.70	$1,713.45	$2,450.70	$2,736.01	$74.27	$0.00	$7,467.76	$143.23	$7,324.53	$0.00
126	$0.00	$500.00	$0.00	$500.00	($500.00)	$3,500.00	($1,000.00)	($3,000.00)	$0.00	$0.00	$500.00	($500.00)	$0.00
127	$4.94	$0.32	$13.38	$5.48	$0.40	$99.46	$135.84	$142.22	$0.00	$408.54	$11.76	$396.78	$0.00
128	**$10,537.75**	**$26,217.44**	**$28,001.41**	**$27,801.32**	**$35,250.68**	**$37,233.76**	**$25,174.97**	**$57,838.62**	**($393.55)**	**$259,079.12**	$48,171.91	$210,907.21	$0.00
129	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
130	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
131	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
132	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	$0.00	$0.00	$0.00
133	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
134	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
135	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
136	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	$0.00	$0.00	$0.00
137	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
138	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
139	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
140	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	$0.00	$0.00	$0.00
141	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
142	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
143	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
144	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	$0.00	$0.00	$0.00
145	$7,568.46	$4,291.33	$2,326.08	$3,611.15	$2,664.53	$3,614.64	$2,654.25	$4,159.31	$0.00	$39,170.70	$20,140.74	$19,029.96	$0.00
146	$6,464.42	$2,179.64	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$8,644.06	$8,644.06	$0.00	$0.00
147	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
148	$9.12	$0.72	$21.57	$5.86	$0.40	$19.20	$0.28	$90.50	$0.00	$164.78	$26.97	$137.81	$0.00
149	**$14,042.00**	**$6,471.69**	**$2,347.65**	**$3,617.01**	**$2,664.93**	**$3,633.84**	**$2,654.53**	**$4,249.81**	**$0.00**	**$47,979.54**	$28,811.77	$19,167.77	$0.00
150	$422.15	$0.00	$0.00	$228.53	$560.92	$922.40	$1,105.71	$1,254.30	$0.00	$4,692.68	$620.82	$4,071.86	$0.00
151	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
152	$6,298.73	$6,494.73	$6,710.62	$6,969.05	$8,154.69	$8,132.89	$8,079.46	$6,429.69	$193.54	$81,584.93	$36,914.99	$44,669.94	$0.00
153	$20,583.41	$20,108.78	$19,992.27	$19,206.73	$22,313.34	$22,158.37	$22,283.30	$22,203.17	$913.51	$251,955.98	$122,885.29	$129,070.69	$0.00
154	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
155	$1,664.44	($1,432.22)	$709.36	$14.40	$0.00	$0.00	$5,500.00	$8,197.44	$135.32	$38,969.46	$24,412.94	$14,556.52	$0.00
156	$0.00	$0.04	$0.00	$0.00	$0.04	$4.15	$0.08	$5.36	$0.00	$9.67	$0.04	$9.63	$0.00
157	**$28,968.73**	**$25,171.33**	**$27,412.25**	**$26,418.71**	**$31,028.99**	**$31,217.81**	**$36,968.55**	**$38,089.96**	**$1,242.37**	**$377,212.72**	$184,834.08	$192,378.64	$0.00
158													
159	***$1,066,023.84***	***$857,484.70***	***$674,274.72***	***$1,007,568.12***	***$1,422,999.71***	***$1,393,973.18***	***$745,319.35***	***$2,279,427.48***	***($8,839.96)***	***$15,228,869.65***	$7,714,147.05	$7,514,722.60	$0.00
160													
161													
162													
163													
164													
165													
166													
167													
168													
169													
170													
171									**Internal Staff Costs**				
172									Res	$294,188.61			
173									C&I	$224,615.73			
174									Indirect	$69,358.76			
175									Total	$588,163.10			

Exhibit NM-18

I&M Discovery Request Response to CAC Set 1, Q2, 2014 Final Verified Savings

I&M

DSM/EE Program Scorecard - December 2014

Program Year 5: January 1,2014 - December 31, 2014

		Measures Implemented				Program Budget Expenditures				Gross Energy Impacts (kWh)				Gross Demand Impacts (kW)					Net kWh	Net kW
Program	End Note	Current Month	YTD	Planning Goal	% to Goal	Current Month Actuals	YTD	Budget	% to Goal	Current Month kWh Savings	YTD	Energy Savings Goal	% to Goal	Current Month kW Savings	YTD	Demand Savings Goal	% to Goal	NTG Ratio	YTD	YTD
CORE PROGRAMS																				
Residential Home Energy Assessment		0	1,632	2,106	77%	$7,143	$756,980	$787,357	96%	0	2,108,623	2,182,000	97%	0	230	924	25%	84%	1,771,244	193
Residential Low Income Weatherization		0	1,104	1,425	77%	$5,155	$975,379	$1,113,647	88%	5,146	1,481,320	1,524,000	97%	0	132	661	20%	100%	1,481,320	132
Residential Lighting		0	407,950	358,069	114%	$6,822	$855,233	$910,819	94%	0	14,836,964	15,685,000	95%	0	1,763	3,787	47%	50%	7,418,482	882
Energy Efficient Schools - Kits		62	3,820	6,048	63%	$32,482	$567,661	$586,561	97%	30,394	1,872,635	1,858,000	101%	0	0	495	0%	100%	1,867,017	0
Energy Efficient Schools - Audits		0	12	12	100%				N/A	0	502,983	92,112	546%	0	33	1	3300%	241%	1,212,189	80
C&I Rebate Programs		0	36,691	114,821	32%	$1,658	$2,576,019	$3,111,298	83%	0	20,849,641	35,000,000	60%	0	3,901	5,645	69%	81%	16,888,209	3,160
Subtotal		**62**	**451,209**	**482,481**	**94%**	**$53,260**	**$5,731,272**	**$6,509,682**	**88%**	**35,539**	**41,652,167**	**56,341,112**	**74%**	**0**	**6,059**	**11,513**	**53%**		**30,638,461**	**4,446**
CORE PLUS PROGRAMS																				
Appliance Recycling Program	7	260	3,879	3,137	124%	$43,270	$676,921	$649,077	104%	270,091	4,002,338	3,181,339	126%	34	506	943	54%	72%	2,881,683	365
Online Energy Check-up Program	8	71	5,395	6,882	78%	$8,765	$306,314	$338,585	90%	38,930	2,818,382	3,750,932	75%	3	245	262	93%	85%	2,395,625	208
Home Energy Reporting Program	9	94,295	96,278	100,000	96%	$1,433	$721,384	$735,348	98%	2,429,547	23,776,713	28,256,000	84%	169	2,092	1,930	108%	100%	23,776,713	2,092
Peak Reduction	10	0	8,440	9,000	94%	$18,103	$1,147,690	$1,047,129	110%	0	62,367	0	#DIV/0!	0	5,295	4,814	110%	100%	62,367	5,295
Renewables/Demo. Residential		1	2	5	40%	$8,757	$37,444	$134,545	28%	3,804	19,079	84,090	23%	1	3	6	53%	54%	10,303	2
Renewables/Demo. Commercial		1	2	2	100%	$2,920	$12,456	$44,848	28%	18,953	21,859	28,030	78%	3	4	2	181%	54%	11,804	2
Home Weatherization		1,694	5,973	6,929	86%	$156,582	$650,292	$1,457,738	45%	441,311	1,401,869	3,425,430	41%	60	206	1,047	20%	72%	1,009,345	148
Res. New Construction		33	204	449	45%	$31,440	$264,884	$333,751	79%	50,895	369,415	911,804	41%	40	237	77	308%	80%	295,532	190
Energy Efficient Products		267	1,063	2,816	38%	$57,445	$259,079	$630,916	41%	190,794	524,551	1,294,742	41%	40	149	3,542	4%	52%	272,767	77
C&I Incentives Program		124	238	34	700%	$616,544	$1,805,460	$1,987,002	91%	8,753,455	15,304,263	17,000,000	90%	0	814	4,888	17%	99%	15,151,220	806
C&I Audit Program		36	67	139	48%	$200,734	$766,465	$774,551	99%	457,218	1,292,080	1,430,770	90%	20	207	778	27%	81%	1,046,585	168
C&I Small Business Direct Install		72	206	175	118%					993,024	2,753,961	3,000,000	92%	0	0	n/a		100%	2,753,961	0
C&I Retro-Commissioning Lite Program		33	57	70	81%	$949,384	$2,030,692	$2,187,808	93%	12,047,037	20,685,678	20,000,000	103%	0	0	n/a		86%	17,789,683	0
C&I HVAC Optimization Program		35	35	357	10%	$3,065	$21,549	$435,669	5%	12,985	12,985	65,000	20%	2	2	528	0%	86%	11,167	2
EECO (Volt Var) Residential		9	9	9	100%	$34,020	$334,734	$396,483	84%	134,916	1,312,960	3,801,405	35%	13	130	1,086	12%	100%	1,312,960	130
EECO (Volt Var) Commerical						$4,205	$41,372	$49,004	84%	146,159	1,422,374	4,118,189	35%	14	140	1,177	12%	100%	1,422,374	140
Subtotal		**96,931**	**121,848**	**130,004**	**94%**	**$2,136,667**	**$9,076,736**	**$11,202,454**	**81%**	**25,989,118**	**75,780,873**	**90,347,731**	**84%**	**399**	**10,030**	**21,080**	**48%**		**70,204,089**	**9,624**
INDIRECT COSTS																				
Staff Development & Prof. Organizations						$3,833	$34,595	$95,000	36%											
Computer System Development						$14,963	$126,164	$235,000	54%											
Marketing & Customer Awareness						$41,161	$195,668	$300,000	65%											
New Program Development						$0	$0	$210,000	0%											
General EE Management & Collaboration						$0	$0	$105,000	0%											
Codes Work						$0	$0	$100,000	0%											
MPS & Action Plan						$0	$0	$75,000	0%											
Evaluation & Related						$4,250	$56,624	$140,000	40%											
Subtotal						**$64,207**	**$413,051**	**$1,260,000**	**33%**											
PORTFOLIO TOTALS																				
Total Residential		96,692	535,749	496,875	108%	$411,417	$7,553,995	$9,121,956	83%	3,595,828	54,587,216	65,954,742	83%	360	10,989	19,574	56%		44,555,358	9,714
Total C&I		229	37,102	115,435	32%	$1,778,510	$7,254,013	$8,590,180	84%	22,428,830	62,845,824	80,734,101	78%	40	5,101	13,019	39%		53,533,231	4,357
Total Portfolio		**96,993**	**573,057**	**612,485**	**94%**	**$2,254,134**	**$15,221,059**	**$18,972,136**	**80%**	**26,024,658**	**117,433,040**	**146,688,843**	**80%**	**399**	**16,089**	**32,593**	**49%**		**100,842,550**	**14,070**

Exhibit NM-19

I&M Discovery Request Response to CAC Set 1, Q2, EM&V Cost Per Program

EM&V Cost Per Program

2015 Indiana EE Programs	Total 2015 Budget	kWh Estimate	EM&V Estimate	2015 EM&V Budget
Residential Peak Reduction	824,835	112,014	50,000	29,694
Schools Energy Education	348,803	1,730,874	50,000	19,882
Residential Appliance Recycling	648,693	2,800,000	112,467	32,435
Residential EE Products - EE Products Componen	371,264	1,294,742	11,250	11,138
Residential EE Products - Lighting Component	1,072,014	14,770,000	50,000	48,241
Residential Home Energy Reporting	1,448,875	33,000,000	40,000	34,773
Residential Online Audit	676,785	3,865,320	46,000	35,870
Residential New Construction	492,422	731,022	50,000	28,560
Residential Weatherization	1,757,283	3,425,430	85,998	52,718
Residential Low Income Weatherization	1,205,906	1,018,912	85,998	51,854
Commercial & Industrial Audit & SBDI (Audit)	164,976	1,430,770	22,500	13,198
Commercial & Industrial Audit & SBDI (SBDI)	658,066	3,000,000	22,500	36,194
Commercial & Industrial Custom	1,443,917	12,000,000	100,000	72,196
Commercial & Industrial Prescriptive	2,763,894	35,000,000	97,547	129,903
Electric Energy Consumption Opt. Indiana			75,000	75,000
Electric Energy Consumption Opt. Michigan				25,000
Total	**13,877,733**		**899,260**	**696,655**

Exhibit NM-20

I&M Discovery Request Response to CAC Set 1, Q2, 2015 Plan

Indiana Michigan Power Company - Indiana
Demand Side Management - 2015 1 Year Plan
2015 DSM Plan

Exhibit JCW-1 (REVISED)

I&M Indiana DSM Direct Program	Program Description	2015 Program Budget	2015 Energy Savings (kWh)	2015 Demand Savings (kW)	Annual Cost of Conserved Energy (cents/kwh)	Lifetime Cost of Conserved Energy (cents/kwh)
Residential EE Products	Rebates for efficient residential lighting & other electro-technologies	$1,443,278	16,064,742	2,697	$0.09	$0.010
Residential Low Income Weatherization	Low Income home weatherization & efficiency	$1,205,906	1,018,912	109	$1.18	$0.087
Schools Energy Education	Energy education for elementary age children with take home kits	$348,803	1,730,874	215	$0.20	$0.034
Residential Appliance Recycling	Rebates for pick up, and recycling of refrigerators and freezers	$648,693	2,800,000	330	$0.23	$0.001
Residential New Construction	Rebates for efficient new home construction	$492,422	731,022	545	$0.67	$0.022
Residential Weatherization	Walk through audit with rebates for home weatherization & efficiency	$1,757,283	3,425,430	395	$0.51	$0.064
Residential Online Audit	Online basic home audit with mailed participant kits	$676,785	3,865,320	483	$0.18	$0.021
Residential Home Energy Reports	Home consumption comparison reports	$1,448,875	33,000,000	3,762	$0.04	$0.079
Residential Peak Reduction	Peak period cycling of residential air conditioners	$824,835	112,014	5,670	$7.36	$0.736
C&I Prescriptive	Rebates for efficient lighting, efficient motors, etc.	$2,763,894	35,000,000	5,600	$0.08	$0.005
C&I Custom	Rebates for custom C&I efficiency improvements (incl building retro-commissioning)	$2,704,917	24,000,000	5,021	$0.11	$0.015
C&I Audit & SBDI	Walk through audits and direct install cost effective measures for small business customers	$823,042	4,430,770	348	$0.19	$0.017
Electric Energy Consumption Optimization (EECO)	Utility distribution voltage control program to optimize & reduce end use consumption	$1,284,653	27,952,632	5,854	$0.05	$0.002
DSM Program Portfolio Total		**$16,423,387**	**154,131,716**	**31,029**	**$0.11**	**$0.013**

Portfolio Level Expenses (Indirect Programs)	
Information Technology & Systems	$200,000
Staff Development & Memberships	$30,000
Potential Studies	$75,000
Marketing & Customer Awareness	$300,000
Planning & Analytic Support	$125,000
New Program Development	$50,000
Budgeting & Accounting Support	$125,000
Total Portfolio Level Expenses	**$905,000**
Total I&M Indiana DSM Portfolio	**$17,328,387**
Count of Direct Programs	**13**

2015 DSM Energy Savings as % I&M IN Utility GWh Sales	1.01%
2015 IN DSM Program Cost as % of I&M IN Utility Revenues	1.49%
2015 IN DSM Program Cost	$17,328,387
2015 IN DSM Energy Savings Plan Target (kWh)	154,131,716
2015 IN DSM Program Operating Cost (cents/kwh saved)	$0.11

Exhibit NM-21

Indiana Technical Resource Manual (also known as Technical Reference Manual) 2.2

Indiana Technical Reference Manual Version 2.1

July 15, 2015

Prepared for the:
Indiana Demand Side Management
Coordination Committee
EM&V Subcommittee

CADMUS Opinion Dynamics Integral Analytics BuildingMetrics Incorporated

The Cadmus Group, Inc.
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Prepared by:
Cadmus
Indiana Statewide Evaluation Team

Table of Contents

Acronyms

Acronym	Definition
ASHP	Air-source heat pump
CDD	Cooling degree days
DEER	Database of Energy Efficiency Resources
DHW	Domestic hot water
DSMCC	Demand Side Management Coordination Committee
ECM	Electronically commuted motor
EISA	Energy Independence and Security Act of 2007
HDD	Heating degree days
HERS	Home Energy Rating System
HID	High-intensity discharge
HPWH	Heat pump water heater
IECC	International Energy Conservation Code
MEF	Modified energy factor
O&M	Operations and maintenance
RESNET	Residential Energy Services Network
SHGC	Solar Heat Gain Coefficient
SRCC	Solar Rating and Certification Company
TRM	Technical Reference Manual
UDRH	User Defined Reference Home

Introduction

This technical reference manual (TRM) was developed at the request of the Indiana Demand Side Management Coordination Committee (DSMCC). It is based on the *Draft Ohio TRM* developed by the Vermont Energy Investment Corporation (VEIC) under contract to the Public Utility Commission of Ohio (PUCO). The DSMCC directed Indiana utilities to use the *Draft Ohio TRM* to develop program plans and *ex-ante* savings estimates. This project was to update the *Draft Ohio TRM* with Indiana-specific data for climate-sensitive measures and parameters, add additional measures as needed to support the DSMCC, and update all measures with more current information.

The savings estimates are expected to serve as representative, recommended values for calculating savings based on program-specific information. All information is presented on a per-unit basis. When using the measure-specific TRM information, it is helpful to keep the following notes in mind:

- The TRM clearly identifies whether the measure impacts pertain to retrofit, time of sale,[1] or early retirement program designs.
- Additional information about the program design is sometimes included in the measure description when it can affect savings and other parameters.
- Savings algorithms are provided for each measure. Several measures provide prescriptive values for each variable along with the output from the algorithm. That output is the deemed savings assumption. Other measures provide prescriptive values for only some variables, directing to use the actual value for other variables. In these cases of deemed calculations,– users should input actual efficiency program data (e.g., capacities or rated efficiencies of central air conditioners) to compute savings. Note that the TRM often provides example calculations for measures requiring actual values for illustrative purposes only.
- All estimates are for annual savings; however, parameters for calculating Lifetime savings (such as measure life) are also included.
- Unless otherwise noted, the measure life is defined as the life of an energy consuming measure, including its equipment life and measure persistence.
- Where provided, deemed values represent average savings that could be expected from the average measures installed that year.
- For non-weather-sensitive measures, peak savings are estimated whenever possible as the average of savings between 3:00 p.m. and 6:00 p.m. across all summer weekdays (the Indiana summer on-peak period).
- Wherever possible, savings estimates and other assumptions are based on Indiana or regional data. However, a number of assumptions are based on sources from other regions of the country. While this information is not perfectly transferable (due to differences in the definition

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[1] In some jurisdictions, this is called replace on burn-out. We use the term time of sale because not all new equipment purchases take place when older, existing equipment reaches the end of its life.

of peak periods as well as in geography, climate, and customer mix), it was used because it was the most transferable and usable source available at the time.

- This TRM presents a combination of engineering equations and building energy simulation results. Engineering equations convey information clearly and transparently, and are widely accepted in the industry. The equations provide flexibility for users to substitute locally specific information and update some or all parameters as they become available on an ad hoc basis. One limitation is that certain interaction effects between end uses, such as how reductions in waste heat impact space conditioning, are not universally captured in this TRM. Such interactive factors are included in calculations for lighting measures. For measures where simple engineering equations do not adequately predict energy savings, simulation model results are presented. Engineering equations may also use parameters derived from simulation modeling. A description of the prototypical building models used in the simulations is shown in Appendix A.
- Many commercial and industrial measures are based on building energy simulations. This was typically done for complex, highly interactive measures, such as envelope improvements or chilled water resets. The building prototype assumptions are primarily based on California DEER prototypes, with adjustments based on data published by the U.S. Energy Information Administration *Commercial Building Energy Consumption Survey*.
- Early replacement measures show two levels of savings:
    - For an initial period during which the existing inefficient unit would have continued to be used had it not been replaced (with savings claimed between the existing unit and the efficient replacement).
    - For the remainder of the measure life, where the existing unit would have been replaced with a standard baseline unit (so savings are claimed between the standard baseline and the efficient replacement).

    We assume that accounting for this step-down adjustment in annual savings is possible in the utilities' tracking systems. This TRM also provides the impact of the deferred replacement payment that would have occurred at the end of the useful life of the existing equipment.
- In general, the baselines are intended to represent average conditions in Indiana. Some baselines are from Indiana specific data, such as household consumption characteristics being provided by the Energy Information Administration. Other baselines are extrapolated from secondary sources, when Indiana data are not available. When weather adjustments were needed in extrapolations, weather conditions in all major Indiana cities were generally used as representative for their regions.

TRM Updating Process

Updates to the Indiana TRM should be initiated when:

1. Indiana impact evaluations have established sufficient evidence to suggest that a change to a specific calculation or variable;
2. When a code or standard has changed at the state or federal level; or
3. If the energy industry has adopted a new value, such as the uniformed methods project (UMP).

As such, it is not recommended that a change be initiated unless agreed upon by the Evaluation Administrator and Subcommittee based on evidence that is consistent.

Following Subcommittee instructions, at the end of each program cycle, the Evaluation Administrator will compare the TRM estimated gross *ex ante* impacts with the *ex post* evaluated energy impact results to assess whether savings levels are statistically different. If the measure-specific savings are statically different, and the cause of that difference is associated with typical installation, use conditions, a change in baseline conditions, or with a change in the efficiency level, the Evaluation Administrator will develop and recommend a new *ex ante* estimation approach to the Subcommittee. A majority vote by the Subcommittee is required to accept the recommendation and update the TRM.

Each change to the TRM will be documented similarly to the change documentation approach for updating the Indiana Evaluation Framework. That is, each change will be recorded in a *TRM Changes and Updates* located in Appendix E.

TRM Changes and Updates

Measure	Edit #	Major Edit Description	Date

Adding New Measures to the TRM

The third-party Program Administrator or independent Evaluation Administrator can recommend to the Subcommittee to add new measures to the TRM. Likewise, based on a majority vote, the Subcommittee can instruct the Evaluation Administrator to include a new measure in the TRM. New measures can be added to the TRM at any time, subject to Subcommittee approval.

Each measure section of the TRM presents the *ex-ante* calculation approach for estimating the projected energy impacts from program implementation efforts undertaken following the release date of this document.

Residential Market Sector

Appliances

Refrigerator and/or Freezer Retirement (Early Retirement)

	Measure Details
Official Measure Code	Res-Appl-Refrig/Freez-Recycle-1
Measure Unit	Per refrigerator or freezer
Measure Category	Appliances
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by appliance
Peak Demand Reduction (kW)	Varies by appliance
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by appliance
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	0
Incremental Cost	Varies by appliance
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the removal of an existing inefficient primary or secondary refrigerator or freezer from service, prior to its natural end of life (early retirement).[2] This measure target units greater than 10 years old, though it is expected that the average age will be greater than 20 years based on other similar program performance. Savings are calculated for the estimated energy consumption during the remaining life of the existing unit.

Definition of Efficient Equipment

The efficient condition is removal of an existing inefficient primary or secondary refrigerator or freezer from service.

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[2] This measure assumes that a mix of primary and secondary units will be replaced (and the savings are reduced accordingly). By definition, a kitchen refrigerator that satisfies the majority of the household demand for refrigeration is the primary refrigerator. One or more additional refrigerators in the household that satisfy supplemental needs for refrigeration are secondary units.

Definition of Baseline Equipment

The baseline condition is an existing, inefficient unit that is in working order prior to being removed from service.

Deemed Lifetime of Efficient Equipment

The remaining useful life of the retired unit is 8 years.[3]

Deemed Measure Cost

The incremental cost for this measure is the actual cost associated with removing and recycling the retired unit.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = UEC_{RETIRED} * F_{RUN\ TIME}$$

Refrigerators

$$UEC_{RETIRED}{}^{4} = 365.25 * [0.769 + (0.008 * Age) + (0.827 * F_{BEFORE\ 1990}) + (0.083 * Size) + (-1.316 * F_{SINGLE\ DOOR}) + (0.862 * F_{SIDE-BY-SIDE}) + (0.642 * F_{PRIMARY}) + (0.031 * CDD * F_{OUTDOOR}) + (-0.049 * HDD * F_{OUTDOOR})]$$

Where:

$UEC_{RETIRED}$ = Average *in situ* energy consumption of retired unit

365.25 = Days of operation per year

$F_{RUN\ TIME}$ = Run time adjustment factor

Age = Unit age in years

$F_{BEFORE\ 1990}$ = Percentage of units manufactured before 1990

Size = Unit size in cubic feet

$F_{SINGLE\ DOOR}$ = Percentage of units with a single door

$F_{SIDE-BY-SIDE}$ = Percentage of side-by-side units

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[3] KEMA. *Residential Refrigerator Recycling Ninth Year Retention Study*. 2004.

[4] Regression model developed by Cadmus for the 2006-2008 California Appliance Recycling Program evaluation. See: Cadmus. *Residential Retrofit High Impact Measure Evaluation Report*. 2010. Available online: http://www.calmac.org/publications/FinalResidentialRetroEvaluationReport_11.pdf. Summary of model constants are in the Reference Tables section for this measure.

$F_{PRIMARY}$ = Percentage of units that are for primary use

CDD = Local cooling degree days per day

$F_{OUTDOOR}$ = Fraction of units that are located in garages or outdoors

HDD = Local heating degree days per day

For example, refrigerator model parameters derived for the NIPSCO Appliance Recycling Program are shown in the table below.[5]

Refrigerator Model Parameters for NIPSCO Appliance Recycling Program

Parameter	Value
Age	18.78
Before 1990	0.27
Size	20.17
Single door	0.11
Side-by-side	0.13
Primary	0.33
CDD	2.225
HDD	17.244
Outdoor	0.62
Run-time adjustment	0.828

This leads to the following savings:

$$\text{Refrigerator }\Delta\text{kWh} = 365.25 * [0.769 + (0.008 * 18.78) + (0.827 * 0.27) + (0.083 * 20.17) + (-1.316 * 0.11) + (0.862 * 0.13) + (0.642 * 0.33) + (0.031 * 2.225 * 0.62) + (-0.049 * 17.244 * 0.62)] * 0.828 = 761\text{ kWh}$$

Freezers

$$UEC_{RETIRED}{}^{6} = 365.25 * [-0.372 + (0.036 * Age) + (0.632 * F_{BEFORE\ 1990}) + (0.107 * Size) + (-0.293 * F_{CHEST}) + (0.047 * CDD * F_{OUTDOOR}) + (-0.052 * HDD * F_{OUTDOOR})]$$

Where:

F_{CHEST} = Percentage of chest freezer units

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[5] TecMarket Works. *Evaluation of the NIPSCO Appliance Recycling Program*. 2012.

[6] Regression model developed by Cadmus for the 2006-2008 California Appliance Recycling Program evaluation. See: Cadmus. *Residential Retrofit High Impact Measure Evaluation Report.* 2010. Available online: http://www.calmac.org/publications/FinalResidentialRetroEvaluationReport_11.pdf. Summary of model constants are in the Reference Tables section for this measure.

This approach was applied to recycling program evaluations for NIPSCO, Vectren, and I&M. The unit energy-savings values varied in each program due to characteristics of the recycled units. The results are shown below.

Unit Energy Saving Results for Several Program Evaluations

Utility	Refrigerator (kWh/unit)	Freezer (kWh/unit)
NIPSCO	761	886
I&M	1,068	946
Vectren	1,093	993
Average	**1,036**	**942**

This TRM uses the average of the above values as the statewide savings estimate.

Summer Peak Coincident Demand Reduction

$$\Delta kW = \frac{\Delta kWh}{8{,}760} * TAF * LSAF$$

Where:

TAF = Temperature adjustment factor (= 1.21)[7]

LSAF = Load shape adjustment factor (= 1.063)[8]

This approach was applied to recycling program evaluations for NIPSCO, Vectren, and I&M. The unit demand reduction values vary due to characteristics of the recycled units. The results are shown in the table below.

Unit Demand Reduction Results for Several Program Evaluations

Utility	Refrigerator (kW/unit)	Freezer (kW/unit)
NIPSCO	0.112	0.130
I&M	0.157	0.139
Vectren	0.160	0.146
Average	**0.152**	**0.138**

This TRM uses the average of these values as the statewide savings estimate.

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[7] Blasnik, Michael. *Measurement and Verification of Residential Refrigerator Energy Use, Final Report, 2003-2004 Metering Study*. July 29, 2004. (p. 47 assumes that 85% of homes have air conditioning).

[8] Ibid. (p. 48, extrapolated by taking the ratio of existing summer to existing annual profile for hours ending 16 through 18, and multiplying by new annual profile).

Reference Tables

Regression Model Coefficients for Refrigerators*

Independent Variables	Coefficient	p-Value	VIF
Regression Model Intercept	0.769	<.0001	0
Age Coefficient (years)	0.008	0.016	2
Dummy: Unit Manufactured Pre-1990 Coefficient	0.827	<.0001	1.7
Size Coefficient (cubic feet)	0.083	<.0001	1.9
Dummy: Single Door Coefficient	-1.316	<.0001	1.3
Dummy: Side-by-Side Coefficient	0.862	<.0001	1.6
Dummy: Primary Appliance Coefficient	0.642	<.0001	1.5
CDD * Fraction Outdoor Coefficient	0.031	<.0001	1.3
HDD * Fraction Outdoor Coefficient	-0.049	<.0001	1.2

* Cadmus estimated this model for Vectren based on monitored data in California and Michigan.

Regression Model Coefficients for Freezers*

Independent Variables	Coefficient	p-Value	VIF
Regression Model Intercept	-0.372	0.043	0
Age Coefficient (years)	0.036	<.0001	2
Dummy: Unit Manufactured Pre-1990 Coefficient	0.632	<.0001	2.1
Size Coefficient (cubic feet)	0.107	<.0001	1.2
Dummy: Chest Freezer Coefficient	-0.293	<.0001	1.2
CDD * Fraction Outdoor Coefficient	0.047	<.0001	1.1
HDD * Fraction Outdoor Coefficient	-0.052	<.0001	1

* Cadmus estimated this model for Vectren based on monitored data in California and Michigan.

Efficient Refrigerator – ENERGY STAR and CEE TIER 2 (Time of Sale)

	Measure Details
Official Measure Code	Res-Appl-Refrig/Freez-TOS-1
Measure Unit	Per refrigerator
Measure Category	Appliances
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by appliance
Peak Demand Reduction (kW)	Varies by appliance
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by appliance
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	17
Incremental Cost	Varies by appliance
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing a new refrigerator meeting either ENERGY STAR or CEE TIER 2 specifications (defined as requiring ≥ 20% and ≥25% less energy consumption than an equivalent unit meeting federal standard requirements, respectively).

Definition of Efficient Equipment

The efficient condition is a new refrigerator meeting either the ENERGY STAR or CEE TIER 2 efficiency standards.

Definition of Baseline Equipment

The baseline condition is a new refrigerator meeting the minimum federal efficiency standard for refrigerators.

Deemed Lifetime of Efficient Equipment

The measure life is 17 years.[9]

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[9] This is consistent with Efficiency Vermont and New Jersey TRMs.

Deemed Measure Cost

The incremental cost for this measure is \$30.00[10] for an ENERGY STAR unit and \$140.00[11] for a CEE Tier 2 unit.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = UEC_{BASE} - UEC_{ES}$$

Where:

UEC_{BASE} = Annual energy consumption of baseline unit[12]

Bottom Freezer = 650 kWh

Top Freezer = 415 kWh

Side-by-Side = 729 kWh

UEC_{ES} = Annual energy consumption of ENERGY STAR unit (= 20% less than baseline)

Bottom Freezer = 520 kWh

Top Freezer = 332 kWh

Side-by-Side = 583 kWh

Or

= Annual energy consumption of CEE Tier 2 unit (= 25% less than baseline)

Bottom Freezer = 488 kWh

Top Freezer = 311 kWh

Side-by-Side = 547 kWh

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[10] From ENERGY STAR calculator: http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Consumer_Residential_Refrig_Sav_Calc.xls

[11] Based on weighted average of units participating in Efficiency Vermont program and retail cost data provided in: U.S. Department of Energy. *TECHNICAL REPORT: Analysis of Amended Energy Conservation Standards for Residential Refrigerator-Freezers*. October 2005. Available online: http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/refrigerator_report_1.pdf

[12] This is the approximate average consumption of a typical baseline refrigerator at federal standard efficiency levels; see: http://www.energystar.gov/index.cfm?fuseaction=refrig.display_products_excel

The above equation leads to these savings from ENERGY STAR units:

Bottom Freezer = 650 – 520 (= 130 kWh)
Top Freezer = 415 – 332 (= 83 kWh)
Side-by-Side = 729 – 583 (= 146 kWh)

The above equation leads to these savings from CEE Tier 2 units:

Bottom Freezer = 650 – 488 (= 162 kWh)
Top Freezer = 415 – 311 (= 104 kWh)
Side-by-Side = 729 – 547 (= 182 kWh)

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = \frac{\Delta\, kWh}{8{,}760} * TAF * LSAF$$

Where:

TAF = Temperature adjustment factor (= 1.21)[13]
LSAF = Load shape adjustment factor (= 1.124)[14]

The above equation leads to these demand reductions from ENERGY STAR units:

Bottom Freezer = $\frac{130}{8{,}760} * 1.21 * 1.124$ = 0.020 kW

Top Freezer = $\frac{83}{8{,}760} * 1.21 * 1.124$ = 0.013 kW

Side-by-Side = $\frac{146}{8{,}760} * 1.21 * 1.124$ = 0.023 kW

The above equation leads to these demand reductions from CEE Tier 2 units:

Bottom Freezer =$\frac{162}{8{,}760} * 1.21 * 1.124$ = 0.025 kW

Top Freezer = $\frac{104}{8{,}760} * 1.21 * 1.124$ = 0.016 kW

Side-by-Side = $\frac{182}{8{,}760} * 1.21 * 1.124$ = 0.028 kW

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[13] Blasnik, Michael. *Measurement and Verification of Residential Refrigerator Energy Use, Final Report, 2003-2004 Metering Study*. July 29, 2004. (p. 47 assumes that 85% of homes have central air conditioning).

[14] Ibid. (p. 48, extrapolated by taking the ratio of existing summer to existing annual profile for hours ending 16 through 18, and multiplying by new annual profile).

Reference Table

Deemed Measure Savings

Efficiency Level	Refrigerator Configuration	Average Annual kWh Savings per Unit	Average Summer Peak Coincident kW Savings per Unit	Average Annual Fossil Fuel Heating MMBtu Savings per Unit
ENERGY STAR	Bottom Freezer	130	0.020	n/a
	Top Freezer	83	0.013	
	Side-by-Side	146	0.023	
CEE Tier 2	Bottom Freezer	162	0.025	n/a
	Top Freezer	104	0.016	
	Side-by-Side	182	0.028	

Refrigerator Replacement (Low Income, Early Replacement)

	Measure Details
Official Measure Code	Res-Appl-Refrig-LI-1
Measure Unit	Per refrigerator
Measure Category	Appliances
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by measure age
Peak Demand Reduction (kW)	Varies by measure age
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by measure age
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	17
Incremental Cost	$490.73
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the early removal of an existing inefficient refrigerator from service, prior to its natural end of life, and replacement with a new ENERGY STAR-qualifying unit. This measure is suitable for low income and home performance programs. Savings are calculated for the estimated energy consumption during the remaining life of the existing unit.

Definition of Efficient Equipment

The efficient condition is a new replacement refrigerator meeting the ENERGY STAR efficiency standard (defined as requiring ≥ 20% less energy consumption than an equivalent unit meeting federal standard requirements).

Definition of Baseline Equipment

The baseline condition is the existing inefficient refrigerator being used for the remaining assumed useful life of the unit. Then, for the remainder of the measure life, the baseline becomes a new refrigerator meeting the minimum federal efficiency standard.

Deemed Lifetime of Efficient Equipment

The measure life is 17 years.[15]

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[15] This is consistent with Efficiency Vermont and New Jersey TRMs.

The assumed remaining useful life of the existing refrigerator being replaced is 8 years.[16]

Deemed Measure Cost

The net present value of the deferred replacement cost (the cost associated with replacing the existing unit with a standard unit that would have had to occur in 8 years had the existing unit not been replaced) is $490.73.[17]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta\text{kWh for remaining life of existing unit (first 8 years)} = UEC_{EXISTING} - UEC_{ES}$$

$$\Delta\text{kWh for remaining measure life (next 9 years)} = UEC_{BASE} - UEC_{ES}$$

Where:

$UEC_{EXISTING}$ = Unit energy consumption of existing refrigerator (= 1,696 kWh)[18]

UEC_{ES} = Unit energy consumption of new ENERGY STAR refrigerator (= 397 kWh)[19]

UEC_{BASE} = Unit energy consumption of new baseline refrigerator (= 453 kWh)[20]

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[16] KEMA. *Residential Refrigerator Recycling Ninth Year Retention Study*. 2004.

[17] Determined by calculating the net present value (with a 5% discount rate) of the annuity payments from years 9 to 17 of a deferred replacement of a standard efficiency unit costing $1,150.00 (from ENERGY STAR calculator, available online: http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Consumer_Residential_Refrig_Sav_Calc.xls).

[18] Navigant Consulting. *AEP Ohio Energy Efficiency/Demand Response Plan Year 1 (1/1/2009-12/31/2009) Program Year Evaluation Report: Appliance Recycling Program*. March 9, 2010. (Used regression-based savings estimates and part-use factors for primary refrigerators, multiplied by an in situ factor of 0.85 as discussed in the Refrigerator and/or Freezer Retirement (Early Retirement) measure section.)

[19] Approximate average consumption of typical ENERGY STAR refrigerator: http://www.energystar.gov/index.cfm?fuseaction=refrig.display_products_excel

[20] Approximate average consumption of typical baseline refrigerator at federal standard efficiency levels: http://www.energystar.gov/index.cfm?fuseaction=refrig.display_products_excel

ΔkWh for remaining life of existing unit (first 8 years) = 1,696 – 397 = 1,299 kWh

ΔkWh for remaining measure life (next 9 years) = 453 – 397 = 56 kWh

Summer Peak Coincident Demand Reduction

$$\Delta kW = \frac{\Delta kWh}{8,760} * TAF * LSAF$$

$$\Delta kW \text{ for existing unit remaining life (first 8 years)} = \left[\left(\frac{UEC_{EXISTING}}{8760} * LSAF_{EXIST}\right) - \left(\frac{UEC_{ES}}{8,760} * LSAF_{NEW}\right)\right] * TAF$$

$$\Delta kW \text{ for remaining measure life (next 9 years)} = \left(\frac{UEC_{EXISTING} - UEC_{ES}}{8,760}\right) * TAF * LSAF_{NEW}$$

Where:

TAF = Temperature adjustment factor (= 1.21)[21]

$LSAF_{exist}$ = Load shape adjustment factor for existing unit (= 1.063)[22]

$LSAF_{new}$ = Load shape adjustment factor for new unit (= 1.124)[23]

$$\Delta kW \text{ for existing unit remaining life (first 8 years)} = \frac{1,696}{8,760} * 1.21 * 1.063 - \frac{397}{8,760} * 1.21 * 1.124 = 0.187 \text{ kW}$$

$$\Delta kW \text{ for remaining measure life (next 9 years)} = \frac{56}{8,760} * 1.21 * 1.124 = 0.009 \text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[21] Blasnik, Michael. *Measurement and Verification of Residential Refrigerator Energy Use, Final Report, 2003-2004 Metering Study*. July 29, 2004. (p. 47 assumes 85% of homes have central air conditioning).

[22] Ibid. p. 48. Assumed existing unit summer average LSAF for hours ending 16 through 18.

[23] Ibid. p. 48. Extrapolated daily load shape adjustment factor by taking the ratio of existing summer to existing annual profile for hours ending 16 through 18, multiplied by the new annual profile.

Clothes Washer – ENERGY STAR and CEE TIER 3 (Time of Sale)

	Measure Details
Official Measure Code	Res-Appl-CloWash-1
Measure Unit	Per clothes washer
Measure Category	Appliances
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by efficiency level
Peak Demand Reduction (kW)	Varies by efficiency level
Annual Fossil Fuel Savings (MMBtu)	Varies by efficiency level
Lifetime Energy Savings (kWh)	Varies by efficiency level
Lifetime Fossil Fuel Savings (MMBtu)	Varies by efficiency level
Water Savings (gal/yr)	Varies by efficiency level
Effective Useful Life (years)	11
Incremental Cost	Varies by efficiency level
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is purchasing (time of sale) and installing a clothes washer exceeding either the ENERGY STAR or CEE Tier 2 minimum qualifying efficiency standards presented in the table below.

Minimum Qualifying ENERGY STAR or CEE Tier 2 Efficiency Standards

Efficiency Level	Modified Energy Factor	Water Factor
Federal Standard	≥ 1.26	No requirement
ENERGY STAR (as of January 1, 2011)	≥ 2.00	≤ 6.0
CEE Tier 2	≥ 2.20	≤ 4.5

The MEF measures the total energy consumption of the laundry cycle (washing and drying). It indicates the number of cubic feet of laundry that can be washed and dried with one kilowatt-hour of electricity; the higher the number, the greater the efficiency.

The water factor is the number of gallons needed for each cubic foot of laundry. A lower number indicates lower consumption and a more efficient use of water.

Definition of Efficient Equipment

The efficient condition is a clothes washer meeting either the ENERGY STAR or CEE Tier 2 efficiency criteria presented in the table above.

Definition of Baseline Equipment

The baseline condition is a clothes washer at the minimum federal baseline efficiency presented in the table above.

Deemed Lifetime of Efficient Equipment

The measure life is 11 years.[24]

Deemed Measure Cost

The incremental cost is $210.12 for an ENERGY STAR unit and $215.90 for a CEE Tier 2 unit. [25]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

Savings are determined by applying the proportion of consumption used for water heating and clothes washer and clothes dryer operation to MEF assumptions, then to the mix of DHW heating fuels and dryer fuels (while factoring in savings from reduced water usage).

The key assumptions and their sources are:

Washer Volume = 3.23 cubic feet[26]
Baseline MEF = 1.26
ENERGY STAR MEF = 2.0
CEE Tier 2 MEF = 2.2
Number of cycles per year = 320[27]
Percentage of energy consumption for water heating and clothes washer and dryer operation = 26%, 7%, and 67% (respectively)[28]

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[24] "ENERGY STAR Certified Products." http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=CW

[25] Itron, Inc. 2010-2012 WO017 Ex Ante Measure Cost Study Final Report. May 27, 2014. Submitted to the California Public Utilities Commission.

[26] Average unit size from Efficiency Vermont program.

[27] U.S. Energy Information Administration. 2005 Residential Energy Consumption Survey (RECS) for East North Central Census Division. Available online: http://www.eia.doe.gov/emeu/recs/recs2005/ hc2005_tables/hc8waterheating/pdf/tablehc12.8.pdf (weighted average).

[28] U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy. Clothes Washer Technical Support Document. Chapter 4 Engineering Analysis, Table 4.1, Page 4-5. Available online: http://www.eere.energy.gov/buildings/appliance_standards/residential/pdfs/chapter_4_engineering.pdf

Average gallons of water savings per load[29] = ENERGY STAR = 19.6; CEE Tier 2= 22.4

Community/municipal water and wastewater pump savings per gallon water saved = 0.0039 kWh[30]

Indiana Domestic Hot Water Fuel Mix

Fuel	Percentage of Homes*
Electric	27%
Natural Gas	63%
Other	10%

* U.S. Energy Information Administration. *2005 Residential Energy Consumption Survey (RECS) for East North Central Census Division*. Available online: http://www.eia.doe.gov/emeu/recs/recs2005/ hc2005_tables/hc8waterheating/pdf/tablehc12.8.pdf

Indiana Dryer Fuel Mix

Fuel	Percentage of Homes*
Electric	66%
Natural Gas	34%

* U.S. Energy Information Administration. *2005 Residential Energy Consumption Survey (RECS) for East North Central Census Division*. Available online: http://www.eia.doe.gov/emeu/recs/recs2005/ hc2005_tables/hc8waterheating/pdf/tablehc12.8.pdf

$$\Delta kWh_{ENERGY\ STAR} = 202\ kWh$$

$$\Delta kWh_{CEE\ TIER\ 2} = 233\ kWh$$

Summer Peak Coincident Demand Reduction

$$\Delta kW = \frac{\Delta kWh}{Hours} * CF$$

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[29] Determined by dividing gallons per load assumption from ENERGY STAR calculator by water factor (gallons per cubic foot) to determine cubic feet assumption, then multiplying by each efficient case water factor.

[30] Efficiency Vermont. (Analysis revealed 0.0024 kWh pump energy consumption per gallon of water supplied, and 0.0015 kWh consumption per gallon for waste water treatment.)

Where:

Hours = Assumed run hours of clothes washer (= 320)[31]

CF = Summer peak coincidence factor (= 0.045)[32]

$$\Delta kW_{\text{ENERGY STAR}} = \frac{202}{320} * 0.045 = 0.028 \text{ kW}$$

$$\Delta kW_{\text{CEE TIER 2}} = \frac{233}{320} * 0.045 = 0.033 \text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

Fossil fuel savings are based on the mix of DHW heating fuels and dryer fuels.

- ENERGY STAR unit savings = 0.447 MMBtu
- CEE Tier 2 unit savings = 0.516 MMBtu

Water Impact Descriptions and Calculation

- ENERGY STAR unit savings = 6,265 gallons
- CEE Tier 2 unit savings = 7,160 gallons

Reference Table

Deemed Measure Savings

	Average Annual kWh Savings per Unit	Average Summer Peak Coincident kW Savings per Unit	Average Annual Fossil Fuel Heating MMBtu Savings per Unit	Average Annual Water Gallon Savings per Unit
ENERGY STAR	202	0.028	0.447	6,265
CEE Tier 2	233	0.033	0.516	7,160

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[31] U.S. Energy Information Administration. *2005 Residential Energy Consumption Survey (RECS) for East North Central Census Division.* Available online: http://www.eia.doe.gov/emeu/recs/recs2005/hc2005_tables/hc10homeappliaceindicators/pdf/tablehc11.10.pdf (used weighted average number of cycles from CW worksheet and 1 hour average per cycle).

[32] Calculated from Itron eShapes, which is 8,760 hourly data by end use for Upstate New York, adjusted for Ohio peak definitions.

ENERGY STAR Dishwasher

	Measure Details
Official Measure Code	Res-Appl-DishWash-1
Measure Unit	Per dishwasher
Measure Category	Appliances
Sector(s)	Residential
Annual Energy Savings (kWh)	77 (natural gas water heater) 150 (electric water heater)
Peak Demand Reduction (kW)	0.027 (natural gas water heater) 0.052 (electric water heater)
Annual Fossil Fuel Savings (MMBtu)	1.3
Lifetime Energy Savings (kWh)	777 (natural gas water heater) 1,650 (electric water heater)
Lifetime Fossil Fuel Savings (MMBtu)	14.3
Water Savings (gal/yr)	TBD
Effective Useful Life (years)	11
Incremental Cost	$211.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is a residential dishwasher meeting the minimum ENERGY STAR qualifying efficiency standards. These dishwashers are assumed to be located within a residential unit.

Definition of Efficient Equipment

The efficient condition is a new dishwasher meeting the ENERGY STAR Tier 2 requirements (EF ≥ 0.68).

Definition of Baseline Equipment

The baseline condition is a new dishwasher meeting minimum federal appliance standards (EF = 0.46).

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 11 years.

Deemed Measure Cost

The incremental cost for this measure is $211.00.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

Energy savings and demand reduction were determined using the U.S. Environmental Protection Agency ENERGY STAR dishwasher calculator.[33]

Annual kWh Savings = 77 kWh (natural gas water heater)
= 150 kWh (electric water heater)

Summer Peak Coincident Demand Reduction

Summer peak coincident factor savings = 0.027 kW (natural gas water heater)
= 0.052 kW (electric water heater)

Fossil Fuel Impact Descriptions and Calculation

Annual MMBtu savings = 1.300 (natural gas water heater only)

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[33] Available online: www.energystar.gov

ENERGY STAR Dehumidifier (Time of Sale)

	Measure Details
Official Measure Code	Res-Appl-ES Dehumid-1
Measure Unit	Per dehumidifier
Measure Category	Appliances
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by capacity
Peak Demand Reduction (kW)	Varies by capacity
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by capacity
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	12
Incremental Cost	$45.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is purchasing and installing a dehumidifier meeting the minimum ENERGY STAR qualifying efficiency standard established on October 1, 2006 in a residential setting in place of a unit that meets the minimum federal standard efficiency.

Definition of Efficient Equipment

To qualify, the new dehumidifier must meet the ENERGY STAR standards as of October 1, 2006, outlined in the table below.

Minimum ENERGY STAR Dehumidifier Standards

Capacity (pints/day)	ENERGY STAR Criteria (L/kWh)
≤ 25	≥ 1.20
> 25 to ≤ 35	≥ 1.40
> 35 to ≤ 45	≥ 1.50
> 45 to ≤ 54	≥ 1.60
> 54 to ≤ 75	≥ 1.80
> 75 to ≤ 185	≥ 2.50

Definition of Baseline Equipment

The baseline condition is a new dehumidifier that meets the federal efficiency standards outlined in the table below.

Minimum Federal Dehumidifier Standards

Capacity (pints/day)	Federal Standard Criteria (L/kWh)
≤ 25	≥ 1.10
> 25 to ≤ 35	≥ 1.20
> 35 to ≤ 45	≥ 1.20
> 45 to ≤ 54	≥ 1.23
> 54 to ≤ 75	≥ 1.55
> 75 to ≤ 185	≥ 1.90

Deemed Lifetime of Efficient Equipment

The assumed lifetime of the measure is 12 years.[34]

Deemed Measure Cost

The assumed incremental capital cost for this measure is $45.00.[35]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = C * \frac{0.473}{24} * \frac{Hours}{\frac{L}{kWh}}$$

Where:

C = Average capacity of dehumidifier in pints per day

0.473 = Constant to convert pints to liters

24 = Hours in a day

Hours = Run hours per year (= 1,620)[36]

L/kWh = Liters of water consumed per kilowatt-hour (= based on capacity; see tables above)

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[34] ENERGY STAR Dehumidifier Calculator http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorConsumerDehumidifier.xls

[35] Based on available data from the U.S. Department of Energy's lifecycle cost analysis spreadsheet available from: http://www1.eere.energy.gov/buildings/appliance_standards/residential/docs/lcc_dehumidifier.xls

[36] ENERGY STAR Dehumidifier Calculator http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorConsumerDehumidifier.xls

The annual kilowatt-hour calculation results for each capacity class are presented in the table below.

Annual Dehumidifier Savings by Capacity

Capacity Range	Pints Used Per Day	ENERGY STAR	Federal Standard	Savings (kWh)
≤ 25	22.4	596	650	54
> 25 to ≤ 35	30	684	798	114
> 35 to ≤ 45	40	851	1,064	213
> 45 to ≤ 54	49.5	988	1,285	297
> 54 to ≤ 75	64.5	1,144	1,329	185
> 75 to ≤ 185	92.8	1,185	1559	374

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = \frac{\Delta kWh}{Hours} * CF$$

Where:

CF = Summer peak coincidence factor (= 0.37)[37]

The peak coincident demand calculation results for each capacity class is presented in the table below.

Summer Peak Coincident Demand Reduction by Capacity

Capacity Range	Pints Used per Day	ENERGY STAR	Federal Standard	Demand Reduction (kW)
≤ 25	22.4	0.136	0.148	0.012
> 25 to ≤ 35	30	0.156	0.182	0.027
> 35 to ≤ 45	40	0.194	0.242	0.048
> 45 to ≤ 54	49.5	0.225	0.293	0.068
> 54 to ≤ 75	64.5	0.261	0.303	0.042
> 75 to ≤ 185	92.8	0.270	0.355	0.085

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[37] Based on usage being evenly distributed day vs. night and weekend vs. weekday, and dehumidifier being used from April through September (for 4,392 possible hours). The ENERGY STAR Dehumidifier Calculator lists 1,620 operating hours; therefore the summer peak coincidence is: 1,620/4,392 = 36.9%.

ENERGY STAR Room Air Conditioner (Time of Sale)

	Measure Details
Official Measure Code	Res-Appl-ES RAC-TOS-1
Measure Unit	Per air conditioning unit
Measure Category	Appliances
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by location
Peak Demand Reduction (kW)	Varies by location
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by location
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	9
Incremental Cost	
Important Comments	$40.00
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is purchasing and installing a room air conditioning unit that meets either the ENERGY STAR or CEE Tier 1 minimum qualifying efficiency specifications, in place of a baseline unit meeting minimum federal standard efficiency ratings presented in the table below.

Minimum Qualifying Room Air Conditioner Efficiency Specifications

Product Class (Btu/hr)	Federal Standard (EER)	ENERGY STAR (EER)	CEE Tier 1 (EER)
8,000 to 13,999	≥ 10.9	≥ 11.3	≥ 11.3

Definition of Efficient Equipment

The efficient condition is a new room air conditioning unit meeting either the ENERGY STAR of CEE Tier 1 efficiency standards presented in the table above.

Definition of Baseline Equipment

The baseline condition is a new room air conditioning unit meeting the minimum federal efficiency standards presented in the table above.

Deemed Lifetime of Efficient Equipment

The measure life is 9 years.[38]

Deemed Measure Cost

Until 2013, the incremental cost was $40.00 for an ENERGY STAR unit and $80.00 for a CEE Tier 1 unit.[39] Now that each share efficiency standards, the incremental cost for each is determined to be $40.00

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = EFLH_{COOL} * Btuh * \frac{\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}}{1{,}000}$$

Where:

$EFLH_{COOL}$ = Equivalent full load hours of room air conditioning unit (= depends on location;[40] see table below)

Equivalent Full Load Hours by City

City	EFLH$_{COOL}$
Indianapolis	332
South Bend	288
Evansville	445
Ft. Wayne	257
Terre Haute	391

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[38] This value was based on the ENERGY STAR value for room air conditioners: www.energystar.gov

[39] Based on field study conducted by Efficiency Vermont.

[40] Based on CDD adjusted values from: RLW Analytics. *Final Report Coincidence Factor Study Residential Room Air Conditioners.* June 23, 2008.

Btuh = Average size of rebated unit (=11,357)[41]

EER_{BASE} = Efficiency of baseline unit (= 10.9)[42]

EER_{EE} = Efficiency of new unit (= 11.3 for ENERGY STAR; = 11.3 for CEE Tier 1)[43]

For example, the energy savings from installing a room air conditioning unit in Indianapolis would be:

$$\Delta kWh_{ENERGY\ STAR} = 332 * 11{,}357 * \frac{\frac{1}{10.9}-\frac{1}{11.3}}{1{,}000} = 12$$

$$\Delta kWh_{CEE\ TIER\ 1} = 332 * 11{,}357 * \frac{\frac{1}{10.9}-\frac{1}{11.3}}{1{,}000} = 12$$

Summer Peak Coincident Demand Reduction

$$\Delta kW = Btuh * \frac{\frac{1}{EER_{BASE}}-\frac{1}{EER_{eEE}}}{1{,}000} * CF$$

Where:

CF = Summer peak coincidence factor (= 0.3)[44]

For example, the energy savings from installing a room air conditioning unit in Indianapolis would be:

$$\Delta kW_{ENERGY\ STAR} = 11{,}357 * \frac{\frac{1}{10.9}-\frac{1}{11.3}}{1{,}000} * 0.3 = 0.011\ kW$$

$$\Delta kW_{CEE\ TIER\ 1} = 11{,}357 * \frac{\frac{1}{10.9}-\frac{1}{11.3}}{1{,}000} * 0.3 = 0.011\ kW$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[41] ENERGY STAR. “ENERGY STAR Certified Room Air Conditioners.” http://www.energystar.gov/productfinder/product/certified-room-air-conditioners/.

[42] Minimum Federal Standard for capacity range. 2015 Federal Energy Conservation Standard for Room ACs (e-CFR Title 10, Chapter II, Subchapter D, Part 430, Subpart C, Section 430.32)

[43] This is the minimum qualifying standards. http://library.cee1.org/sites/default/files/library/9296/CEE_ResApp_RoomAirConditionerSpecification_2003_Updated_Again.pdf

[44] RLW Analytics. *Final Report Coincidence Factor Study Residential Room Air Conditioners*. June 23, 2008. Available online: http://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/National%20Grid/117_RLW_CF%20Res%20RAC.pdf

ENERGY STAR Room Air Conditioner Replacement (Low Income, Early Replacement)

	Measure Details
Official Measure Code	Res-Appl-ES RAC-LI-1
Measure Unit	Per air conditioning unit
Measure Category	Appliances
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by location
Peak Demand Reduction (kW)	Varies by location
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by location
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	12
Incremental Cost	Varies by efficiency rating
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the early removal of an existing inefficient room air conditioner unit from service, prior to its natural end of life, and replacing with a new ENERGY STAR qualifying unit. This measure is suitable for low income and home performance programs. Savings are calculated as the difference between existing unit and efficient unit consumption during the remaining life of the existing unit, and between the new baseline unit and efficient unit consumption for the remainder of the measure life.

Definition of Efficient Equipment

The efficient condition is a new replacement room air conditioning unit meeting the ENERGY STAR efficiency standard (i.e., an efficiency rating greater than or equal to 10.8 EER).

Definition of Baseline Equipment

The baseline condition is the existing inefficient room air conditioning unit for the remaining assumed useful life of the unit; then, for the remainder of the measure life, the baseline becomes a new replacement unit meeting the minimum federal efficiency standard (i.e., an efficiency rating greater than or equal to 9.8 EER).

Deemed Lifetime of Efficient Equipment

The measure life is 12 years.[45]

For dual baseline purposes, the assumed remaining useful life of the existing room air conditioning unit being replaced is 3 years.[46]

Deemed Measure Cost

The actual measure cost for removing the existing unit and installing the new unit should be used.

Deemed O&M Cost Adjustments

The net present value of the deferred replacement cost (the cost associated with replacing the existing unit with a standard unit that would have occurred within three years had the existing unit not been replaced) should be calculated as:

Cost of ENERGY STAR unit - $50 (incremental cost of ENERGY STAR unit over baseline unit)[47] * 69%[48]

Savings Algorithm

Energy Savings

$$\Delta\text{kWh for remaining life of existing unit (first 3 years)} = EFLH_{COOL} * BtuH * \frac{\frac{1}{EER_{EXIST}} - \frac{1}{EER_{EE}}}{1{,}000}$$

$$\Delta\text{kWh for remaining measure life (next 9 years)} = EFLH_{COOL} * BtuH * \frac{\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}}{1{,}000}$$

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[45] GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

[46] Based on Connecticut TRM; Connecticut Energy Efficiency Fund; CL&P and UI Program Savings Documentation for2008 Program Year

[47] Per the ENERGY STAR calculator, ENERGY STAR units are $220.00 while baseline units are $170.00; see http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorConsumerRoomAC.xls

[48] This 69% is the ratio of the net present value (with a 5% discount rate) of the annuity payments from years 4 to 12 of a deferred replacement of a standard efficiency unit costing $170.00, divided by the standard efficiency unit cost (also $170.00). The calculation allows for use of the known ENERGY STAR replacement cost to calculate an appropriate baseline replacement cost.

Where:

$EFLH_{COOL}$ = Equivalent full load hours of room air conditioning unit (= dependent on location;[49] see table below)

Equivalent Full Load Hours by Location

City	$EFLH_{COOL}$
Indianapolis	332
South Bend	288
Evansville	445
Ft. Wayne	257
Terre Haute	391

Btuh = Average size of rebated unit (= 11,357)[50]

EER_{EXIST} = Efficiency of existing unit (= 7.7)[51]

EER_{BASE} = Efficiency of baseline unit that will be replacing exiting unit (= 10.9)[52]

EER_{EE} = Efficiency of ENERGY STAR unit (= 11.3)[53]

For example, the energy savings from installing a room air conditioner in Indianapolis would be:

$$\Delta\text{kWh for remaining life of existing unit (first 3 years)} = 332 * 11{,}357 * \frac{\frac{1}{7.7} - \frac{1}{11.3}}{1{,}000} = 156 \text{ kWh}$$

$$\Delta\text{kWh for remaining measure life (next 9 years)} = 332 * 11{,}357 * \frac{\frac{1}{10.9} - \frac{1}{11.3}}{1{,}000} = 12 \text{ kWh}$$

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[49] Based on CDD adjusted values from: RLW Analytics. *Final Report Coincidence Factor Study Residential Room Air Conditioners.* June 23, 2008. Available online: http://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/National%20Grid/117_RLW_CF%20Res%20RAC.pdf

[50] ENERGY STAR. "ENERGY STAR Certified Room Air Conditioners." http://www.energystar.gov/productfinder/product/certified-room-air-conditioners/

[51] Nexus Market Research Inc. and RLW Analytics. *Impact, Process, and Market Study of the Connecticut Appliance Retirement Program: Overall Report*. December 2005.

[52] Minimum Federal Standard for capacity range. 2015 Federal Energy Conservation Standard for Room ACs (e-CFR Title 10, Chapter II, Subchapter D, Part 430, Subpart C, Section 430.32)

[53] This is the minimum qualifying ENERGY STAR standard. http://www.energystar.gov/index.cfm?c=roomac.pr_crit_room_ac

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW for remaining life of existing unit (first 3 years)} = BtuH * \frac{\frac{1}{EER_{EXIST}} - \frac{1}{EER_{EE}}}{1{,}000} * CF$$

$$\Delta\text{kW for remaining measure life (next 9 years)} = BtuH * \frac{\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}}{1{,}000} * CF$$

Where:

CF = Summer peak coincidence factor (= 0.3)[54]

$$\Delta\text{kW for remaining life of existing unit (1}^{st}\text{ 3 years)} = 11{,}357 * \frac{\frac{1}{7.7} - \frac{1}{11.3}}{1{,}000} * 0.3 = 0.141\text{ kW}$$

$$\Delta\text{kW for remaining measure life (next 9 years)} = 11{,}357 * \frac{\frac{1}{10.9} - \frac{1}{11.3}}{1{,}000} * 0.3 = 0.011\text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[54] RLW Analytics. *Final Report Coincidence Factor Study Residential Room Air Conditioners.* June 23, 2008.

ENERGY STAR Room Air Conditioner Recycling (Early Retirement)

	Measure Details
Official Measure Code	Res-Appl-ES RAC-Recycle-1
Measure Unit	Per air conditioning unit
Measure Category	Appliances
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by location
Peak Demand Reduction (kW)	Varies by location
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by location
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	3
Incremental Cost	$129.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is a drop-off service that takes existing inefficient room air conditioner units from service prior to their natural end of life. The measure savings are based on a percentage of these units being replaced with a baseline standard efficiency unit (note that units actually replaced by a new ENERGY STAR qualifying unit record the savings increment between the baseline and ENERGY STAR).

Definition of Efficient Equipment

There is no efficient condition; this measure relates to retiring an existing inefficient unit.

Definition of Baseline Equipment

The baseline condition is the existing inefficient room air conditioning unit.

Deemed Lifetime of Equipment

The assumed remaining useful life of the early replacement existing room air conditioning unit being retired is 3 years.

Deemed Measure Cost

The actual implementation cost for recycling the existing unit plus the cost for replacing some of the units is $129.00.[55]

Deemed O&M Cost Adjustments

The net present value of the deferred replacement cost (the cost associated with replacing units with a standard unit that would have occurred within three years had the existing unit not been replaced) is $89.36.[56]

Savings Algorithm

Energy Savings

$$\Delta kWh = \frac{EFLH_{COOL} * Btuh}{1{,}000} * \left(\frac{1}{EER_{EXIST}} - \frac{\%\ \text{replaced}}{EER_{NEWBASE}}\right)$$

Where:

$EFLH_{COOL}$ = Equivalent full load hours of room air conditioning unit (= dependent on location; see table below)*

Equivalent Full Load Hours by City

City	$EFLH_{COOL}$
Indianapolis	332
South Bend	288
Evansville	445
Ft. Wayne	257
Terre Haute	391

Based on CDD adjusted values from: RLW Analytics. *Final Report Coincidence Factor Study Residential Room Air Conditioners.* June 23, 2008. Available online: http://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/National%20Grid/117_RLW_CF%20Res%20RAC.pdf

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[55] This is calculated by multiplying the percentage assumed to be replaced (76% based on: Nexus Market Research Inc. and RLW Analytics. *Impact, Process, and Market Study of the Connecticut Appliance Retirement Program: Overall Report*. December 2005.) by the assumed cost of a standard efficiency unit ($170.00 from: ENERGY STAR calculator. http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorConsumerRoomAC.xls). .

[56] Determined by calculating the net present value (with a 5% discount rate) of the annuity payments from years 4 to 12 for a deferred replacement of a standard efficiency unit costing $170.00 multiplied by the 76%, the percentage of units being replaced (0.76 * $170 = $129.20). Baseline cost from ENERGY STAR calculator: http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorConsumerRoomAC.xls

Btuh = Average capacity of rebated unit (= 11,357)[57]

EER_{EXIST} = Efficiency of existing unit (= 7.7)[58]

% replaced = Percentage of units dropped off that are replaced (= 76%)[59]

$EER_{NEWBASE}$ = Efficiency of baseline unit that replaces exiting unit (= 10.9)[60]

For example, the energy savings from removing a room air conditioning unit in Indianapolis would be:

$$\Delta kWh = \frac{332 * 11{,}357}{1{,}000} * \left(\frac{1}{7.7} - \frac{0.76}{10.9}\right) = 227$$

Summer Peak Coincident Demand Reduction

$$\Delta kW = \frac{Btuh * CF}{1{,}000} * \left(\frac{1}{EER_{EXIST}} - \frac{\%\ \text{replaced}}{EER_{NEWBASE}}\right)$$

Where:

CF = Summer peak coincidence factor (= 0.3)[61]

For example, the demand reduction from removing a room air conditioner in Indianapolis would be:

$$\Delta kWh = \frac{11{,}357 * 0.3}{1{,}000} * \left(\frac{1}{7.7} - \frac{0.76}{10.9}\right) = 0.205$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[57] ENERGY STAR. "ENERGY STAR Certified Room Air Conditioners." http://www.energystar.gov/productfinder/product/certified-room-air-conditioners/

[58] Nexus Market Research Inc. and RLW Analytics. *Impact, Process, and Market Study of the Connecticut Appliance Retirement Program: Overall Report*. December 2005.

[59] Ibid. Report states that 63% of units were replaced with ENERGY STAR units and 13% with non-ENERGY STAR. However, this formula assumes that all units are non-ENERGY STAR since the increment of savings between baseline units and ENERGY STAR unit would be recorded for the Efficient Products Program when the new unit is purchased.

[60] This is the minimum federal standard for capacity range. Department of Energy. *2015 Federal Energy Conservation Standard for Room ACs*. e-CFR Title 10, Chapter II, Subchapter D, Part 430, Subpart C, Section 430.32. June 2015

[61] RLW Analytics. *Final Report Coincidence Factor Study Residential Room Air Conditioners*. June 23, 2008. Available online: http://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/National%20Grid/117_RLW_CF%20Res%20RAC.pdf

Smart Strip Power Strip (Time of Sale)

	Measure Details
Official Measure Code	Res-Appl-Strip-1
Measure Unit	Per power strip
Measure Category	Appliances
Sector(s)	Residential
Annual Energy Savings (kWh)	23
Peak Demand Reduction (kW)	0.002
Annual Fossil Fuel Savings (MMBtu)	-0.041
Lifetime Energy Savings (kWh)	92
Lifetime Fossil Fuel Savings (MMBtu)	-0.164
Water Savings (gal/yr)	0
Effective Useful Life (years)	4
Incremental Cost	$16.00 for a 5-plug $26.00 for a 7-plug
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is controlled power strips (also known as smart strips), which are multi-plug power strips with the ability to automatically disconnect specific connected loads depending on the power draw of a control load, also plugged into the strip. Power is disconnected from the switched (controlled) outlets when the control load power draw is reduced below a certain adjustable threshold, thus turning off the appliances plugged into the switched outlets. By disconnecting, the overall standby load of a centralized group of equipment (i.e. entertainment centers and home office) can be reduced. Uncontrolled outlets are also provided that are not affected by the control device and are always providing power to any device plugged in. This measure provides savings from controllable peripheral devices associated with home computers and television sets.

Definition of Efficient Equipment

The efficient condition is the use of a smart strip.

Definition of Baseline Equipment

The baseline condition is a standard power strip that does not control connected loads.

Deemed Lifetime of Efficient Equipment

The assumed lifetime of the smart strip is 4 years.[62]

Deemed Measure Cost

The incremental cost over a standard power strip with surge protection is $16.00 for a 5-plug smart strip and $26.00 for a 7-plug smart strip.[63]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\sum^{Peripherals} W_{STANDBY} * F_{HOMES} * F_{CONTROL} * H * \frac{1 + WHF_E}{1{,}000}$$

Where:

$W_{STANDBY}$= Power use in standby mode

F_{HOMES} = Percentage of homes with peripherals (= see tables below)

F_{CONTOL} = Percentage of peripherals controlled (= see tables below)

H = Number of hours per year peripherals are controlled (= 7,474 for computer peripherals; = 6,784 for television peripherals) [64]

WHF_E = Waste heat factor for energy to account for HVAC interactions with efficient lighting (= - 0.059 as weighted average across all HVAC systems and cities; see Appendix B)

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[62] David Rogers, Power Smart Engineering. *Smart Strip Electrical Savings and Usability.* October 2008. p. 22.

[63] New York State Energy Research and Development Authority. *Measure Characterization for Advanced Power Strips*. August 2011. p. 4.

[64] Ibid.

Assumptions for Home Computer Peripherals

Peripheral	$W_{STANDBY}$	$F_{CONTROL}$	F_{HOMES}
Flat Panel Monitor	1.29	100.0%	69.3%
CRT Monitor	0.72	100.0%	25.1%
Printer	2.32	80.0%	43.1%
Multifunction Printer (without fax)	7.81	66.7%	4.0%
Multifunction Printer (with fax)	7.57	57.3%	8.3%
Speakers	4.76	100.0%	0.6%
Scanner	1.42	95.5%	7.4%
Copier	0.32	58.1%	4.8%
Modem	6.46	90.4%	8.1%
Router	5.07	93.3%	9.9%
External Hard Drive	1.13	100.0%	0.3%

Assumptions for Television Peripherals

Peripheral	$W_{STANDBY}$	$F_{CONTROL}$	F_{HOMES}
DVD Player	2.12	93.3%	53.3%
VCR	5.92	97.9%	21.3%
Stereo	4.07	50.7%	30.9%
Speakers	11.07	86.2%	2.1%
Video Game Console	0.57	98.0%	5.3%
Computer Used for Video	17.77	66.7%	0.3%

For example, the energy savings would be calculated as:

$$\Delta kWh_{COMPUTER} = ((1.29 * 1.0 * 0.693) + (0.72 * 1.0 * 0.251) + (2.32 * 0.80 * 0.431) + (7.81 * 0.667 * 0.04) + (7.57 * 0.573 * 0.083) + (4.76 * 1.0 * 0.006) + (1.42 * 0.955 * 0.074) + (0.32 * 0.581 * 0.048) + (6.46 * 0.904 * 0.081) + (5.07 * 0.933 * 0.099) + (1.13 * 1.0 * 0.003)) * 7{,}474 * \frac{(1 - 0.059)}{1{,}000} = 24.8 \text{ kWh}$$

$$\Delta kWh_{TELEVISION} = ((2.12 * 0.933 * 0.533) + (5.92 * 0.979 * 0.213) + (4.07 * 0.507 * 0.309) + (11.07 * 0.862 * 0.021) + (0.57 * 0.98 * 0.053) + (17.77 * 0.667 * 0.003)) * 6{,}784 * \frac{1 - 0.059}{1{,}000} = 20.4$$

$$\Delta kWh = \frac{\Delta kWh_{COMPUTER} + \Delta kWh_{TELEVISION}}{2} = \frac{24.8+20.4}{2} = 23$$

Summer Peak Coincident Demand Reduction

$$\Delta kW = \sum_{1}^{Peripherals} W_{STANDBY} * F_{HOMES} * F_{CONTROL} * CF * \frac{1+WHF_D}{1{,}000}$$

Where:

WHF_D = Waste heat factor for demand to account for HVAC interactions with efficient lighting (= 0.057 as weighted average value across all HVAC systems and cities; see Appendix B)

CF = Summer peak coincidence factor (= 0.50)

Using default data from above, the demand reduction would be calculated as:

$$\Delta kW_{COMPUTER} = ((1.29 * 1.0 * 0.693) + (0.72 * 1.0 * 0.251) + (2.32 * 0.80 * 0.431) + (7.81 * 0.667 * 0.04) + (7.57 * 0.573 * 0.083) + (4.76 * 1.0 * 0.006) + (1.42 * 0.955 * 0.074) + (0.32 * 0.581 * 0.048) + (6.46 * 0.904 * 0.081) + (5.07 * 0.933 * 0.099) + (1.13 * 1.0 * 0.003)) * 0.5 * \frac{(1 + 0.057)}{1{,}000} = 0.002$$

$$\Delta kW_{TELEVISION} ((2.12 * 0.933 * 0.533) + (5.92 * 0.979 * 0.213) + (4.07 * 0.507 * 0.309) + 11.07 * 0.862 * 0.021) + (0.57 * 0.98 * 0.053) + (17.77 * 0.667 * 0.003)) * 0.5 * \frac{1 + 0.057}{1{,}000} = 0.002$$

$$\Delta kW = \frac{\Delta\, kW_{COMPUTER} + \Delta\, kW_{TELEVISION}}{2} = \frac{0.002+0.002}{2} = 0.002$$

Fossil Fuel Impact Descriptions and Calculation

$$\Delta MMBtu_{WH} = \Delta kWh * WHF_G = 23 * (-0.0018) = -0.041$$

Where:

$\Delta MMBtu_{WH}$ = Gross customer annual heating MMBtu fuel increased usage from the reduction in lighting heat

WHF_G = Waste heat factor for fossil fuels to account for HVAC interactions with efficient lighting (=-0.0018 as weighted average value across all HVAC systems and cities; see Appendix B)

Building Shell

Envelope Insulation (Retrofit)

	Measure Details
Official Measure Codes	Res-Shell-RoofInsul-1, Res-Shell-WallIns-1
Measure Unit	Per square foot
Measure Category	Building shell
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by location
Peak Demand Reduction (kW)	Varies by location
Annual Fossil Fuel Savings (MMBtu)	Varies by location
Lifetime Energy Savings (kWh)	Varies by location
Lifetime Fossil Fuel Savings (MMBtu)	Varies by location
Water Savings (gal/yr)	0
Effective Useful Life (years)	25
Incremental Cost	TBD
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing additional insulation in the attic, roof, ceiling, or wall of a residential building. The energy savings are based on an auditor, contractor, or utility staff member being on location to measure and record the existing and new insulation depth and type (to calculate R-values), and the surface area of insulation added.

Definition of Efficient Equipment

The new insulation should meet any qualification criteria required for participation in the program. The new insulation R-value should include the effective R-value of any existing insulation left in situ, as well as installation conditions, such as insulation compression and void fraction.

Definition of Baseline Equipment

The existing insulation R-value should include appropriate adjustment factors for insulation compression and void fraction. The R-value should include the insulation layer only; air gaps and other building materials are accounted for in the simulation models.

Deemed Lifetime of Efficient Equipment

The measure life is 25 years.[65]

Deemed Measure Cost

The actual insulation installation measure cost should be used.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = kSF * \frac{\Delta kWh}{kSF}$$

Where:

kSF = Area of installed insulation in 1,000 square feet

$\frac{\Delta\text{kWh}}{\text{kSF}}$ = Unit energy savings (= dependent on city; see tables in Reference Tables section)

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW}_\text{S} = kSF * \frac{\Delta kW}{kSF} * CF$$

Where:

$\frac{\Delta\text{kW}}{\text{kSF}}$ = Unit demand reduction (= dependent on city; see tables in Reference Tables section)

CF = Summer peak coincidence factor (= 0.88)[66]

Fossil Fuel Impact Descriptions and Calculation

Space Heating Savings Calculation

$$\Delta MMBtu = kSF * \frac{\Delta MMBtu}{kSF}$$

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[65] GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

[66] Duke Energy. Load shape data for residential air conditioner loads from DSMore cost-effectiveness tool. Available online: www.integralanalytics.com

Where:

$\frac{\Delta MMBtu}{kSF}$ = Unit fossil fuel energy savings (=dependent on city; see tables in Reference Tables section)

General Calculation Methodology

Unit energy savings values are provided in the Reference Tables sections for a set of baseline and measure R-values, for certain HVAC system types. These values are for homes with and without cooling, and for homes with natural gas, heat pump, or electric resistance heating systems. The R-values are for the insulation layer only; R-values of building materials are included in the simulation model. Interpolation within the tables is permissible for R-values not explicitly listed. The baseline and measure R-values should consider installation conditions, such as insulation compression and coverage. Insulation compression adjustment factors (F_{COMP}) are shown in the table below.

Insulation Compression Adjustment Factor Lookup

Compression Percentage	F_{COMP}
0%	1.00
5%	0.97
10%	0.93
15%	0.89
20%	0.85

An additional adjustment should be taken for the insulation coverage. This factor (F_{VOID}) is determined by the installation grade or void fraction, and the ratio of the insulation R-value (R_{MFG}) to the full assembly R-value (R_{TOTAL}). The insulation coverage adjustment is shown in the table below.

Insulation Void Factor Lookup

$\frac{R_{MFG} * F_{COMP}}{R_{TOTAL}}$	F_{VOID}	
	2% Void (Grade II)	5% Void (Grade III)
0.50	0.96	0.90
0.55	0.96	0.90
0.60	0.95	0.88
0.65	0.94	0.87
0.70	0.94	0.85
0.75	0.92	0.83
0.80	0.91	0.79
0.85	0.88	0.74
0.90	0.83	0.66
0.95	0.71	0.49
0.99	0.33	0.16

The adjusted R-value is the nominal R-value multiplied by the adjustment factors:

$$R_{ADJ} = R_{NOMINAL} * F_{COMP} * \ F_{VOID}$$

Calculations are given below for the following example project: 2,000 square feet of attic floor insulation is installed in an average Indianapolis home. The home started with uncompressed R-11 insulation with a 5% void fraction. The final R-value (including the original insulation) is R-38, with a 2% void fraction. The building materials and attic air space represent an additional R-5.

Initial Adjusted R-Value Calculation

$$\frac{R_{MFG}\ *\ F_{COMP}}{R_{TOTAL}} = \frac{11\ *\ 1}{11+5} = 0.69$$

$$F_{VOID} = 0.85$$

The adjusted initial R-value is:

$$R_{ADJ} = R_{NOMINAL} * F_{COMP} *\ F_{VOID} = 11 *\ 1\ *\ 0.85 = 9.4$$

Final Adjusted R-Value Calculation

$$\frac{R_{MFG}\ *\ F_{COMP}}{R_{TOTAL}} = \frac{38\ *\ 1}{38+5} = 0.88$$

$$F_{VOID} = 0.85 \text{ (interpolated)}$$

The adjusted final R-value is:

$$R_{ADJ} = R_{NOMINAL} * F_{COMP} *\ F_{VOID} = 38 * 1 * .85 = 32.3$$

Overall Savings Calculations

The following savings are calculated for the example project using values from tables in the Reference Tables section:

$$\Delta kWh = kSF * \frac{\Delta kWh}{kSF} = 2 * 774.6 = 1{,}550\ kWh$$

$$\Delta kW\ = kS * \frac{\Delta kW}{kSF} * CF\ = 2 * 0.1179 * 0.88 = 0.118\ kW$$

$$\Delta \text{MMBtu} = kS * \frac{\Delta MMBtu}{kSF} = 2 * 8.05 = 16.100\ MMBtu$$

Reference Tables

Building: Single Family
City: Indianapolis
HVAC: Weighted Average
Measure: Roof/Attic/Ceiling Installation

Base R_{ADJ}	0			11			19		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	2,253.3	0.2109	23.00	N/A	N/A	N/A	N/A	N/A	N/A
19	2,519.1	0.2669	25.77	265.8	0.0557	2.81	N/A	N/A	N/A
30	2,673.3	0.2924	27.43	420.1	0.0813	4.42	154.3	0.0255	1.67
38	2,730.7	0.3093	28.05	477.6	0.0984	5.03	211.7	0.0424	2.28
49	2,783.0	0.3136	28.58	529.9	0.1027	5.64	264.2	0.0468	2.83
60	2,817.8	0.3136	28.96	564.7	0.1027	5.95	298.8	0.0468	3.19

Base R_{ADJ}	30			38		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	N/A	N/A	N/A	N/A	N/A	N/A
19	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A
38	57.5	0.0169	0.62	N/A	N/A	N/A
49	109.8	0.0212	1.22	52.3	0.0043	0.53
60	144.6	0.0212	1.53	87.1	0.0043	0.91

Building: Single Family
City: South Bend
HVAC: Weighted Average
Measure: Roof/Attic/Ceiling Installation

Base R_{ADJ}	0			11			19		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	2,222.2	0.1062	23.16	N/A	N/A	N/A	N/A	N/A	N/A
19	2,486.0	0.1399	25.98	263.7	0.0337	2.83	N/A	N/A	N/A
30	2,636.0	0.1603	27.59	413.8	0.0541	4.50	150.1	0.0204	1.67
38	2,693.5	0.1611	28.26	471.3	0.0549	5.11	207.5	0.0212	2.29
49	2,745.3	0.1647	28.81	522.9	0.0585	5.65	259.3	0.0248	2.83
60	2,779.0	0.1647	29.19	556.7	0.0585	6.02	292.9	0.0248	3.21

Base R_{ADJ}	30			38		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	N/A	N/A	N/A	N/A	N/A	N/A
19	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A
38	57.6	0.008	0.62	N/A	N/A	N/A
49	109.2	0.0043	1.22	51.8	0.0036	0.61
60	142.8	0.0043	1.60	85.3	0.0036	0.91

Building: Single Family
City: Evansville
HVAC: Weighted Average
Measure: Roof/Attic/Ceiling Installation

Base R_{ADJ}	0			11			19		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	1,870.3	0.4391	18.44						
19	2,096.1	0.5081	20.80	226	0.0682	2.29			
30	2,225.6	0.5544	22.11	355.5	0.1144	3.66	129.7	0.0462	1.37
38	2,275.4	0.5713	22.64	405.3	0.132	4.19	179.3	0.0631	1.90
49	2,318.4	0.5846	23.09	448.3	0.1453	4.65	222.5	0.0764	2.36
60	2,346.5	0.6007	23.40	476.4	0.1616	4.95	250.4	0.0923	2.66

Base R_{ADJ}	30			38		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	N/A	N/A	N/A	N/A	N/A	N/A
19	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A
38	49.7	0.0169	0.53	N/A	N/A	N/A
49	92.8	0.0301	0.99	43	0.0133	0.46
60	120.9	0.0462	1.29	71.1	0.0294	0.76

Building: Single Family
City: Ft Wayne
HVAC: Weighted Average
Measure: Roof/Attic/Ceiling Installation

Base R_{ADJ}	0			11			19		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	2,279.7	0.1639	24.32	N/A	N/A	N/A	N/A	N/A	N/A
19	2,546.1	0.1976	27.27	266.3	0.0337	2.96	N/A	N/A	N/A
30	2,699.8	0.2305	28.96	420	0.0666	4.71	153.7	0.0329	1.75
38	2,761.2	0.2305	29.64	481.5	0.0666	5.40	215.1	0.0329	2.43
49	2,814.6	0.2465	30.25	534.9	0.0827	6.00	268.5	0.049	3.04
60	2,848.5	0.2473	30.63	568.7	0.0835	6.38	302.4	0.0498	3.42

Base R_{ADJ}	30			38		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	N/A	N/A	N/A	N/A	N/A	N/A
19	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A
38	61.4	0.000	0.68	N/A	N/A	N/A
49	115	0.0161	1.29	53.5	0.0161	0.61
60	148.8	0.0169	1.67	87.3	0.0169	0.99

Building: Single Family
City: Terre Haute
HVAC: Weighted Average
Measure: Roof/Attic/Ceiling Installation

Base R_{ADJ}	0			11			19		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	2,289.2	0.1863	24.24	N/A	N/A	N/A	N/A	N/A	N/A
19	2,559.1	0.2032	27.21	269.9	0.0169	2.96	N/A	N/A	N/A
30	2,715.2	0.22	28.96	425.9	0.0337	4.71	156	0.0169	1.75
38	2,778.0	0.2359	29.64	488.9	0.0506	5.40	218.8	0.0337	2.43
49	2,828.3	0.2359	30.25	539.1	0.0506	6.00	269.2	0.0337	3.04
60	2,863.8	0.2376	30.63	574.7	0.0513	6.38	304.8	0.0345	3.42

Base R_{ADJ}	30			38		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	N/A	N/A	N/A	N/A	N/A	N/A
19	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A
38	62.8	0.0169	0.68	N/A	N/A	N/A
49	113.2	0.0169	1.29	50.4	0.000	0.61
60	148.8	0.0176	1.67	85.9	0.008	0.99

Building: Single Family
City: Indianapolis
HVAC: Weighted Average
Measure: Wall Installation

Base R_{ADJ}	0			11			13		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	563.6	0.0871	6.16						
13	643.7	0.0918	7.07	80.1	0.0047	0.91			
17	769.2	0.1144	8.45	205.6	0.0273	2.28	125.5	0.0225	1.37
19	815.0	0.1152	8.98	251.4	0.0282	2.81	171.3	0.0233	1.90
21	852.4	0.1322	9.42	288.8	0.0451	3.27	208.8	0.0406	2.36
25	913.4	0.1330	10.05	349.8	0.0461	3.89	269.7	0.0414	2.98
27	937.2	0.1377	10.35	373.6	0.0506	4.18	293.5	0.0461	3.27

Base R_{ADJ}	17			19		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	N/A	N/A	N/A	N/A	N/A	N/A
13	N/A	N/A	N/A	N/A	N/A	N/A
17	N/A	N/A	N/A	N/A	N/A	N/A
19	45.8	0.008	0.53	N/A	N/A	N/A
21	83.4	0.0178	0.91	37.4	0.0170	0.46
25	144.2	0.0187	1.60	98.4	0.0178	1.08
27	168.0	0.0233	1.90	122.3	0.0225	1.37

Building: Single Family
City: South Bend
HVAC: Weighted Average
Measure: Wall Installation

Base R_{ADJ}	0			11			13		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	558.4	0.0583	6.23	N/A	N/A	N/A	N/A	N/A	N/A
13	644.5	0.0591	7.22	86.3	0.008	0.99	N/A	N/A	N/A
17	770.7	0.0770	8.60	212.4	0.0187	2.37	126.2	0.0178	1.38
19	815.1	0.0770	9.13	256.9	0.0187	2.89	170.6	0.0178	1.90
21	851.4	0.0770	9.51	293.1	0.0187	3.34	206.8	0.0178	2.36
25	912.2	0.0808	10.20	353.9	0.0225	4.03	267.7	0.0216	2.98
27	936.6	0.0816	10.50	378.2	0.0233	4.27	292.1	0.0225	3.27

Base R_{ADJ}	17			19		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	N/A	N/A	N/A	N/A	N/A	N/A
13	N/A	N/A	N/A	N/A	N/A	N/A
17	N/A	N/A	N/A	N/A	N/A	N/A
19	44.4	0.000	0.53	N/A	N/A	N/A
21	80.7	0.000	0.91	36.1	0.000	0.46
25	141.5	0.0037	1.60	97.1	0.0037	1.08
27	165.9	0.0047	1.90	121.4	0.0047	1.37

Building: Single Family
City: Evansville
HVAC: Weighted Average
Measure: Wall Installation

Base R_{ADJ}	0			11			13		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	456.6	0.1089	5.00	N/A	N/A	N/A	N/A	N/A	N/A
13	531.1	0.1267	5.78	74.4	0.0178	0.84	N/A	N/A	N/A
17	639.6	0.1594	6.92	182.9	0.0505	1.98	108.5	0.0319	1.14
19	676.6	0.1642	7.37	220.0	0.0554	2.36	145.6	0.0366	1.60
21	707.9	0.1775	7.68	251.4	0.0686	2.74	177.0	0.0505	1.90
25	756.9	0.1820	8.27	300.2	0.0732	3.27	225.8	0.0554	2.43
27	777.3	0.1953	8.44	320.6	0.0864	3.50	246.2	0.0686	2.66

Base R_{ADJ}	**17**			**19**		
New R_{ADJ}	**kWh/ kSF**	**kW/ kSF**	**MMBtu/ kSF**	**kWh/ kSF**	**kW/ kSF**	**MMBtu/ kSF**
11	N/A	N/A	N/A	N/A	N/A	N/A
13	N/A	N/A	N/A	N/A	N/A	N/A
17	N/A	N/A	N/A	N/A	N/A	N/A
19	37.0	0.0047	0.38	N/A	N/A	N/A
21	68.3	0.0178	0.76	31.5	0.0132	0.38
25	117.3	0.0225	1.29	80.3	0.0178	0.91
27	137.7	0.0357	1.52	100.7	0.0310	1.14

Building: Single Family
City: Ft Wayne
HVAC: Weighted Average
Measure: Wall Installation

Base R_{ADJ}	**0**			**11**			**13**		
New R_{ADJ}	**kWh/ kSF**	**kW/ kSF**	**MMBtu/ kSF**	**kWh/ kSF**	**kW/ kSF**	**MMBtu/ kSF**	**kWh/ kSF**	**kW/ kSF**	**MMBtu/ kSF**
11	361.1	0.0322	4.03	N/A	N/A	N/A	N/A	N/A	N/A
13	417.3	0.0416	4.64	56.2	0.0104	0.61	N/A	N/A	N/A
17	496.2	0.0526	5.55	135.1	0.0213	1.52	78.9	0.0110	0.91
19	525.1	0.0526	5.93	163.9	0.0213	1.82	107.7	0.0110	1.22
21	548.9	0.0526	6.16	187.8	0.0213	2.13	131.6	0.0110	1.52
25	587.9	0.0526	6.61	226.8	0.0213	2.58	170.7	0.0110	1.90
27	602.5	0.0530	6.76	241.5	0.0218	2.74	185.3	0.0114	2.13

Base R_{ADJ}	**17**			**19**		
New R_{ADJ}	**kWh/ kSF**	**kW/ kSF**	**MMBtu/ kSF**	**kWh/ kSF**	**kW/ kSF**	**MMBtu/ kSF**
11	N/A	N/A	N/A	N/A	N/A	N/A
13	N/A	N/A	N/A	N/A	N/A	N/A
17	N/A	N/A	N/A	N/A	N/A	N/A
19	28.9	0.000	0.30	N/A	N/A	N/A
21	52.8	0.000	0.61	23.8	0.000	0.30
25	91.6	0.000	1.06	62.8	0.000	0.68
27	106.4	0.005	1.22	77.5	0.005	0.85

Building: Single Family
City: Terre Haute
HVAC: Weighted Average
Measure: Wall Installation

Base R_{ADJ}	0			11			13		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	349.1	0.0328	3.88	N/A	N/A	N/A	N/A	N/A	N/A
13	404.7	0.0328	4.56	55.6	0.00	0.61	N/A	N/A	N/A
17	487.0	0.0427	5.40	137.9	0.011	1.52	82.3	0.0110	0.91
19	513.8	0.0427	5.71	164.7	0.011	1.82	109.1	0.0110	1.22
21	538.5	0.0427	6.00	189.5	0.011	2.13	133.8	0.0110	1.46
25	575.7	0.0535	6.46	226.7	0.0218	2.51	171.0	0.0218	1.90
27	592.1	0.0535	6.61	243.0	0.0218	2.66	187.4	0.0218	2.05

Base R_{ADJ}	17			19		
New R_{ADJ}	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	N/A	N/A	N/A	N/A	N/A	N/A
13	N/A	N/A	N/A	N/A	N/A	N/A
17	N/A	N/A	N/A	N/A	N/A	N/A
19	26.8	0.000	0.30	N/A	N/A	N/A
21	51.7	0.000	0.61	24.8	0.00	0.30
25	88.7	0.0110	0.99	61.9	0.011	0.68
27	105.0	0.0110	1.20	78.2	0.011	0.84

Air Sealing - Reduce Infiltration (Retrofit)

	Measure Details
Official Measure Code	Res-Shell-AirSeal-1
Measure Unit	Per Installation
Measure Category	Building shell
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by heating and cooling system
Peak Demand Reduction (kW)	Varies by heating and cooling system
Annual Fossil Fuel Savings (MMBtu)	Varies by heating and cooling system
Lifetime Energy Savings (kWh)	Varies by heating and cooling system
Lifetime Fossil Fuel Savings (MMBtu)	Varies by heating and cooling system
Water Savings (gal/yr)	0
Effective Useful Life (years)	15
Incremental Cost	Varies by heating and cooling system
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is improving a building's air barrier, which together with insulation defines the thermal boundary of the conditioned space. Air leakage in buildings represents between 5% and 40% of the space conditioning costs,[67] but is also very difficult to control. The measure savings are based on a trained auditor, contractor, or utility staff member being on location to measure and record the existing air leakage rate[68] and post-air sealing leakage using a blower door.

Definition of Efficient Equipment

Air sealing materials and diagnostic testing should meet all eligibility program qualification criteria. The initial and final leakage rates should be tested in such a manner such that the identified reductions can be properly discerned, particularly in situations wherein multiple building envelope measures may be implemented simultaneously.

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[67] Krigger, J. and C. Dorsi. *Residential Energy*. 2004. p. 73.

[68] In accordance with industry best practices per: Building Performance Institute. *Building Analyst and Envelope Professional Standards*. Available online: http://www.bpi.org/standards_approved.aspx

Definition of Baseline Equipment

The existing air leakage should be determined through approved and appropriate test methods. The baseline condition of a building upon first inspection significantly impacts the opportunity for cost-effective energy savings through air sealing.

Deemed Lifetime of Efficient Equipment

The measure life is 15 years.[69]

Deemed Measure Cost

The actual air sealing measure cost should be used.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\mathrm{kWh} = \frac{\mathrm{CFM50_{EXIST}} - \mathrm{CFM50_{NEW}}}{\mathrm{N - factor}} * \frac{\mathrm{kWh}}{\mathrm{CFM}}$$

Where:

$CFM50_{EXIST}$ = Existing cubic feet per minute at 50 Pascal pressure differential as measured by the blower door before air sealing (= actual)

$CFM50_{NEW}$ = New cubic feet per minute at 50 Pascal pressure differential as measured by the blower door after air sealing (= actual)

N-factor = Conversion factor from 50 Pascal airflows to natural airflow (= dependent on exposure level, see table below;[70] if exposure is unknown, assume “Normal;” if number of stories is unknown, use average value for stories 1-2; if both unknown, use 16.3)

N-Factor by Exposure Level and Number of Stories

Exposure	1 Story	1.5 Stories	2 Stories	3 Stories
Well Shielded	22.2	20.0	17.8	15.5
Normal	18.5	16.7	14.8	13.0
Exposed	16.7	15.0	13.3	11.7

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[69] GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

[70] Krigger, J and C. Dorsi. “Residential Energy” 2004 p. 286.

ΔkWh/CFM = kWh impacts per CFM of infiltration rate reduction (= dependent on home cooling and heating types; see tables in Reference Tables section)

For example, the energy savings from reducing air leakage in a well-shielded, 1-story Ft Wayne home with central air conditioning and natural gas heat, from 5,000 CFM_{50} to 3,500 CFM_{50}, would be:

$$\Delta\text{kWh} = \frac{5{,}000-3{,}500}{22.2} * 2.1 = 142\text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$kW = \frac{CFM50_{EXIST} - CFM50_{NEW}}{N - factor} * \frac{\Delta\, kW}{CFM} * CF$$

Where:

ΔkW/CFM = kW impacts per CFM of infiltration rate reduction

CF = Summer peak coincidence factor (= 0.88)

For example, the demand reduction from reducing air leakage in a well-shielded, 2-story Indianapolis home with central air conditioning and natural gas heat, from 5,000 CFM_{50} to 3,500 CFM_{50}, would be:

$$\Delta\text{kW} = \frac{5{,}000-3{,}500}{17.8} * .001 * 0.88 = 0.074$$

Fossil Fuels Impact Descriptions and Calculation

$$\Delta MMBtu = \frac{CFM50Exist - CFM50New}{N - factor} * \frac{\Delta\text{MMBtu}}{\text{CFM}}$$

Where:

ΔMMBtu/CFM = Fossil fuel impacts per CFM of infiltration rate reduction

For example, the fossil fuel savings from reducing air leakage in a well-shielded, 2-story Indianapolis home with central air conditioning and natural gas heat, from 5,000 CFM_{50} to 3,500 CFM_{50}, would be:

$$\Delta\text{MMBtu} = \frac{5{,}000-3{,}500}{17.8} * 0.21 = 17.697\text{ MMBtu}$$

Reference Tables

Electricity and Fossil Fuel Impacts of Air Leakage Sealing*

City	AC Natural Gas Heat			Heat Pump		AC Electric Heat	
	kWh/cfm	kW/cfm	MMBtu/cfm	kWh/cfm	kW/cfm	kWh/cfm	kW/cfm
Indianapolis	2.4	0.001	0.21	30.9	0.003	50.1	0.006
South Bend	1.7	0.001	0.20	30.0	0.003	47.6	0.003
Evansville	3.0	0.005	0.16	20.5	0.007	40.3	0.009
Ft Wayne	2.1	0.001	0.24	36.0	0.002	54.1	0.001
Terre Haute	3.0	0.00	0.19	24.8	0.003	43.5	0.00

* Infiltration unit savings derived from residential simulation models. See Appendix A.

City	Natural Gas Heat Only			Electric Heat Only	
	kWh/cfm	kW/cfm	MMBtu/cfm	kWh/cfm	kW/cfm
Indianapolis	1.1	0.00	0.22	48.2	0.00
South Bend	1.0	0.00	0.21	46.5	0.00
Evansville	0.8	0.00	0.17	36.9	0.00
Ft Wayne	1.2	0.00	0.24	53.1	0.00
Terre Haute	0.9	0.00	0.19	41.4	0.00

* Infiltration unit savings derived from residential simulation models. See Appendix A.

Weighted Average by City

City	kWh/cfm	kW/cfm	MMBtu/cfm
Indianapolis	12.87	0.0018	0.1609
South Bend	11.90	0.0013	0.1533
Evansville	10.81	0.0051	0.1229
Ft Wayne	13.72	0.009	0.1824
Terre Haute	11.66	0.001	0.1444

Duct Sealing and Insulation (Retrofit)

	Measure Details
Official Measure Code	Res-HVAC-DTS-1
Measure Unit	Per installation
Measure Category	Building shell
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by location
Peak Demand Reduction (kW)	Varies by location
Annual Fossil Fuel Savings (MMBtu)	Varies by location
Lifetime Energy Savings (kWh)	Varies by location
Lifetime Fossil Fuel Savings (MMBtu)	Varies by location
Water Savings (gal/yr)	0
Effective Useful Life (years)	20
Incremental Cost	$71.45
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is performing duct sealing and insulation upgrades. Duct sealing is done using mastic sealant or metal tape to the distribution system of homes with either central air conditioning or a ducted heating system. The methodology requires either measuring the amount of duct leakage and observing the duct insulation R-value, or evaluating three duct characteristics (listed) below using the Building Performance Institute *Distribution Efficiency Look-Up Table*:[71]

1. Percentage of duct work within the conditioned space
2. Duct leakage evaluation
3. Duct insulation evaluation

Definition of Efficient Equipment

The efficient condition is sealed and/or insulated duct work throughout the home's unconditioned space.

Definition of Baseline Equipment

The baseline condition is leaky and/or uninsulated duct work within the home's unconditioned space.

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[71] This look-up table is available online: http://www.bpi.org/files/pdf/DistributionEfficiencyTable-BlueSheet.pdf

Deemed Lifetime of Efficient Equipment

The lifetime of this measure is 20 years.[72]

Deemed Measure Cost

The incremental cost for the duct sealing measure is $71.45 per dwelling.[73]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh_{COOLING} = \frac{DE_{AFTER} - DE_{BEFORE}}{DE_{AFTER}} * \frac{EFLH_{COOL} * Btuh_{COOL}}{SEER * 1{,}000}$$

Where:

DE_{AFTER} = Distribution efficiency after duct sealing (= actual; based on total leakage and R-value; see tables in Reference Tables section or determine by evaluating duct system before and after duct sealing and insulation using BPI *Distribution Efficiency Look-Up Table*)

DE_{BEFORE} = Distribution efficiency before duct sealing (= actual; based on total leakage and R-value; see tables in Reference Tables section or determine by evaluating duct system before and after duct sealing and insulation using BPI *Distribution Efficiency Look-Up Table*)

$EFLH_{COOL}$ = Equivalent full load cooling hours (= dependent on location; see table below)

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[72] GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

[73] Itron, Inc. *2010-2012 WO017 Ex Ante Measure Cost Study Final Report*. Submitted to the California Public Utilities Commission. May 27, 2014.

Equivalent Full Load Cooling Hours by City

Location	$EFLH_{COOL}$*
Indianapolis	487
South Bend	431
Evansville	600
Ft. Wayne	373
Terre Haute	569

* Based on prototypical building simulations. See Appendix A.

$Btuh_{COOL}$ = Cooling capacity of equipment in Btuh (= actual; otherwise assume 28,994 Btuh; note: 1 ton = 12,000 Btuh)[74]

SEER = Seasonal average efficiency of air conditioning equipment in SEER (= actual; otherwise assume 11.15)[75]

For example, the energy savings from adding duct sealing to a house in Indianapolis with a 3-ton, SEER 11 central air conditioning and the following duct evaluation results would be:

$$DE_{AFTER} = 0.92$$

$$DE_{BEFORE} = 0.85$$

$$\Delta kWh = \frac{0.92-0.85}{0.92} * 487 * \frac{36{,}000}{11*1{,}000} = 121 \text{ kWh}$$

The heating savings for homes with electric heat (heat pump or resistance) would be:

$$kWh_{HEATING} = \frac{DE_{AFTER} - DE_{BEFORE}}{DE_{AFTER}} * \frac{EFLH_{HEAT} * Btuh_{HEAT}}{3{,}412 * \eta_{HEAT}}$$

Where:

$EFLH_{HEAT}$ = Equivalent full load heating hours (= actual; dependent on location, see table below)

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[74] TecMarket Works, et al. *Residential Baseline Report Final*. Prepared for the Indiana Demand Side Management Coordination Committee Core Programs. November 2, 2012.

[75] Ibid.

Equivalent Full Load Heating Hours by City

Location	$EFLH_{HEAT}$*
Indianapolis	1,341
South Bend	1,427
Evansville	982
Ft. Wayne	1,356
Terre Haute	804

* Heating EFLH extracted from simulations. See Appendix A.

$Btuh_{HEAT}$ = Heating capacity (output) of equipment in Btuh (= actual)

η_{HEAT} = Efficiency in COP of heating equipment (= actual; otherwise based on table below)

COP Estimates by System Type

System Type	Age of Equipment	HSPF Estimate	COP Estimate
Heat Pump	Before 2006	6.8	2.00
	After 2006	7.7	2.26
Resistance	N/A	N/A	1.00

3,412 = Conversion from Btuh to kW

For example, the energy savings from adding duct sealing to a house in Indianapolis with a 100,000 Btu/hr, 6.8 HSPF heat pump and the following duct evaluation results would be:

$$DE_{AFTER} = 0.92$$

$$DE_{BEFORE} = 0.85$$

$$\Delta kWh = \frac{0.92-0.85}{0.92} * 1{,}341 * \frac{100{,}000}{2*3{,}412} = 1{,}495 \text{ kWh}$$

Summer Coincident Peak kW savings

$$\Delta kW = \frac{DE_{PK,AFTER} - DE_{PK,BEFORE}}{DE_{PK,AFTER}} * \frac{Btuh_{COOL}}{EER*1{,}000} * CF$$

Where:

$DE_{PK,AFTER}$ = Distribution efficiency under peak summer conditions after duct sealing

$DE_{PK,BEFORE}$ = Distribution efficiency under peak summer conditions before duct sealing

CF = Summer peak coincidence factor (= 0.88)[76]

EER = Peak efficiency in EER of Air Conditioning equipment (= actual; otherwise calculate as SEER * 0.9)

Fossil Fuel Impact Descriptions and Calculation

The fossil fuel savings for homes with fossil fuel heating would be:

$$\Delta\text{MMBtu} = \frac{DE_{AFTER} - DE_{BEFORE}}{DE_{AFTER}} * \frac{EFLH_{HEAT} * Btuh_{FF}}{1{,}000{,}000}$$

Where:

$Btuh_{FF}$ = Heating capacity of equipment in Btuh input (= actual; otherwise assume 77,386 Btuh)[77]

1,000,000 = Conversion from Btu to MMBtu

For example, the fossil fuel savings from adding duct sealing in a house in Indianapolis with a 100,000 Btu/hr, 84 AFUE natural gas furnace with the following duct evaluation results would be:

$$DE_{AFTER} = 0.92$$

$$DE_{BEFORE} = 0.85$$

$$\Delta\text{MMBtu} = \frac{0.92 - 0.85}{0.92} * 1{,}341 * \frac{100{,}000}{1{,}000{,}000} = 10.203\ \text{MMBtu}$$

Reference Tables

Distribution efficiencies, as based on observed R-values and measured leakage rates, are shown in the tables below.[78]

Single Family Distribution System Efficiency, Ducts Located in Unconditioned Basement

Total Duct Leakage	Duct System R-Value (supply and return)	Cooling		Heating
		DE_{COOL}	DE_{PK}	DE_{HEAT}
8%	Uninsulated	0.88	0.86	0.74
10%	Uninsulated	0.87	0.84	0.73
15%	Uninsulated	0.84	0.82	0.71
20%	Uninsulated	0.82	0.79	0.68

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[76] Duke Energy. Data for residential air conditioning loads.

[77] TecMarket Works, et al. *Residential Baseline Report Final*. Prepared for the Indiana Demand Side Management Coordination Committee Core Programs. November 2, 2012.

[78] Distribution efficiencies were calculated using Indianapolis climate data and according to: ASHRAE Standard 152-2004. “Method of Test for Determining the Design and Seasonal Efficiencies of Residential Thermal Distribution Systems.”

Total Duct Leakage	Duct System R-Value (supply and return)	Cooling		Heating
		DE_{COOL}	DE_{PK}	DE_{HEAT}
25%	Uninsulated	0.80	0.76	0.66
30%	Uninsulated	0.77	0.73	0.64
8%	R-4.2	0.91	0.90	0.88
10%	R-4.2	0.90	0.89	0.87
15%	R-4.2	0.88	0.86	0.84
20%	R-4.2	0.86	0.83	0.82
25%	R-4.2	0.83	0.80	0.79
30%	R-4.2	0.81	0.78	0.77
8%	R-8	0.92	0.91	0.90
10%	R-8	0.91	0.89	0.89
15%	R-8	0.88	0.86	0.86
20%	R-8	0.86	0.84	0.83
25%	R-8	0.84	0.81	0.81
30%	R-8	0.81	0.78	0.78

Single Family Distribution System Efficiency, Ducts Located in Unconditioned Attic

Total Duct Leakage	Duct System R-Value (supply and return)	Cooling		Heating
		DE_{COOL}	DE_{PK}	DE_{HEAT}
8%	Uninsulated	0.68	0.54	0.69
10%	Uninsulated	0.66	0.52	0.68
15%	Uninsulated	0.62	0.47	0.65
20%	Uninsulated	0.58	0.42	0.63
25%	Uninsulated	0.55	0.37	0.60
30%	Uninsulated	0.51	0.32	0.58
8%	R-4.2	0.84	0.79	0.86
10%	R-4.2	0.83	0.77	0.85
15%	R-4.2	0.78	0.71	0.82
20%	R-4.2	0.74	0.65	0.79
25%	R-4.2	0.70	0.59	0.76
30%	R-4.2	0.66	0.54	0.73
8%	R-8	0.86	0.82	0.88
10%	R-8	0.84	0.79	0.87
15%	R-8	0.80	0.73	0.84
20%	R-8	0.76	0.67	0.81
25%	R-8	0.71	0.62	0.78
30%	R-8	0.67	0.56	0.75

ENERGY STAR Windows (Time of Sale)

	Measure Details
Official Measure Code	Res-Shell-ESWind-1
Measure Unit	Per square foot
Measure Category	Building shell
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by location
Peak Demand Reduction (kW)	Varies by location
Annual Fossil Fuel Savings (MMBtu)	Varies by location
Lifetime Energy Savings (kWh)	Varies by location
Lifetime Fossil Fuel Savings (MMBtu)	Varies by location
Water Savings (gal/yr)	0
Effective Useful Life (years)	25
Incremental Cost	$150.00 per 100 square feet of windows
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is purchasing and installing ENERGY STAR windows meeting the minimum requirement for the North Central region (Evansville) or Northern region (Indianapolis, South Bend, Ft. Wayne, and Terre Haute) at the natural time of replacement or during new construction. This does not relate to a window retrofit program.

Definition of Efficient Equipment

To qualify for this measure, the new window must meet ENERGY STAR criteria for the North Central region (u factor ≤ 0.32; SHGC ≤ 0.40) or Northern region (u factor ≤ 0.30). There is no minimum SHGC criterion for windows in the North region, so a medium gain window with SHGC of 0.40 is assumed.

Definition of Baseline Equipment

The baseline condition is a code-compliant window in IECC Climate Zone 4 (u factor = 0.35, SHGC = 0.40) or IECC Climate Zone 3 (u factor = 0.32). SHGC is not specified in climate zone 3, so a medium gain window with SHGC of 0.40 is assumed.

Deemed Lifetime of Efficient Equipment

The measure life is 25 years.[79]

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[79] GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

Deemed Measure Cost

The incremental cost for this measure is $150.00 per 100 square feet of windows.[80]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = \frac{SF}{100} * \frac{\Delta kWh}{100SF}$$

Where:

SF = Area of installed windows

$\frac{\Delta kWh}{100SF}$ = Unit energy savings (= dependent on type of HVAC system and city; see table in Reference Tables section)

For example, the energy savings from installing 200 square feet of ENERGY STAR windows in a home in Indianapolis with central air conditioning and natural gas heat would be:

$$\Delta kWh = \frac{200}{100} * \ 44 = 88 \text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = \frac{SF}{100} * \frac{\Delta kW}{100SF} * \ CF_S$$

Where:

$\frac{\Delta kW}{100SF}$ = Unit demand reduction (= dependent on type of HVAC system and city; see table in Reference Tables section)

CF_S = Summer peak coincidence factor (= 0.88)[81]

For example, the demand reduction from installing 200 square feet of ENERGY STAR windows in a home in Indianapolis with central air conditioning and natural gas heat would be:

$$\Delta \text{kW} = \frac{200}{100} * 0.1 * 0.88 = \ 0.176 \text{ kW}$$

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[80] Alliance to Save Energy Efficiency Windows Collaborative Report, December 2007

[81] Duke Energy. Load shape data for residential air conditioning loads from DSMore cost-effectiveness tool. Available online: www.integralanalytics.com

Fossil Fuels Impact Descriptions and Calculation

$$\Delta \text{MMBtu} = \frac{SF}{100} * \frac{\Delta MMBtu}{100SF}$$

Where:

$\frac{\Delta MMBtu}{100SF}$ = Unit fossil fuel energy savings (= dependent on type of HVAC system and city; see table in Reference Tables section)

For example, the fossil fuel savings from installing 200 square feet of ENERGY STAR windows in a home in Indianapolis with central air conditioning and natural gas heat would be:

$$\Delta \text{MMBtu} = \frac{200}{100} * 1.07 = 2.140$$

Reference Tables

Electricity and Fossil Fuel Impacts of Window Upgrades*HVAC System	kWh/100 Square Feet	kW/100 Square Feet	MMBtu/100 Square Feet
Indianapolis			
AC Natural Gas Heat	44	0.1	1.07
Heat Pump	1,378	0.2	0
AC Electric Heat	2,399	0.1	0
Electric Heat Only	2,380	0	0
Natural Gas Heat Only	55	0	1.09
South Bend			
AC Natural Gas Heat	70	0.1	1.01
Heat Pump	1,265	0.1	0
AC Electric Heat	2,252	0.1	0
Electric Heat Only	2,246	0	0
Natural Gas Heat Only	50	0	1.01
Evansville			
AC Natural Gas Heat	45	0	0.84
Heat Pump	838	0.1	0
AC Electric Heat	1,812	0.1	0
Electric Heat Only	1,787	0	0
Natural Gas Heat Only	40	0	0.85
Ft Wayne			
AC Natural Gas Heat	44	0	1.1
Heat Pump	1,428	0.1	0
AC Electric Heat	2,431	0	0
Electric Heat Only	2,443	0	0
Natural Gas Heat Only	53	0	1.1

Electricity and Fossil Fuel Impacts of Window Upgrades*HVAC System	kWh/100 Square Feet	kW/100 Square Feet	MMBtu/100 Square Feet
Terre Haute			
AC Natural Gas Heat	62	0.1	0.9
Heat Pump	1,036	0.1	0
AC Electric Heat	1,967	0.1	0
Electric Heat Only	1,949	0	0
Natural Gas Heat Only	43	0	0.9

HVAC System Weighted Average*

City	kWh/100 Square Feet	kW/100 Square Feet	MMBtu/100 Square Feet
Indianapolis	569.4	0.0890	0.8158
South Bend	551.5	0.0850	0.7676
Evansville	429.0	0.0220	0.6397
Ft Wayne	578.2	0.0040	0.8360
Terre Haute	479.1	0.0850	0.6840

* Infiltration unit savings derived from residential simulation models. See Appendix A.

Domestic Hot Water

Heat Pump Water Heaters (Time of Sale)

	Measure Details
Official Measure Code	Res-DHW-HPWH-1
Measure Unit	Per heat pump
Measure Category	Domestic hot water
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by heating system
Peak Demand Reduction (kW)	Varies by heating system
Annual Fossil Fuel Savings (MMBtu)	-7.380
Lifetime Energy Savings (kWh)	Varies by heating system
Lifetime Fossil Fuel Savings (MMBtu)	-73.80
Water Savings (gal/yr)	0
Effective Useful Life (years)	10
Incremental Cost	$700.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing a heat pump DHW heater in place of a standard electric hot water heater. This is a time of sale measure. Savings are presented dependent on the heating system installed in the home.

Definition of Efficient Equipment

To qualify for this measure, the installed equipment must be a heat pump DHW heater.

Definition of Baseline Equipment

The baseline condition is a standard electric hot water heater.

Deemed Lifetime of Efficient Equipment

The measure life is 10 years.[82]

Deemed Measure Cost

The incremental cost for this measure is $700.00[83]

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[82] ENERGY STAR. *Residential Water Heaters, Final Criteria Analysis*. Available online: http://www.energystar.gov/ia/partners/prod_development/new_specs/downloads/water_heaters/WaterHeaterDraftCriteriaAn alysis.pdf

[83] Duke Energy. *Measure Cost Data*. 2012.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = kWh_{BASE} * \frac{COP_{NEW}-COP_{BASE}}{COP_{NEW}} + kWh_{COOLING} - kWh_{HEATING}$$

Where:

kWh_{BASE} = Average electric DHW consumption (= 3,460)[84]

COP_{NEW} = Coefficient of performance (efficiency) of heat pump water heater (= 2.0)[85]

COP_{BASE} = Coefficient of performance (efficiency) of standard electric water heater (= 0.904)[86]

$kWh_{COOLING}$ = Cooling savings from conversion of heat in home to water heat (= 180)[87]

$kWh_{heating}$ = Heating cost from conversion of heat in home to water heat (= dependent on heating system as follows)[88]

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[84] U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy. *Residential Water Heaters Technical Support Document for the January 17, 2001, Final Rule.* DOE/EE-0317. Table 9.3.9, p. 9-34. May 2007. Available online: http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/09.pdf

[85] ENERGY STAR. *Residential Water Heaters, Final Criteria Analysis.* Available online: http://www.energystar.gov/ia/partners/prod_development/new_specs/downloads/water_heaters/WaterHeaterDraftCriteriaAn alysis.pdf

[86] Ibid.

[87] Determined by: (1) calculating the MMBtu removed from the air, (2) applying the REM Rate-determined percentage of lighting savings that result in reduced cooling loads (35%; lighting is used as a proxy for DHW heating since load shapes suggest their seasonal usage patterns are similar), (3) assuming a SEER 11 central air conditioning unit, (4) multiplying by 64% to adjust for the percentage of Indiana homes with cooling (Energy Information Administration. *2005 Residential Energy Consumption Survey*. East North Central census division. Available online: http://www.eia.doe.gov/emeu/recs/recs2005/hc2005_tables/hc6airconditioningchar/pdf/tablehc12.6.pdf), and (5) applying a discretionary usage adjustment of 0.75 (Energy Center of Wisconsin. *Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research*. p. 31. May 2008).

[88] Determined by applying the REM Rate-determined percentage of lighting savings that result in increased heating loads (45%) to the calculated MMBtu removed from the air, then converting to kilowatt-hours and dividing by the heating system efficiency (1.0 for electric resistance, 2.0 for heat pump).

Heating System	$kWh_{heating}$
Electric resistance	1,577
Heat pump COP 2.0	779
Fossil fuel	0

$$\Delta\text{kWh electric resistance heat} = 3460 * \frac{2.0-0.904}{2.0} + 180 - 1577 = 499\text{ kWh}$$

$$\Delta\text{kWh heat pump heat} = 3460 * \frac{2.0-0.904}{2.0} + 180 - 779 = 1{,}297\text{ kWh}$$

$$\Delta\text{kWh fossil fuel heat} = 3460 * \frac{2.0-0.904}{2.0} + 180 - 0 = 2{,}076\text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW} = \frac{\Delta\, kWh}{Hours} * CF$$

Where:

Hours = Equivalent full load hours of hot water heater (= 2,533)[89]

CF = Summer peak coincidence factor (= 0.346)[90]

$$\Delta\text{kW electric resistance heat} = \frac{499}{2{,}533} * 0.346 = 0.068\text{ kW}$$

$$\Delta\text{kW heat pump heat} = \frac{1{,}297}{2{,}533} * 0.346 = 0.177\text{ kW}$$

$$\Delta\text{kW fossil fuel heat} = \frac{2{,}076}{2{,}533} * 0.346 = 0.284\text{ kW}$$

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[89] Efficiency Vermont. Load shape calculated from Itron eShapes.

[90] Calculated from Itron eShapes, which is 8,760 hourly data by end use for Upstate New York, adjusted for Ohio peak definitions. The resulting peak coincident kilowatts are consistent with result shown in: U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy. *Field Testing of Pre-Production Prototype Residential Heat Pump Water Heaters*. DOE/EE-0317. May 2007. Available online: http://www1.eere.energy.gov/femp/pdfs/tir_heatpump.pdf

Fossil Fuel Impact Descriptions and Calculation

$$\Delta MMBtu = -7.380\ MMBtu^{91}$$

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[91] This is the additional energy consumption (therefore a negative value) required to replace the heat removed from the home during the heating season by the heat pump water heater. Determined by: (1) calculating the MMBtu removed from the air, (2) applying the REM Rate-determined percentage of lighting savings that result in increased heating loads (45%; lighting is used as a proxy for DHW heating since load shapes suggest their seasonal usage patterns are similar), and (3) dividing by the efficiency of the heating system (estimated assuming that natural gas central furnace heating is typical for Indiana residences; 65% of East North Central homes have a natural gas furnace (Energy Information Administration. *2005 Residential Energy Consumption Survey*. Available online: http://www.eia.doe.gov/emeu/recs/recs2005/hc2005_tables/hc4spaceheating/pdf/tablehc12.4.pdf).
In 2000, 40% of furnaces purchased in Indiana were condensing (based on data from GAMA, provided to U.S. Department of Energy during the federal standard setting process). Assuming typical efficiencies for condensing and non-condensing furnace and duct losses, the average heating system efficiency is estimated as: (0.4 * 0.92) + (0.6 * 0.8) * (1 - 0.15) = 0.72.

Low-Flow Faucet Aerator (Time of Sale or Early Replacement)

	Measure Details
Official Measure Code	Res-DHW-Aerator-1
Measure Unit	Per aerator
Measure Category	Domestic hot water
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by space, building type, and location
Peak Demand Reduction (kW)	Varies by space, building type, and location
Annual Fossil Fuel Savings (MMBtu)	Varies by space, building type, and location
Lifetime Energy Savings (kWh)	Varies by space, building type, and location
Lifetime Fossil Fuel Savings (MMBtu)	Varies by space, building type, and location
Water Savings (gal/yr)	Varies by space, building type, and location
Effective Useful Life (years)	10
Incremental Cost	$2.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing a low-flow (1.0 - 1.5 GPM) kitchen or bathroom faucet aerator in a home. This could be a retrofit direct install measure or a new installation. Both electric and fossil fuel savings are provided, although only savings corresponding to the hot water heating fuel should be claimed.

Definition of Efficient Equipment

The efficient equipment is a low-flow faucet aerator.

Definition of Baseline Equipment

The baseline equipment is a standard faucet aerator using > 2 GPM.

Deemed Lifetime of Efficient Equipment

The measure life is 10 years.[92]

Deemed Measure Cost

As a retrofit measure, the cost will be the actual cost for the aerator and installation.

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[92] California Public Utilities Commission. *Database for Energy Efficient Resources.* Assumption for faucet aerators. Available online: www.deeresources.com

As a measure distributed to and installed by participants, the cost is the price of the aerator and distribution, determined to be $2.00.[93]

Deemed O&M Cost Adjustments

When a retrofit measure, there would be a very small O&M benefit associated with the deferral of the next replacement, but this has conservatively not been characterized.

Savings Algorithm

Energy Savings

The energy savings from homes with an electric DHW heater would be:

$$\Delta\text{kWh} = ISR * (GPM_{BASE} - GPM_{LOW}) * MPD * \frac{PH}{FH} * DR * 8.3 * (T_{MIX} - T_{IN}) * \frac{365}{RE * 3{,}412}$$

Where:

ISR = In-service rate, or fraction of units that get installed (= 1.0 for retrofit/direct install; = 0.48 for customer self-install)[94]

GPM_{BASE} = Gallons per minute of baseline faucet aerator (= 1.90 for bathrooms, = 2.44 for kitchens)[95]

GPM_{LOW} = Gallons per minute of low-flow faucet aerator (= 1.01 for bathrooms, = 1.49 for kitchens)[96]

MPD = Average minutes of faucet use per person per day (= 1.6 for bathrooms, = 4.5 for kitchens)[97]

PH = Average number of people per household (= 2.64 for single family, = 1.83 for multifamily, = 2.47 for unknown housing type)[98]

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[93] Navigant Consulting and Ontario Energy Board. *Measures and Assumptions for Demand Side Management (DSM) Planning.* April 2009.

[94] EGD_2009_DSM_Annual Report from table 27 survey of Install rates: Overall averages of 62% and 34% for kitchen and bath aerators respectively are averaged to get 48%. There is significant variation in rates by building type, aerator type, and distribution so surveying participants is encouraged

[95] Cadmus. *2011 IPL Residential Core Plus Evaluation, Multifamily Direct Install Program.* 2012.

[96] Ibid.

[97] Cadmus and Opinion Dynamics. *Showerhead and Faucet Aerator Meter Study.* Memorandum prepared for Michigan Evaluation Working Group. 2013.

[98] Census data from Ferret Software for Indiana uses ACS three-year public-use microdata (2008-2010). Weighted values by housing type of 79% for single family and 21% for multifamily) determined from: U.S. Energy Information Administration. *Residential Energy Consumption Surveys.* 2009.

FH = Average faucets per household (= dependent on sink and housing type; see table below)[99]

Quantity of Faucets by Sink and Housing Type

Housing Type	Bathroom	Kitchen
Single-Family	2.04	1.00
Multifamily	1.43	1.00
Unknown	1.91	1.00

365 = Days of faucet use per year

DR = Percentage of water flowing down drain (= 50% for kitchens, = 70% for bathrooms;[100] if water is collected in a sink, a faucet aerator will not result in any saved water)

8.3 = Specific weight of water in pounds per gallon, which is then multiplied by the specific water temperature ($1.0 \frac{Btu}{lb*°\mathrm{F}}$)

T_{MIX} = Mixed water temperature exiting faucet (= 86.0°F for bathrooms, = 93.0°F for kitchens)[101]

T_{IN} = Cold water temperature entering the DWH system (= dependent on climate, see table below)

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[99] Cadmus and Opinion Dynamics. *Showerhead and Faucet Aerator Meter Study.* Memorandum prepared for Michigan Evaluation Working Group. 2013. "Unknown" housing type percentages of 79% for single family and 21% for multifamily are weighted averages from: U.S. Energy Information Administration. *Residential Energy Consumption Surveys*. 2009.

[100] Navigant Consulting and Ontario Energy Board. *Measures and Assumptions for Demand Side Management (DSM) Planning.* April 2009.

[101] Cadmus and Opinion Dynamics. *Showerhead and Faucet Aerator Meter Study.* Memorandum prepared for Michigan Evaluation Working Group. 2013.

Cold Water Entering Temperature by City*

City	Groundwater Temperature (°F)
Indianapolis	58.1
South Bend	57.4
Terre Haute	60.5
Evansville	62.8
Ft Wayne	55.6

* Burch, J. and C. Christensen, National Renewable Energy Lab. White paper: “Towards Development of an Algorithm for Mains Water Temperature.” Prepared for American Solar Energy Society. 2007.

RE = Recovery efficiency of electric hot water heater (= 0.98)[102]

3,412 = Constant to convert Btu to kWh

For example, the energy savings from a 1.5 GPM direct-installation bathroom aerator in a single family Indianapolis home with an electric water heater would be:

$$\Delta\text{kWh} = 1.0 * (1.90 - 1.01) * 1.6 * \frac{2.64}{2.04} * 0.70 * 8.3 * (86 - 58.1) * \frac{365}{0.98 * 3{,}412} = 33\text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW} = ISR * (GPM_{BASE} - GPM_{LOW}) * 60 * DR * 8.3 * \frac{T_{MIX} - T_{IN}}{RE * 3{,}412} * CF$$

Where:

60 = Minutes per Hour

CF = Summer peak coincidence factor (= 0.0012 for bathrooms, = 0.0033 for kitchens)[103]

For example, the demand reduction from a 1.5 GPM direct-installation bathroom aerator in a multifamily home in South Bend with an electric water heater would be:

$$\Delta\text{kW} = 1.0 * (1.90 - 1.01) * 60 * 0.70 * 8.3 * \frac{(86-57.4)}{0.98 * 3{,}412} * 0.0012 = 0.003\text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

Homes with a fossil fuel DHW heater have the following MMBtu savings:

$$\Delta\text{MMBtu} = ISR * (GPM_{BASE} - GPM_{LOW}) * MPD * \frac{PH}{FH} * DR * 8.3 * (T_{MIX} - T_{IN}) * \frac{365}{RG * 1{,}000{,}000}$$

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[102] NREL, Building America Research benchmark definition, 2009, p. 12. http://www.nrel.gov/docs/fy10osti/47246.pdf.

[103] Cadmus. *Wisconsin Technical Reference Manual.* Prepared for Wisconsin Focus on Energy. January 2015.

Where:

RG = Recovery efficiency of natural gas hot water heater (= 0.76)[104]

1,000,000 = Constant to convert Btu to MMBtu

For example, the fossil fuel savings from a 1.5 GPM direct-installation kitchen aerator in a single family home in Evansville with a natural gas water heater would be:

$$\Delta \text{MMBtu} = 1.0 * (2.44 - 1.49) * 4.5 * \frac{2.64}{1.00} * 0.50 * 8.3 * (93.0 - 62.8) * \frac{365}{0.76 * 1{,}000{,}000} = 0.679$$

Water Impact Descriptions and Calculation

$$\text{Water Savings} = ISR * (GPM_{BASE} - GPM_{LOW}) * MPD * \frac{PH}{FH} * DR * 365$$

For example, the water savings from a 1.5 GPM direct-installation bathroom aerator in an unknown home type would be:

$$\text{Water Savings} = 1.0 * (1.90 - 1.01) * 1.6 * \frac{2.47}{1.91} * 0.70 * 365 = 470.5 \text{ gallons}$$

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[104] NREL, Building America Research benchmark definition, 2009, p. 12.

http://www.nrel.gov/docs/fy10osti/47246.pdf.

Low-Flow Showerhead (Time of Sale or Early Replacement)

	Measure Details
Official Measure Code	Res-DHW-SH-1
Measure Unit	Per showerhead
Measure Category	Domestic hot water
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by building type and location
Peak Demand Reduction (kW)	Varies by building type and location
Annual Fossil Fuel Savings (MMBtu)	Varies by building type and location
Lifetime Energy Savings (kWh)	Varies by building type and location
Lifetime Fossil Fuel Savings (MMBtu)	Varies by building type and location
Water Savings (gal/yr)	Varies by building type and location
Effective Useful Life (years)	10
Incremental Cost	$18.50
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing a low-flow showerhead in a home. This is a retrofit direct install measure or for a new installation. Both electric and fossil fuel savings are provided, although only savings corresponding to the hot water heating fuel should be claimed.

Definition of Efficient Equipment

The efficient condition is a low-flow showerhead of 1.74 GPM or less.

Definition of Baseline Equipment

The baseline is a standard showerhead with a flow of 2.63 GPM (the baseline in Indiana).

Deemed Lifetime of Efficient Equipment

The measure life is 10 years.

Deemed Measure Cost

As a retrofit measure, the incremental cost will be the cost of the showerhead including its installation.

As a measure distributed to and installed by participants, the cost is the price of the showerhead and for distribution, or $18.50[105].

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[105] Itron, Inc. *2010-2012 WO017 Ex Ante Measure Cost Study Final Report*. May 27, 2014. Submitted to the California Public Utilities Commission.

Deemed O&M Cost Adjustments

When a retrofit measure, there would be a very small O&M benefit associated with the deferral of the next replacement, but this has conservatively not been characterized.

Savings Algorithm

Energy Savings

The energy savings from homes with an electric domestic hot water heater would be:

$$\Delta \text{kWh} = ISR * (GPM_{BASE} - GPM_{LOW}) * MS * SPD * \frac{PH}{SH} * 8.3 * (T_{MIX} - T_{IN}) * \frac{365}{RE * 3{,}412}$$

Where:

ISR = In-service rate, or fraction of units that get installed (= 1.0 for retrofit/direct install; = 0.81 for customer self-install)

GPM_{BASE} = Gallons per minute of baseline showerhead (= 2.63)[106]

GPM_{LOW} = Gallons per minute of low-flow showerhead (= actual; otherwise = 1.74)[107]

MS = Average minutes per shower event (= 7.8)[108]

SPD = Average number of shower events per person per day (= 0.6)[109]

PH = Average number of people per household (= 2.64 for single family, = 1.83 for multifamily, = 2.47 for unknown housing type)[110]

SH = Average number of showerheads per household (= 1.6 for single family,[111] = 1.2 for multifamily)[112]

365 = Days of shower use per year

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[106] Cadmus. *2011 IPL Residential Core Plus Evaluation, Multifamily Direct Install Program*. 2012.

[107] Ibid.

[108] Cadmus and Opinion Dynamics. *Showerhead and Faucet Aerator Meter Study.* Memorandum prepared for Michigan Evaluation Working Group. 2013.

[109] Ibid.

[110] Census data from Ferret Software for Indiana Uses ACS three-year public use microdata (2008-2010). Weighted values by housing type of 79% for single family and 21% for multifamily determined from: U.S. Energy Information Administration. *Residential Energy Consumption Surveys.* 2009.

[111] TecMarket Works, et al. *Residential Baseline Report Final*. November 2, 2012. Prepared for the Indiana Demand Side Management Coordination Committee Core Programs

[112] Cadmus. *2011 IPL Residential Core Plus Evaluation, Multifamily Direct Install Program*. 2012.

8.3 = Specific weight of water in pounds per gallon, which is multiplied by the specific heat of water (1.0 $\frac{Btu}{lb*°\mathrm{F}}$)

T_{MIX} = Average mixed temperature of water used for shower (= 101°F) [113]

T_{IN} = Cold water temperature entering the DWH system (= depending on climate, see table below)

Cold Water Temperature by City

City	Groundwater Temperature (°F)
Indianapolis	58.1
South Bend	57.4
Terre Haute	60.5
Evansville	62.8
Ft Wayne	55.6

* Burch, J. and C. Christensen, National Renewable Energy Lab. White paper: “Towards Development of an Algorithm for Mains Water Temperature.” Prepared for American Solar Energy Society. 2007.

RE = Recovery efficiency of electric hot water heater (= 0.98)[114]

3412 = Constant to convert Btu to kWh

For example, the energy savings from a 2.0 GPM direct installation in an Indianapolis single family home would be:

$$\Delta\mathrm{kWh} = 1.0 * (2.63 - 2.0) * 7.8 * 0.6 * \frac{2.64}{1.6} * 8.3 * (101 - 58.1) * \frac{365}{0.98*3{,}412} = 189$$

Summer Peak Coincident Demand Reduction

The demand reduction from homes with an electric DHW heater would be:

$$\Delta\mathrm{kW} = ISR * (GPM_{BASE} - GPM_{LOW}) * 60 * 8.3 * \frac{(T_{MIX} - T_{IN})}{RE * 3{,}412} * CF$$

Where:

60 = Minutes per hour

CF = Summer peak coincidence factor (= 0.0023)[115]

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[113] Cadmus and Opinion Dynamics Evaluation Team, *Showerhead and Faucet Aerator Meter Study* [Memorandum]. Michigan Evaluation Working Group, 2013

[114] NREL, Building America Research benchmark definition, 2009, p. 12.

http://www.nrel.gov/docs/fy10osti/47246.pdf.

[115] Cadmus. *Wisconsin Technical Reference Manual.* Prepared for Wisconsin Focus on Energy. January 2015.

For example, the demand reduction from a 2.0 GPM direct-installation in an Indianapolis multifamily home would be:

$$\Delta \text{kW} = 1.0 * (2.63 - 2.0) * 60 * 8.3 * \frac{(101-58.1)}{0.98 * 3{,}412} * 0.0023 = 0.009$$

Fossil Fuel Impact Descriptions and Calculation

The fossil fuel savings for homes with a fossil fuel DHW heater would be:

$$\Delta \text{MMBtu} = ISR * (GPM_{BASE} - GPM_{LOW}) * MS * SPD * \frac{PH}{SH} * 8.3 * (T_{MIX} - T_{IN}) * \frac{365}{RG * 1{,}000{,}000}$$

Where:

RG = Recovery efficiency of natural gas hot water heater (= 0.76)[116]

1,000,000 = Conversion from Btu to MMBtu

For example, the fossil fuel savings from a 2.0 GPM direct-installation in an Indianapolis multifamily home would be:

$$\Delta \text{MMBtu} = 1.0 * (2.63 - 2.0) * 7.8 * 0.6 * \frac{1.83}{1.2} * 8.3 * (101 - 58.1) * \frac{365}{0.76 * 1{,}000{,}000} = 0.318$$

Water Impact Descriptions and Calculation

$$\text{Water Savings} = ISR * (GPM_{BASE} - GPM_{LOW}) * MS * SPD * \frac{PH}{SH} * 365$$

For example, the water savings from a 2.0 GPM direct installation in an Indianapolis multifamily home would be:

$$\text{Water Savings} = 1.0 * (2.63 - 2.0) * 7.8 * 0.6 * \frac{1.83}{1.2} * 365 = 1{,}641 \text{ gallons}$$

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[116] NREL, Building America Research benchmark definition, 2009, p. 12.

http://www.nrel.gov/docs/fy10osti/47246.pdf.

Domestic Hot Water Pipe Insulation (Retrofit)

	Measure Details
Official Measure Code	Res-DHW-PipeIns-1
Measure Unit	Per installation
Measure Category	Domestic hot water
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by pipe length
Peak Demand Reduction (kW)	Varies by pipe length
Annual Fossil Fuel Savings (MMBtu)	Varies by pipe length
Lifetime Energy Savings (kWh)	Varies by pipe length
Lifetime Fossil Fuel Savings (MMBtu)	Varies by pipe length
Water Savings (gal/yr)	0
Effective Useful Life (years)	15
Incremental Cost (per linear foot)	$8.98
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is adding insulation to uninsulated DHW pipes. The measure savings are based on the pipe wrap being installed to the first length of both the hot and cold pipe up to the first elbow.

Definition of Efficient Equipment

The efficient condition is installing pipe wrap insulation to a length of hot water carrying copper pipe.

Definition of Baseline Equipment

The baseline is an uninsulated hot water carrying copper pipe.

Deemed Lifetime of Efficient Equipment

The measure life is 15 years.[117]

Deemed Measure Cost

The measure cost including material and installation is $8.98 per linear foot. [118].

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

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[117] GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

[118] Itron, Inc. *2010-2012 WO017 Ex Ante Measure Cost Study Final Report*. May 27, 2014. Submitted to the California Public Utilities Commission.

Savings Algorithm

Energy Savings

The energy savings for homes with an electric DHW system would be:

$$\Delta\text{kWh} = \left(\frac{1}{R_{EXIST}} - \frac{1}{R_{NEW}}\right) * \frac{L * C * \Delta T * 8{,}760}{\eta_{DHW} * 3{,}412}$$

Where:

R_{EXIST} = Pipe heat loss coefficient (R-value) of uninsulated pipe existing (= 1.0 $\frac{°\text{F} * hr * ft^2}{Btu}$)[119]

R_{NEW} = Pipe heat loss coefficient (R-value) of insulated pipe (= actual; otherwise = 3)[120]

L = Feet of pipe from water heating source covered by pipe wrap (= actual)

C = Circumference of pipe in feet (= actual; = π * diameter)

ΔT = Average temperature difference between supplied water and ambient air temperature (= 65°F)[121]

8,760 = Hours per year

η_{DHW} = Recovery efficiency of electric hot water heater (= 0.98)[122]

3,412 = Conversion from Btu to kWh

For example, the energy savings from insulating 5 feet of 0.75-inch pipe with R-4 wrap would be:

$$\Delta kWh = \left(\frac{1}{1} - \frac{1}{5}\right) * \frac{5 * \left(\pi * \frac{0.75}{12}\right) * 65 * 8{,}760}{0.98 \ * \ 3{,}412} = 134\ kWh$$

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW} = \frac{\Delta kWh}{8{,}760}$$

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[119] Navigant Consulting and Ontario Energy Board. *Measures and Assumptions for Demand Side Management (DSM) Planning.* "Appendix C Substantiation Sheets." P. 77. April 2009.

[120] Assumes standard 0.5-inch insulation with 4 $\frac{°\text{F} * \text{hr} * \text{ft}^2}{\text{Btu}*\text{in}}$ in addition to R-value of uninsulated pipe, based on: ASHRAE Fundamentals Chapter 23-Table 2.

[121] Assumes 130°F average water temperature leaving the hot water tank and average basement temperature of 65°F.

[122] Electric water heater have recovery efficiency of 98%: http://www.ahrinet.org/ARI/util/showdoc.aspx?doc=576

Where:

ΔkWh = kWh savings from pipe wrap installation

8,760 = Number of hours in a year

For example, the demand savings from insulating 5 feet of 0.75-inch pipe with R-4 wrap would be:

$$\Delta kW = \frac{133}{8{,}760} = 0.015\ kW$$

Fossil Fuel Impact Descriptions and Calculation

The fossil fuel savings for homes with a fossil fuel DHW system would be:

$$\Delta MMBtu = \left(\frac{1}{R_{EXIST}} - \frac{1}{R_{NEW}}\right) * \frac{L * C * \Delta T * 8{,}760}{\eta_{DHW} * 1{,}000{,}000}$$

Where:

η_{DHW} = Recovery efficiency of natural gas hot water heater (= 0.75)[123]

1,000,000 = Conversion from Btu to MMBtu

For example, the fossil fuel savings from insulating 5 feet of 0.75-inch pipe with R-4 wrap would be:

$$\Delta MMBtu = \left(\frac{1}{1} - \frac{1}{5}\right) * \frac{5 * 0.196 * 65 * 8{,}760}{0.75 * 1{,}000{,}000} = 0.596\ MMBtu$$

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[123] Per AHRI directory, the range of recovery efficiency ratings for new natural gas DHW units is 70% to 87%, so the average of existing units is estimated as 75%.

Natural Gas Water Heaters (Time of Sale)

	Measure Details
Official Measure Code	Res-DHW-StorWH-1
Measure Unit	Per water heater
Measure Category	Domestic hot water
Sector(s)	Residential
Annual Energy Savings (kWh)	0
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	Varies by location
Lifetime Energy Savings (kWh)	0
Lifetime Fossil Fuel Savings (MMBtu)	Varies by location
Water Savings (gal/yr)	0
Effective Useful Life (years)	13
Incremental Cost	Varies by technology
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is purchasing and installing an efficient natural gas water heater meeting or exceeding ENERGY STAR criteria[124] for the water heater category.

Definition of Efficient Equipment

The efficient condition is a natural gas water heater meeting the minimum efficiency ENERGY STAR qualification criteria, listed by category in the table below[125].

ENERGY STAR Criteria by Water Heater Type

Water Heater Type	Energy Factor
Natural Gas Storage ≤ 55 gallons	0.67
Natural Gas Storage > 55 gallons	0.77
Natural Gas Tankless (whole house)	0.90

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[124] ENERGY STAR. “Residential Water Heaters Key Product Criteria.” 2015http://www.energystar.gov/index.cfm?c=water_heat.pr_crit_water_heaters

[125] Ibid.

Definition of Baseline Equipment

The baseline condition is a 50-gallon conventional natural gas storage water heater with the federal minimum rating of 0.58 EF.

Deemed Lifetime of Efficient Equipment

The measure life is 13 years.[126]

Deemed Measure Cost

The deemed measure cost by water heater type is given in the table below.

Incremental cost by Water Heater Type

Water Heater Type	Incremental Cost*
Natural Gas Storage (0.67 EF)	$400
Natural Gas Storage Condensing (0.80 EF)	$685
Natural Gas Tankless (whole house; 0.82 EF)	$605

* U.S. Environmental Protection Agency. *ENERGY STAR Water Heater Criteria Final Analysis*. Used the low end of the cited range for the tankless category due to age of report.

Deemed O&M Cost Adjustments

There is no justification at this time for O&M cost adjustments.

Savings Algorithm

Energy Savings

$$\Delta\text{MMBtu} = GPD * 365 * 8.3 * \frac{\Delta T}{1{,}000{,}000} * \left(\frac{1}{EF_{BASE}} - \frac{1}{EF_{EFF}}\right)$$

Where:

GPD = Average daily hot water consumption (= see table)

8.3 = Constant (Btu/gal-°F)

Hot water use varies by family size. Estimates of hot water use per person as a function of number of people in the home are shown in the table below.

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[126] The life expectancy of each water heater depends on local variables, such as water chemistry and homeowner maintenance. While there is currently insufficient data to determine tankless water heaters lifetimes, preliminary data show lifetimes up to 20 years. This value of 13 years is the weighted average lifetime for this measure category in aggregate and is supported by the findings in: http://www.aceee.org/consumerguide/WH_LCC_1107.pdf

Hot Water Use by Family Size

Number of People	Gallons per Person per Day	Gallons per Day per Household
1	29.4	29
2	22.8	46
3	20.6	62
4	19.5	78
5	18.9	94
6	18.5	111

ΔT = Water temperature difference between water heater setpoint and entering cold water

The water heater setpoint for residential buildings is usually between 120°F and 140°F. The average cold water entering temperature varies by climate, as shown in the table below.

City	Groundwater Temperature (°F)
Indianapolis	58.1
South Bend	57.4
Terre Haute	60.5
Evansville	62.8
Ft Wayne	55.6

* Burch, J. and C. Christensen, National Renewable Energy Lab. White Paper: "Towards Development of an Algorithm for Mains Water Temperature." 2007.

EF_{BASE} = Energy factor for baseline equipment (= 0.594)

EF_{EFF} = Energy factor for efficient equipment (= actual)

For example, the energy savings from installing a new tankless unit with an EF of 0.82 in a four person home in Indianapolis would be:

$$\Delta\text{MMBtu} = GPD * 365 * 8.3 * \frac{\Delta T}{1{,}000{,}000} * \left(\frac{1}{EF_{BASE}} - \frac{1}{EF_{EFF}}\right)$$

$$= 78 * 365 * 8.3 * \frac{140-58.1}{1{,}000{,}000} * \left(\frac{1}{0.594} - \frac{1}{0.82}\right) = 8.98\ \text{MMBtu}$$

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

Water Heater Wrap (Direct Install)

	Measure Details
Official Measure Code	Res-DHW-TankWrap-1
Measure Unit	Per wrap
Measure Category	Domestic hot water
Sector(s)	Residential
Annual Energy Savings (kWh)	79
Peak Demand Reduction (kW)	0.009
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	393
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	5
Incremental Cost	TBD
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is wrapping tank wrap or an insulation blanket around the outside of a hot water tank to reduce standby losses. This measure savings only apply to homes with an electric water heater that is not already well insulated. Generally this can be determined based on the appearance of the tank and whether it is insulated by foam (which is newer, rigid, and more effective) or fiberglass (which is older and gives to gently pressure).

Definition of Efficient Equipment

The efficient condition is properly installed insulating tank wrap that reduces standby energy losses from the tank to the surrounding ambient area.

Definition of Baseline Equipment

The baseline condition is a standard electric DHW tank without additional tank wrap. Natural gas storage water heaters are excluded due to the limitations of retrofit wrapping and the associated impacts on reduced savings and safety.

Deemed Lifetime of Efficient Equipment

The measure life is 5 years.[127]

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[127] This estimate is based on tank wrap being installed on an existing unit with 5 years of remaining life. On average when retrofitting an existing tank, the tank would be roughly halfway through its 13 to 15 year life, but qualifying baseline tanks with fiberglass (rather than foam insulation) are older on average by a few years.

Deemed Measure Cost

The incremental cost is the actual material cost of procuring and labor cost of installing the tank wrap.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

This calculation is based on the finding that a poorly insulated electric resistance water heater with a pre-wrap EF of 0.86 has a new and more effective EF of 0.88 after being properly wrapped with supplemental insulation. The impacts of waste heat on heating and cooling savings are not included.

Energy Savings

$$\Delta\text{kWh} = kWh_{BASE} * \frac{EF_{NEW} - EF_{BASE}}{EF_{NEW}}$$

Where:

kWh_{BASE} = Average kilowatt-hour consumption of electric DHW tank (= 3,460)[128]

EF_{NEW} = Assumed efficiency of electric tank with tank wrap installed (= 0.88)[129]

EF_{BASE} = Assumed efficiency of electric tank without tank wrap installed (= 0.86)

$$\Delta\text{kWh} = 3{,}460 * \frac{0.88 - 0.86}{0.88} = 79\ \text{kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW} = \frac{\Delta kWh}{8{,}760}$$

Where:

ΔkWh = Kilowatt-hour savings from tank wrap installation

8,760 = Number of hours in a year

$$\Delta\text{kW} = \frac{79}{8{,}760} = 0.009\ \text{kW}$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[128] U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy. *Residential Water Heaters Technical Support Document for the January 17, 2001, Final Rule.* DOE/EE-0317. Table 9.3.9, p. 9-34. May 2007. Available online: http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/09.pdf

[129] Oak Ridge National Laboratory. *Meeting the Challenge: The Prospect of Achieving 30 percent Energy Savings Through the Weatherization Assistance Program*. May 2002. Available online: http://www.cee1.org/eval/db_pdf/309.pdf. Study predicted that wrapping a 40-gallon water heater would increase the electric DHW tank energy factor by 0.02 (from 0.86 to 0.88).

Solar Water Heater with Electric Backup (Retrofit)

	Measure Details
Official Measure Code	Res-DHW-SWH-1
Measure Unit	Per system
Measure Category	Domestic hot water
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by project
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	20
Incremental Cost	$9,506.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing a new solar water heater system with electric backup meeting the SRCC OG-300 performance standards presented below. This measure relates to installing a new system in an existing home.

Definition of Efficient Equipment

The efficient equipment is an SRCC OG-300 certified solar water heater with a solar energy factor meeting the ENERGY STAR specification.

Definition of Baseline Equipment

The baseline equipment is a standard electric water heater meeting or exceeding the minimum energy factor set in the 2004 federal conservation standard for water heaters.

Deemed Lifetime of Efficient Equipment

The expected measure life is 20 years.[130]

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[130] ENERGY STAR. *Residential Water Heaters, Final Criteria Analysis.* Available online: http://www.energystar.gov/ia/partners/prod_development/new_specs/downloads/water_heaters/WaterHeaterDraftCriteriaAn alysis.pdf

Deemed Measure Cost

The cost for this measure is \$9,506.00.[131]

Deemed O&M Cost Adjustments

The deemed O&M cost adjustment for this measure is \$344.00.[132]

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = \left(\frac{1}{EF} - \frac{1}{SEF}\right) * Q_{DEL}$$

Where:

EF = Minimum energy factor for residential electric water heater (= 0.96 - (0.003 * Rated Storage Volume in gallons) = 0.945 for 50-gallon residential tank)[133]

SEF = Minimum system performance for solar water heaters (= actual)[134]

Q_{DEL} = Annual energy delivered to hot water load ($= 23{,}470 * (135 - T_{IN}) * \frac{8.3}{3{,}412}$)

Where:

23,470 = Average gallons of water drawn per year, assuming 365 days per year operation[135]

135 = Average hot water supply temperature [136]

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[131] Green Energy Ohio. “GEO Solar Thermal Rebate Program.” http://www.greenenergyohio.org/page.cfm?pageID=2712. The average cost of a fully installed solar thermal system is \$9,506, ranging from \$6,825 to \$11,850.

[132] Vermont Energy Investment Corporation. *Appendix 2 APS-Incentives for Photovoltaic Distributed Generation*. 2010. This value reflects the net present value of future costs including glycol, pump, and tank replacement. Because this retrofit measure replaces an existing water tank with some years remaining, this net present value conservatively overstates the O&M costs to the degree that the existing tank would have required replacement a few years earlier.

[133] 2015 Federal Energy Conservation Standard for water heaters (e-CFR Title 10, Chapter II, Subchapter D, Part 430, Subpart C, Section 430.32).

[134] Based on SRCC annual system performance rating for solar water heaters (OG-300 7/28/2010). ENERGY STAR specifications require a solar fraction greater than 0.5, which equates to a minimum solar energy factor of 1.8.

[135] Based on U.S. DOE and SRCC test procedure assumptions.

[136] Based on U.S. DOE and SRCC test procedure assumptions.

T_{IN} = Average cold water entering home (= depending on location; see table below)

Average Cold Water Temperature Entering Home by City*

City	Groundwater Temperature (°F)
Indianapolis	58.1
South Bend	57.4
Terre Haute	60.5
Evansville	62.8
Ft Wayne	55.6

* Burch, J. and C. Christensen, National Renewable Energy Lab. White paper: “Towards Development of an Algorithm for Mains Water Temperature.” Prepared for American Solar Energy Society. 2007.

8.3 = Specific weight of water in pounds per gallon, multiplied by the specific heat of water (1.0 $\frac{Btu}{lb*°F}$)

3,412 = Conversion constant (1 kWh = 3,412 Btu)

For example, the energy savings from installing a solar water heater system with solar EF rating of 1.8 in Indianapolis would be:

$$\Delta kWh = \left(\frac{1}{0.945} - \frac{1}{1.8}\right) * 23{,}470 * (135 - 58.1) * \frac{8.3}{3{,}412} = 2{,}207 \text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta kW = \frac{1}{EF} * \frac{Q_{DEL}}{Hours} * CF$$

Where:

Hours = Equivalent full load hours of water heater (= 2,533)[137]

CF = Summer peak coincidence factor for measure (= 0.203)[138]

For example, the demand reduction from installing a solar water heater system with solar EF rating of 1.8 in Indianapolis would be:

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[137] Efficiency Vermont. Load shape calculated from Itron eShapes.

[138] Calculated from Itron eShapes, which has 8,760 hourly data by end use for Upstate New York.

$$\Delta \text{kW} = \frac{1}{0.945} * \frac{23{,}470 * (135 - 58.1) * \frac{8.3}{3{,}412}}{2{,}533} * 0.203 = 0.372\ kW$$[139]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[139] The resultant demand reduction from the Itron eShapes is consistent with the results of the ADM whitepaper for FirstEnergy's solar water heater program in Pennsylvania, in which the demand reduction is based on the system being designed to meet 100% of a home's hot water need during the summer months and is the product of two factors: (1) the annual baseline energy usage of an electric water heater and (2) the fraction of energy usage during the coincident peak times of 3:00 p.m. to 6:00 p.m. during the months of June thru August. The fractional usage was calculated from: PJM. *Deemed Savings Estimates for Legacy Air Conditioning and Water Heating Direct Load Control Programs in PJM Region*. Available online: http://www.pjm.com/~/media/committees-groups/working-groups/lrwg/20070301/20070301-pjm-deemed-savings- report.ashx

HVAC

Residential HVAC Maintenance/Tune-Up (Retrofit)

	Measure Details
Official Measure Code	Res-HVAC-AC/Furn Tuneup-1
Measure Unit	Per tune-up
Measure Category	HVAC
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by location
Peak Demand Reduction (kW)	Varies by location
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by location
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	5
Incremental Cost	$64.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is (1) measuring refrigerant charge levels and airflow over the central air conditioning or heat pump unit coil, (2) correcting any problems found, and (3) re-measuring the levels and airflow post-treatment. Measurements must be performed with standard industry tools and the results tracked by the efficiency program.

Savings from this measure are based on a reputable Wisconsin study. It is recommended that future evaluation be conducted in Indiana to generate a more locally appropriate characterization.

Definition of Efficient Equipment

The efficient condition is measuring, correcting, and verifying the refrigerant charge levels and airflow over the central air conditioning or heat pump unit coil.

Definition of Baseline Equipment

The measure savings are based on the existing unit being regularly maintained being either a residential central air conditioning unit or an air-source heat pump.

Deemed Lifetime of Efficient Equipment

The measure life is 5 years.[140]

Deemed Measure Cost

If the implementation mechanism involves delivering and paying for the tune-up service, the actual cost should be used. If the customer receives a rebate and the private contractors perform the work, the measure cost is $64.00.[141]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \mathrm{kWh}_{CAC} = EFLH_{COOL} * Btuh_{COOL} * \frac{1}{SEER_{CAC} * 1{,}000} * MF_E$$

$$\Delta \mathrm{kWh}_{ASHP} = \left(EFLH_{COOL} * Btuh_{COOL} * \frac{1}{SEER_{ASHP}} + EFLH_{HEAT} * Btuh_{HEAT} * \frac{1}{HSPF_{ASHP}}\right) * \frac{MF_E}{1{,}000}$$

Where:

$EFLH_{COOL}$ = Equivalent full load cooling hours (= dependent on location; see table below)

Equivalent Full Load Cooling Hours by City

Location	$EFLH_{COOL}$*
Indianapolis	487
South Bend	431
Evansville	600
Ft. Wayne	373
Terre Haute	569

* Based on prototypical building simulations. See Appendix A.

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[140] GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures* June 2007.

[141] A survey of Dayton-area HVAC contractors revealed inspection and tune-up cost of $160.00. Given that inspection costs are $96.00, the tune-up cost is $64.00.

$\text{Btuh}_{\text{COOL}}$ = Cooling capacity of equipment in Btuh (= actual; otherwise = 28,994 Btuh;[142] Note: 1 ton = 12,000 Btuh)

SEER_{CAC} = SEER efficiency of existing central air conditioning unit receiving maintenance (= actual; otherwise use 11.15)[143]

1,000 = Conversion from Wh to kWh

MF_{E} = Maintenance energy savings factor (= 0.05)[144]

$\text{SEER}_{\text{ASHP}}$ = SEER efficiency of existing air-source heat pump unit receiving maintenance (= actual; otherwise use 11.15)[145]

$\text{EFLH}_{\text{HEAT}}$ = Equivalent full load heating hours (= actual; dependent on location, see table below)

Equivalent Full Load Heating Hours by City

Location	$\text{EFLH}_{\text{HEAT}}$*
Indianapolis	1,341
South Bend	1,427
Evansville	982
Ft. Wayne	1,356
Terre Haute	804

* Extracted from simulations. See Appendix B.

$\text{Btuh}_{\text{HEAT}}$ = Heating capacity of equipment in Btuh (= actual)

$\text{HSPF}_{\text{BASE}}$ = Heating season performance factor of existing air-source heat pump unit receiving maintenance (= actual; otherwise use 6.8)[146]

For example, the energy savings from conducting maintenance on a 3-ton, SEER 10 air conditioning unit in Indianapolis would be:

$$\Delta \text{kWh}_{\text{CAC}} = 487 * 36{,}000 * \frac{1}{10 * 1{,}000} * 0.05 = 88 \text{ kWh}$$

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[142] TecMarket Works, et al. *Residential Baseline Report Final*. November 2, 2012. Prepared for the Indiana Demand Side Management Coordination Committee Core Programs

[143] Ibid.

[144] Energy Center of Wisconsin. *Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research*. May 2008. Note: the MF_{E} for heat pumps is set to the MF_{E} for air conditioners, pending EM&V review.

[145] TecMarket Works, et al. *Residential Baseline Report Final*. November 2, 2012. Prepared for the Indiana Demand Side Management Coordination Committee Core Programs

[146] This was the minimum federal standard between 1992 and 2006.

For example, the energy savings from conducting maintenance on a 3-ton (cooling and heating) , SEER 10, HSPF 6.8 air-source heat pump unit in Indianapolis would be:

$$\Delta \text{kWh}_{\text{ASHP}} = \frac{487 * 36{,}000 * \frac{1}{10}}{1{,}000} * 0.05 + 1{,}341 * 36{,}000 * \frac{1}{6.8 * 1{,}000} * 0.05 = 443 \text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = Btuh_{COOL} * \frac{1}{EER * 1{,}000} * MF_D * CF$$

Where:

EER = EER efficiency of existing unit receiving maintenance (= actual; otherwise calculate using SEER * 0.9)

MF_D = Maintenance demand reduction factor (= 0.05)[147]

CF = Summer peak coincidence factor (= 0.88)[148]

For example, the demand reduction from conducting maintenance on 3-ton, SEER 10 (equals EER 9.0) unit would be:

$$\Delta \text{kW} = 36{,}000 * \frac{1}{9.0 * 1{,}000} * 0.05 * 0.88 = 0.176 \text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[147] Data are sparse for this parameter. Set equal to MF_E, subject to EM&V review.

[148] Duke Energy. Data for residential AC loads.

Residential Boiler Tune-Up

	Measure Details
Official Measure Code	Res-HVAC-Boiler Tuneup-1
Measure Unit	Per tune-up
Measure Category	HVAC
Sector(s)	Residential
Annual Energy Savings (kWh)	0
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	Varies by location
Lifetime Energy Savings (kWh)	0
Lifetime Fossil Fuel Savings (MMBtu)	Varies by location
Water Savings (gal/yr)	0
Effective Useful Life (years)	5
Incremental Cost	$140.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the tune-up of an existing residential boiler to improve the seasonal heating efficiency.

Definition of Efficient Equipment

The efficient condition is the boiler after a tune up is performed.

Definition of Baseline Equipment

The baseline condition is the existing boiler before a tune up.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 5 years.

Deemed Measure Cost

The incremental cost for this measure is $140.00 per boiler.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

There are no expected energy savings associated with this measure.

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.

Fossil Fuel Impact Descriptions and Calculation

$$\text{Annual MMBtu Savings } = EFLH_{HEAT} * Btuh * ESF * 10^{-6}$$

Where:

Btuh = Size of equipment in Btuh input capacity (= actual; otherwise = 77,386)[149]

$EFLH_{HEAT}$ = Equivalent full load heating hours (= dependent on location; see table below)

Equivalent Full Load Heating Hours by City

Location	$EFLH_{HEAT}$*
Indianapolis	1,341
South Bend	1,427
Evansville	982
Ft. Wayne	1,356
Terre Haute	804

* Heating EFLH extracted from simulations. See Appendix B.

ESF = Energy savings factor (= 0.05)[150]

For example, the fossil fuel savings from tuning up a 100 kBtu/hr boiler installed in Indianapolis would be:

$$\text{Annual MMBtu Savings} = EFLH_{HEAT} * BtuH * ESF * 10^{-6} = 1{,}341 * 100{,}000 * 0.05 * 10^{-6}$$
$$= 6.7 \text{ MMBtu per year}$$

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[149] TecMarket Works, et al. *Residential Baseline Report Final*. November 2, 2012. Prepared for the Indiana Demand Side Management Coordination Committee Core Programs

[150] *Michigan Efficiency Measures Database*. Report uses energy savings of 5% for residential boiler tune ups.

Central Air Conditioning (Early Replacement)

	Measure Details
Official Measure Code	Res-HVAC-AC-ER-1
Measure Unit	Per unit
Measure Category	HVAC
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by location
Peak Demand Reduction (kW)	Varies by location
Annual Fossil Fuel Savings (MMBtu)	Varies by location
Lifetime Energy Savings (kWh)	Varies by location
Lifetime Fossil Fuel Savings (MMBtu)	Varies by location
Water Savings (gal/yr)	0
Effective Useful Life (years)	18
Incremental Cost	Varies by location
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the early removal of an existing inefficient central air conditioning unit from service, prior to its natural end of life, and replacing with a new ENERGY STAR-qualifying unit. Savings are calculated between the existing unit and efficient unit consumption during the remaining life of the existing unit, and between the new baseline unit and efficient unit consumption for the remainder of the measure life.

Definition of Efficient Equipment

The efficient equipment is a ducted, split central air conditioning unit meeting the minimum ENERGY STAR efficiency level standards of 14.5 SEER and 12 EER.

Definition of Baseline Equipment

The baseline condition is the existing inefficient central air conditioning unit for the remaining assumed useful life of the unit, then for the remainder of the measure life the baseline becomes a new replacement unit meeting the minimum federal efficiency standard of 13 SEER and 11 EER.

Deemed Lifetime of Efficient Equipment

The expected measure life is 18 years.[151]

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[151] GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

The assumed remaining useful life of the existing central air conditioning unit being replaced is 5 years.[152]

Deemed Measure Cost

The actual measure cost for removing the existing unit and installing the new should be used.

Deemed O&M Cost Adjustments

The net present value of the deferred replacement cost (the cost associated with replacing the existing unit with a standard unit that would have had to have occurred after 5 years, had the existing unit not been replaced) should be calculated as: Actual Cost of ENERGY STAR unit - incremental cost of ENERGY STAR unit over baseline unit (depending on SEER; see table below)[153] * 63%.[154]

Deemed O&M Cost Adjustments per Ton by SEER

Efficiency Level	Cost per Ton
SEER 14	$119
SEER 15	$238
SEER 16	$357
SEER 17	$476
SEER 18	$596
SEER 19	$715
SEER 20	$834
SEER 21	$908

Savings Algorithm

Energy Savings

ΔkWh for remaining life of existing unit (first 5 years) = $EFLH_{COOL} * Btuh * \frac{\frac{1}{SEER_{EXIST}} - \frac{1}{SEER_{EE}}}{1,000}$

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[152] This value is a parameter estimate.

[153] California Public Utilities Commission. *Database for Energy Efficient Resources.* 2008. Available online: www.deeresources.com.

[154] This 63% is the ratio of the net present value (with a 5% discount rate) of the annuity payments from years 6 to 18 of a deferred replacement of a standard efficiency unit costing $2,857.00, divided by the standard efficiency unit cost ($2,857.00). This way of calculating savings allows for using the known ENERGY STAR replacement cost to calculate an appropriate baseline replacement cost. The standard unit cost based on: ENERGY STAR. "Central Air Conditioning Calculator." http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_CAC.xls

ΔkWh for remaining measure life (next 13 years) = $EFLH_{COOL} * Btuh * \frac{\frac{1}{SEER_{BASE}} - \frac{1}{SEER_{EE}}}{1,000}$

Where:

$EFLH_{COOL}$ = Equivalent full load cooling hours (= dependent on location; see table below)

Equivalent Full Load Cooling Hours by City

Location	$EFLH_{COOL}$*
Indianapolis	487
South Bend	431
Evansville	600
Ft. Wayne	373
Terre Haute	569

* Based on prototypical building simulations. See Appendix A.

Btuh = Size of equipment in Btuh (= actual; otherwise assume 28,994;[155] note: 1 ton = 12,000 Btuh)

$SEER_{EXIST}$ = Seasonal average efficiency of existing unit (= actual; otherwise assume 11.15)[156]

$SEER_{EE}$ = SEER efficiency of ENERGY STAR unit (= actual)

$SEER_{BASE}$ = SEER efficiency of baseline unit (= 13)[157]

For example, the energy savings from replacing a 3-ton, SEER 10 unit with a new SEER 14.5 unit in Indianapolis would be:

ΔkWh for remaining life of existing unit (first 5 years) =$487 * 36,000 * \frac{\frac{1}{10} - \frac{1}{14.5}}{1,000}$ = 544 kWh

ΔkWh for remaining measure life (next 13 years) = $487 * 36,000 * \frac{\frac{1}{13} - \frac{1}{14.5}}{1,000}$ = 139.5 kWh

Summer Peak Coincident Demand Reduction

ΔkW for remaining life of existing unit (first 5 years) = $Btuh * \frac{\frac{1}{EER_{EXIST}} - \frac{1}{EER_{EE}}}{1,000} * CF$

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[155] TecMarket Works, et al. *Residential Baseline Report Final*. November 2, 2012. Prepared for the Indiana Demand Side Management Coordination Committee Core Programs

[156] Ibid.

[157] This value reflects the minimum federal standard.

$$\Delta\text{kW for remaining measure life (next 13 years)} = Btuh * \frac{\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}}{1{,}000} * CF$$

Where:

EER_{EXIST} = EER efficiency of existing unit (= actual; otherwise calculate as SEER * 0.9)

EER_{BASE} = EER efficiency of baseline unit (= 11)[158]

EER_{EE} = EER efficiency of ENERGY STAR unit (= actual)

CF = Summer peak coincidence factor (= 0.88)[159]

For example, the demand reduction from replacing a 3-ton, SEER 10 unit (EER 9) with a new SEER 14.5, EER 12 unit in Indianapolis would be:

$$\Delta\text{kW for remaining life of existing unit (first 5 years)} = 36{,}000 * \frac{\frac{1}{9} - \frac{1}{12}}{1{,}000} * 0.88 = 0.88\text{ kW}$$

$$\Delta\text{kW for remaining measure life (next 13 years)} = 36{,}000 * \frac{\frac{1}{11} - \frac{1}{12}}{1{,}000} * 0.88 = 0.24\text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[158] Ibid.

[159] Duke Energy load shape data for residential AC loads from: Integral Analytics, Inc. DSMore cost-effectiveness tool. Available online: www.integralanalytics.com

Central Air Conditioning (Time of Sale)

	Measure Details
Official Measure Code	Res-HVAC-AC-1
Measure Unit	Per unit
Measure Category	HVAC
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by location
Peak Demand Reduction (kW)	Varies by location
Annual Fossil Fuel Savings (MMBtu)	Varies by location
Lifetime Energy Savings (kWh)	Varies by location
Lifetime Fossil Fuel Savings (MMBtu)	Varies by location
Water Savings (gal/yr)	0
Effective Useful Life (years)	18
Incremental Cost	Varies by location
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is replacing a central air conditioning unit with a new ENERGY STAR-qualifying unit. Savings are calculated between a new baseline unit and an efficient unit.

Definition of Efficient Equipment

The efficient equipment is a ducted, split central air conditioning unit meeting the minimum ENERGY STAR efficiency level standards of 14.5 SEER and 12 EER.

Definition of Baseline Equipment

The baseline condition is a new replacement unit meeting the minimum federal efficiency standard of 13 SEER and 11 EER.

Deemed Lifetime of Efficient Equipment

The expected measure life is 18 years.[160]

Deemed Measure Cost

The incremental measure cost between a new baseline unit and the efficient unit should be used; see table below.

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[160] GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

Deemed Incremental Measure Cost per Ton by SEER

Efficiency Level	Incremental Cost per Ton
SEER 14	$119
SEER 15	$238
SEER 16	$357
SEER 17	$476
SEER 18	$596
SEER 19	$715
SEER 20	$834
SEER 21	$908

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = EFLH_{COOL} * Btuh * \frac{\frac{1}{SEER_{BASE}} - \frac{1}{SEER_{EE}}}{1{,}000}$$

Where:

$EFLH_{COOL}$ = Equivalent full load cooling hours (= dependent on location; see table below)

Equivalent Full Load Cooling Hours by City

Location	$EFLH_{COOL}$*
Indianapolis	487
South Bend	431
Evansville	600
Ft. Wayne	373
Terre Haute	569

* Based on prototypical building simulations. See Appendix A.

Btuh = Size of equipment in Btuh (= actual; otherwise assume 28,994;[161] note: 1 ton = 12,000 Btuh)

$SEER_{EE}$ = SEER efficiency of ENERGY STAR unit (= actual)

$SEER_{BASE}$ = SEER efficiency of baseline unit (= 13)[162]

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[161] TecMarket Works, et al. *Residential Baseline Report Final*. November 2, 2012. Prepared for the Indiana Demand Side Management Coordination Committee Core Programs

[162] This value reflects the minimum federal standard.

For example, the energy savings from installing a new 3-ton, SEER 14.5 unit in Indianapolis would be:

$$\Delta\text{kWh} = 487 * 36{,}000 * \frac{\frac{1}{13} - \frac{1}{14.5}}{1{,}000} = 140 \text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW} = BtuH * \frac{\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}}{1{,}000} * CF$$

Where:

EER_{BASE} = EER efficiency of baseline unit (= 11)[163]

EER_{EE} = EER efficiency of ENERGY STAR unit (= actual)

CF = Summer peak coincidence factor (= 0.88)[164]

For example, the demand reduction from installing a new 3-ton, SEER 14.5, EER 12 unit in Indianapolis would be:

$$\Delta\text{kW} = 36{,}000 * \frac{\frac{1}{11} - \frac{1}{12}}{1{,}000} * 0.88 = 0.220 \text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[163] Ibid.

[164] Duke Energy load shape data for residential AC loads from: Integral Analytics, Inc. DSMore cost-effectiveness tool. Available online: www.integralanalytics.com

Central Air Source Heat Pump (Early Replacement)

	Measure Details
Official Measure Code	Res-HVAC-ASHP-ER-1
Measure Unit	Per unit
Measure Category	HVAC
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by location
Peak Demand Reduction (kW)	Varies by location
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by location
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	18
Incremental Cost	Varies by location
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the early removal of an existing inefficient central heat pump unit from service, prior to its natural end of life, and replacing with a new ENERGY STAR-qualifying unit. Savings are calculated between the existing unit and efficient unit consumption during the remaining life of the existing unit, and between the new baseline unit and efficient unit consumption for the remainder of the measure life.

Definition of Efficient Equipment

The efficient equipment is a ducted, split central heat pump unit meeting the minimum ENERGY STAR efficiency level standards of 14.5 SEER, 12 EER, and 8.2 HSPF.

Definition of Baseline Equipment

The baseline condition is the existing inefficient central heat pump unit for the remaining assumed useful life of the unit, then for the remainder of the measure life the baseline becomes a new replacement unit meeting the minimum federal efficiency standard of 13 SEER, 11 EER, and 7.7 HSPF).

Deemed Lifetime of Efficient Equipment

The expected measure life is 18 years.[165]

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[165] GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

The assumed remaining useful life of the existing central heat pump unit being replaced is 5 years.[166]

Deemed Measure Cost

The actual measure cost for removing the existing unit and installing the new should be used.

Deemed O&M Cost Adjustments

The net present value of the deferred replacement cost (the cost associated with replacing the existing unit with a standard unit that would have occurred after 5 years, had the existing unit not been replaced) should be calculated as: Actual Cost of ENERGY STAR unit - incremental cost of ENERGY STAR unit over baseline unit (based on efficiency level; see table below)[167] * 63%.[168]

Deemed O&M Cost Adjustment per Ton by SEER Level

Efficiency Level	Cost per Ton
SEER 14	$137
SEER 15	$274
SEER 16	$411
SEER 17	$548
SEER 18	$685

Savings Algorithm

Energy Savings

ΔkWh for remaining life of existing unit (first 5 years) =

$$EFLH_{COOL} * Btuh_{COOL} * \frac{\frac{1}{SEER_{EXIST}} - \frac{1}{SEER_{EE}}}{1{,}000} + EFLH_{HEAT} * Btuh_{HEAT} * \frac{\frac{1}{HSPF_{EXIST}} - \frac{1}{HSPF_{EE}}}{1000}$$

ΔkWh for remaining measure life (next 13 years) =

$$FLH_{COOL} * Btuh_{COOL} * \frac{\frac{1}{SEER_{BASE}} - \frac{1}{SEER_{EE}}}{1{,}000} + EFLH_{HEAT} * Btuh_{HEAT} * \frac{\frac{1}{HSPF_{BASE}} - \frac{1}{HSPF_{EE}}}{1{,}000}$$

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[166] Ohio Technical Reference Manual.

[167] California Public Utilities Commission. *Database for Energy Efficient Resources.* 2008. Available online: www.deeresources.com.

[168] This 63% is the ratio of the net present value (with a 5% discount rate) of the annuity payments from years 6 to 18 of a deferred replacement of a standard efficiency unit costing $2,857.00, divided by the standard efficiency unit cost ($2,857.00). This way of calculating savings allows for using the known ENERGY STAR replacement cost to calculate an appropriate baseline replacement cost. The standard unit cost based on: ENERGY STAR. “Central Air Conditioning Calculator."

Where:

$EFLH_{COOL}$ = Equivalent full load cooling hours (= dependent on location; see table below)

Equivalent Full Load Cooling Hours by City

Location	$EFLH_{COOL}$*
Indianapolis	487
South Bend	431
Evansville	600
Ft. Wayne	373
Terre Haute	569

* Based on prototypical building simulations. See Appendix A.

$EFLH_{HEAT}$ = Equivalent full load heating hours (= dependent on location; see table below)

Equivalent Full Load Heating Hours by City

Location	$EFLH_{HEAT}$*
Indianapolis	1,341
South Bend	1,427
Evansville	982
Ft. Wayne	1,356
Terre Haute	804

* Heating EFLH extracted from simulations. See Appendix A.

$Btuh_{COOL}$ = Cooling capacity of equipment in Btu/hr (= actual; note: 1 ton = 12,000 Btuh)

$Btuh_{HEAT}$ = Heating capacity of equipment in Btu/hr (= actual)

$SEER_{EXIST}$ = Seasonal average efficiency of existing unit in SEER (= actual; otherwise assume 11.15)[169]

$SEER_{EE}$ = SEER efficiency of ENERGY STAR unit (= actual)

$SEER_{BASE}$ = SEER efficiency of baseline unit (= 13)[170]

$HSPF_{EXIST}$ = Heating seasonal performance factor of existing air-source heat pump (= actual)

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[169] TecMarket Works, et al. *Residential Baseline Report Final*. November 2, 2012. Prepared for the Indiana Demand Side Management Coordination Committee Core Programs

[170] This value reflects the minimum federal standard.

$HSPF_{EE}$ = Heating seasonal performance factor of efficient air-source heat pump (= actual installed)

$HSPF_{BASE}$ = Heating seasonal performance factor of baseline air-source heat pump (= 7.7)[171]

1,000 = Conversion from Wh to kWh

For example, the energy savings from replacing a 3-ton SEER 10, HSPF 7.2 unit with a new SEER 14.5, HSPF 8.7 unit in Indianapolis would be:

$$\Delta\text{kWh for remaining life of existing unit (first 5 years)} = 487 * 36{,}000 * \frac{\frac{1}{10}-\frac{1}{14.5}}{1{,}000} + 1{,}341 * \frac{36{,}000}{1{,}000} * \left(\frac{1}{7.2}-\frac{1}{8.7}\right) = 1{,}700\text{ kWh}$$

$$\Delta\text{kWh for remaining measure life (next 13 years)} = 487 * 36{,}000 * \frac{\frac{1}{13}-\frac{1}{14.5}}{1{,}000} + 1{,}341 * \frac{36{,}000}{1{,}000} * \left(\frac{1}{7.7}-\frac{1}{8.7}\right) = 860\text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW for remaining life of existing unit (first 5 years)} = Btuh_{COOL} * \frac{\frac{1}{EER_{EXIST}}-\frac{1}{EER_{EE}}}{1{,}000} * CF$$

$$\Delta\text{kW for remaining measure life (next 13 years)} = Btuh_{COOL} * \frac{\frac{1}{EER_{BASE}}-\frac{1}{EER_{EE}}}{1{,}000} * CF$$

Where:

EER_{EXIST} = EER efficiency of existing unit (= actual; = SEER * 0.9)[172]

EER_{BASE} = EER efficiency of baseline unit (= 11)[173]

EER_{EE} = EER efficiency of ENERGY STAR unit (= actual)

CF = Summer peak coincidence factor (= 0.88)[174]

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[171] Ibid.

[172] If SEER is unknown, use the default EER of (10 * 0.9) = 9.0. This calculation is based on a prior assessment of industry equipment efficiency ratings.

[173] This value reflects the minimum federal standard.

[174] Duke Energy load shape data for residential AC loads from: Integral Analytics, Inc. DSMore cost-effectiveness tool. Available online: www.integralanalytics.com

For example, the demand reduction from replacing a 3-ton, SEER 10 (EER 9) unit with a new SEER 14.5 (EER 12) unit in Indianapolis would be:

$$\Delta\text{kW for remaining life of existing unit (first 5 years)} = 36{,}000 * \frac{\frac{1}{9} - \frac{1}{12}}{1{,}000} * 0.88 = 0.88\text{ kW}$$

$$\Delta\text{kW for remaining measure life (next 13 years)} = 36{,}000 * \frac{\frac{1}{11} - \frac{1}{12}}{1{,}000} * 0.88 = 0.24\text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

Central Air Source Heat Pump (Time of Sale)

	Measure Details
Official Measure Code	Res-HVAC-ASHP-1
Measure Unit	Per unit
Measure Category	HVAC
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by location
Peak Demand Reduction (kW)	Varies by location
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by location
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	18
Incremental Cost	Varies by location
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the installation a new ENERGY STAR-qualifying unit. Savings are calculated between a new baseline unit and the efficient unit.

Definition of Efficient Equipment

The efficient equipment is a ducted, split central heat pump unit meeting the minimum ENERGY STAR efficiency level standards of 14.5 SEER, 12 EER, and 8.2 HSPF.

Definition of Baseline Equipment

The baseline condition is a new replacement unit meeting the minimum federal efficiency standard of 13 SEER, 11 EER, and 7.7 HSPF.

Deemed Lifetime of Efficient Equipment

The expected measure life is 18 years.[175]

Deemed Measure Cost

The incremental measure cost of installing the new unit over the baseline unit should be used; see table below.

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[175] GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

Deemed Incremental Measure Cost by SEER

Efficiency Level	Incremental Cost per Ton
SEER 14	$137
SEER 15	$274
SEER 16	$411
SEER 17	$548
SEER 18	$685

Savings Algorithm

Energy Savings

$$\Delta kWh = \left(\frac{EFLH_{COOL}*Btuh_{COOL}}{1{,}000}\right)*\left(\frac{1}{SEER_{BASE}}-\frac{1}{SEER_{EE}}\right)+\left(\frac{EFLH_{HEAT}*Btuh_{HEAT}}{1{,}000}\right)*\left(\frac{1}{HSPF_{BASE}}-\frac{1}{HSPF_{EE}}\right)$$

Where:

$EFLH_{COOL}$ = Equivalent full load cooling hours (= dependent on location; see table below)

Equivalent Full Load Cooling Hours by City

Location	$EFLH_{COOL}$*
Indianapolis	487
South Bend	431
Evansville	600
Ft. Wayne	373
Terre Haute	569

* Based on prototypical building simulations. See Appendix A.

$EFLH_{HEAT}$ = Equivalent full load heating hours (= actual; dependent on location, see table below)

Equivalent Full Load Heating Hours by City

Location	$EFLH_{HEAT}$*
Indianapolis	1,341
South Bend	1,427
Evansville	982
Ft. Wayne	1,356
Terre Haute	804

* Heating EFLH extracted from simulations. See Appendix A.

$Btuh_{COOL}$ = Cooling capacity of equipment in Btuh (= actual; note: 1 ton = 12,000 Btuh)

$Btuh_{HEAT}$ = Heating capacity of equipment in Btuh (= actual)

$SEER_{EE}$ = SEER efficiency of ENERGY STAR unit (= actual)

$SEER_{BASE}$ = SEER efficiency of baseline unit (= 13)[176]

$HSPF_{EE}$ = Heating seasonal performance factor of efficient air-source heat pump (= actual)

$HSPF_{BASE}$ = Heating sseasonal performance factor of baseline air-source heat pump (= 7.7)[177]

For example, the energy savings from installing a new SEER 14.5, HSPF 8.7, 3-ton unit in Indianapolis would be:

$$\Delta \text{kWh} = 487 * 36{,}000 * \frac{\frac{1}{13} - \frac{1}{14.5}}{1{,}000} + 1{,}341 * \frac{36{,}000}{1{,}000} * \left(\frac{1}{7.7} - \frac{1}{8.7}\right) = 860 \text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = Btuh_{COOL} * \frac{\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}}{1{,}000} * CF$$

Where:

EER_{BASE} = EER efficiency of baseline unit (= 11)[178]

EER_{EE} = EER efficiency of ENERGY STAR unit (= actual)

CF = Summer peak coincidence factor (= 0.88)[179]

For example, the demand reduction from installing a new SEER 14.5, EER 12 unit in Indianapolis would be:

$$\Delta \text{kW} = 36{,}000 * \frac{\frac{1}{11} - \frac{1}{12}}{1{,}000} * 0.88 = 0.24 \text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[176] This value reflect the minimum federal standard.

[177] Ibid.

[178] Ibid.

[179] Roberts and Salcido, Architectural Energy Corporation. *Peak Electric Demand Calculations in the REM/Rate Home Energy Rating Software and REM/Design Home Energy Analysis Software*. February 2008. “This formulaic relationship was derived from 1,861 unique combinations of data, from nearly 200,000 ARI-rated residential central air conditioners.

Ground Source Heat Pumps (Time of Sale)

	Measure Details
Official Measure Code	Res-HVAC-GSHP-1
Measure Unit	Per unit
Measure Category	HVAC
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by location
Peak Demand Reduction (kW)	Varies by location
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by location
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	18
Incremental Cost	$3,609.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure in installing a new GSHP system meeting the ENERGY STAR efficiency standards presented in the table below. This measure relates to installing a new system in an existing home (i.e., time of sale).

ENERGY STAR Efficiency Standards for Ground-Source Heat Pumps

Product Type	EER	COP
Water-to-Air		
Closed Loop	17.1	3.6
Open Loop	21.1	4.1
Water-to-Water		
Closed Loop	16.1	3.1
Open Loop	20.1	3.5
DGX	16	3.6

Definition of Efficient Equipment

The efficient equipment is a GSHP meeting the minimum ENERGY STAR efficiency level standards effective at the time of installation, as detailed in the table above.

Definition of Baseline Equipment

The baseline equipment is an ASHP meeting the federal standard efficiency level of 13 SEER and 11 EER.

Deemed Lifetime of Efficient Equipment

The expected measure life is 18 years.[180]

Deemed Measure Cost

The actual installed cost of the GSHP should be used, minus the assumed installation cost of a 3-ton, standard baseline ASHP of $3,609.00.[181]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = \left(EFLH_{COOL} * Btuh_{COOL} * \frac{\frac{1}{SEER_{BASE}} - \frac{1}{EER_{EE} \; * \; 1.02}}{1{,}000} \right) + \left(EFLH_{HEAT} * Btuh_{HEAT} * \frac{\frac{1}{HSPF_{BASE}} - \frac{1}{COP_{EE} \; * \; 3.412}}{1{,}000} \right)$$

Where:

$EFLH_{COOL}$ = Equivalent full load cooling hours (= dependent on location; see table below)

Equivalent Full Load Cooling Hours by City

Location	$EFLH_{COOL}$*
Indianapolis	487
South Bend	431
Evansville	600
Ft. Wayne	373
Terre Haute	569

* Based on prototypical building simulations. See Appendix A.

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[180] GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

[181] California Public Utilities Commission. *Database for Energy Efficient Resources.* 2008. Available online: www.deeresources.com. The material cost of a 13 SEER air conditioner is $796.00 per ton, with a labor cost of $407.00 per ton. The cost for a 3-ton unit would be: (796 + 407) * 3 = $3,609.00.

$Btuh_{COOL}$ = Cooling capacity of equipment in Btuh (= actual; note: 1 ton = 12,000 Btuh)

$Btuh_{HEAT}$ = Heating capacity of equipment in Btuh (= actual)

$SEER_{BASE}$ = SEER efficiency of baseline unit (= 13)[182]

EER_{EE} = EER efficiency of efficient unit (= actual)

1.02 = Constant used to estimate the SEER based on the efficient unit EER[183]

$EFLH_{HEAT}$ = Equivalent full load heating hours (= actual; dependent on location, see table below)

Equivalent Full Load Heating Hours by City

Location	$EFLH_{HEAT}$*
Indianapolis	1,341
South Bend	1,427
Evansville	982
Ft. Wayne	1,356
Terre Haute	804

* Heating EFLH extracted from simulations. See Appendix A.

$HSPF_{BASE}$ = Heating season performance factor for baseline unit (= 7.7)[184]

COP_{ee} = Coefficient of Performance of efficient unit (= actual)

3.412 = Constant to convert the COP of the unit to the heating season performance factor

For example, the energy savings from installing a 3-ton heating and cooling unit with EER rating of 16 and COP of 3.5 in Indianapolis would be:

$$\Delta kWh = \left(487 * 36{,}000 * \frac{\frac{1}{13} - \frac{1}{16\ *\ 1.02}}{1{,}000}\right) + \left(1{,}341 * 36{,}000 * \frac{\frac{1}{7.7} - \frac{1}{3.5\ *\ 3.412}}{1{,}000}\right) = 2{,}501$$

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[182] This is the minimum federal standard from: Federal Register, Vol. 66, No. 14, Monday, January 22, 2001/Rules and Regulations. p. 7,170-7,200.

[183] Note that the EERs of GSHPs are measured differently than EERs of ASHP, as they are focused on entering water temperatures rather than ambient air temperatures. The equivalent SEER of a GSHP can be estimated by multiplying the EER by 1.02 (based on extrapolating manufacturer data).

[184] This is the minimum federal standard from: Federal Register, Vol. 66, No. 14, Monday, January 22, 2001/Rules and Regulations. p. 7,170-7,200.

Summer Peak Coincident Demand Reduction

$$\Delta kW = Btuh_{COOL} * \frac{\left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}\ *\ 1.02\ *\ 0.37\ +\ 6.43}\right)}{1{,}000} * CF$$

Where:

EER_{BASE} = EER efficiency of baseline unit (= 11)[185]

EER_{EE} = EER efficiency of ENERGY STAR unit (= actual)

1.02 = Constant used to estimate the unit's equivalent air conditioning SEER based on GSHP unit's EER.[186] This is then converted to the unit's equivalent air conditioning EER to enable comparisons to the baseline unit using the following algorithm: EER_{AC} = $(SEER\ *\ 0.37)\ +\ 6.43$[187]

CF = Summer peak coincidence factor (= 0.88)[188]

For example, a 3 ton unit with EER rating of 16:

$$\Delta kW = 36{,}000 * \frac{\frac{1}{11} - \frac{1}{16 * 1.02 * 0.37 + 6.43}}{1000} * 0.88 = 0.34\ kW$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[185] Ibid.

[186] Note that the EERs of GSHPs are measured differently than EERs of ASHP, as they are focused on entering water temperatures rather than ambient air temperatures. The equivalent SEER of a GSHP can be estimated by multiplying the EER by 1.02 (based on extrapolating manufacturer data).

[187] Roberts and Salcido, Architectural Energy Corporation. *Peak Electric Demand Calculations in the REM/Rate Home Energy Rating Software and REM/Design Home Energy Analysis Software*. February 2008. "This formulaic relationship was derived from 1,861 unique combinations of data, from nearly 200,000 ARI-rated residential central air conditioners.

[188] Duke Energy load shape data for residential AC loads from: Integral Analytics, Inc. DSMore cost-effectiveness tool. Available online: www.integralanalytics.com

Residential Electronically Commutated Motors

	Measure Details
Official Measure Code	Res-HVAC-ECMotor-1
Measure Unit	Per motor
Measure Category	HVAC
Sector(s)	Residential
Annual Energy Savings (kWh)	415
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	
Lifetime Fossil Fuel Savings (MMBtu)	
Water Savings (gal/yr)	0
Effective Useful Life (years)	10
Incremental Cost	$250.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing an electronically commutated motors on a natural gas furnace or heat pump supply fans. Energy savings and demand reduction are realized through reductions in fan power due to improved motor efficiency and variable flow operation.

Definition of Efficient Equipment

The efficient condition is installing an electronically commutated motor on a furnace or heat pump air handler fan.

Definition of Baseline Equipment

The baseline condition is a standard furnace or heat pump supply fan motor.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 10 years.

Deemed Measure Cost

The incremental cost for this measure is $250.00.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = 415 \text{ per furnace or air handler}$$

The deemed energy savings per electronically commutated motor furnace or air handler were originally based on a 2009 impact evaluation of these furnaces in Wisconsin.[189] The study findings were based on field measurements of furnaces with and without electronically commutated motors as well as on surveys with homeowners and contractors to determine homeowner behavior with respect to fan control strategies for electronically commutated motor furnaces. The study included details of cycling versus continuous fan operation in furnaces before and after installing a furnace with an electronically commutated motor. The 2015 publication of the Wisconsin Focus on Energy Technical Reference Manual[190] revised the deemed savings from this study to 415 kWh per year.

Summer Peak Coincident Demand Reduction

There is no summer peak coincident demand reduction from this measure.

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.[191]

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[189] PA Consulting Group. *ECM Furnace Impact Assessment Report.* January 12, 2009. https://focusonenergy.com/sites/default/files/emcfurnaceimpactassessment_evaluationreport.pdf

[190] The Cadmus Group, Inc. *Wisconsin Focus on Energy Technical Reference Manual.* January 2015. p. 338.

[191] Fossil fuel interactions are expected for this technology, but were not evaluated.

Wi-Fi Connected Smart Thermostats (Time of Sale, Direct Install)

	Measure Details
Official Measure Code	Res-HVAC-Tstat-1
Measure Unit	Per unit
Measure Category	HVAC
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by location
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	Varies by location
Lifetime Energy Savings (kWh)	Varies by location
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	15
Incremental Cost	$250.00
Important Comments	Assumes standard programmable thermostat as baseline
Effective Date	January 10, 2013
End Date	TBD

Description

Programmable thermostats can save energy through the advanced scheduling of time-of-day and/or day-of-week setbacks to control heating and cooling setpoints. In addition to these capabilities, Wi-Fi connected smart thermostats provide remote control and monitoring via a smartphone application or web portal. Smart thermostats also have the capacity to detect when the house is unoccupied, and can be set to automatically lower energy use without requiring active programming from the user. When the house in unoccupied, the smart thermostat will reduce the heating setpoint in the winter, and increase the cooling setpoint in the summer. As a result, smart thermostats optimize energy without the need for interaction from the user.

Definition of Efficient Equipment

The efficient condition is a Wi-Fi connected smart thermostat.

Definition of Baseline Equipment

The baseline condition is a standard, non-programmable thermostat for the central cooling and/or heating system (baseboard electric is excluded).

Deemed Lifetime of Efficient Equipment

The lifetime of this measure is 15 years.

Deemed Measure Cost

The incremental cost for purchasing a programmable thermostat has significant variation, but is typically around $250.00 (based on current retail market prices). Measures directly installed through retrofit programs should use the actual material and labor costs.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

The measure savings are based on a 2015 evaluation study[192] in Indiana that revealed the heating and cooling energy saving impacts of Wi-Fi connected smart thermostats on users with a manual thermostat as baseline, using large sample sizes and billing analyses.

Energy Savings

The cooling energy savings for homes with a central air conditioner would be:

$$\Delta\text{kWh} = \frac{1}{SEER} * EFLH_{COOL} * \frac{Btuh_{COOL}}{1{,}000} * ESF_{COOL}$$

Where:

SEER = Seasonal average energy efficiency ratio (Btu/watt-hour; = actual, otherwise based on year from table below)

SEER by Equipment Age

Age of Equipment	SEER Estimate
Before 2006	10
After 2006	11.15[193]

$EFLH_{COOL}$ = Equivalent full load cooling hours (= dependent on location; see table below)

Equivalent Full Load Cooling Hours by City

Location	$EFLH_{COOL}$*
Indianapolis	487
South Bend	431
Evansville	600
Ft. Wayne	373
Terre Haute	569

* Based on prototypical building simulations. See Appendix A.

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[192] Cadmus (Aarish, C., M. Perussi, A. Rietz, and D. Korn). *Evaluation of the 2013–2014 Programmable and Smart Thermostat Program.* Prepared for Northern Indiana Public Service Company and Vectren Corporation. 2015.

[193] TecMarket Works, et al. *Residential Baseline Report Final*. Prepared for the Indiana Demand Side Management Coordination Committee Core Programs. November 2, 2012.

$Btuh_{COOL}$= Cooling system capacity in Btu/hr (= actual; otherwise assume 28,994 Btuh)[194]

1,000 = Conversion from Wh to kWh

ESF_{COOL} = Cooling energy savings fraction (= 0.139)[195]

For example, the cooling savings in a home in Indianapolis with a 3-ton, 10 SEER heat pump would be:

$$\Delta\text{kWh} = \frac{1}{10} * 487 * \frac{36,000}{1,000} * 0.139 = 244 \text{ kWh}$$

The heating savings from that same home (which has a heat pump or electric furnace) would be:

$$\Delta\text{kWh} = EFLH_{HEAT} * \frac{Btuh_{HEAT}}{\eta_{HEAT} * 3,412} * ESF_{HEAT}$$

Where:

$EFLH_{HEAT}$ = Equivalent full load heating hours (= actual; dependent on location, see table below)

Equivalent Full Load Heating Hours by City

Location	$EFLH_{HEAT}$*
Indianapolis	1,341
South Bend	1,427
Evansville	982
Ft. Wayne	1,356
Terre Haute	804

* Heating EFLH extracted from simulations. See Appendix B.

$Btuh_{HEAT}$ = Heating capacity (output) of equipment in Btuh (= actual)[196]

η_{HEAT} = Efficiency in COP of heating equipment (= actual; otherwise depending on equipment age, see table below)

COP Estimates by System Type

System Type	Age of Equipment	HSPF Estimate	COP Estimate
Heat Pump	Before 2006	6.8	2.00
	After 2006	7.7	2.26

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[194] Ibid.

[195] Cadmus (Aarish, C., M. Perussi, A. Rietz, and D. Korn). *Evaluation of the 2013–2014 Programmable and Smart Thermostat Program.* Prepared for Northern Indiana Public Service Company and Vectren Corporation. 2015.

[196] TecMarket Works, et al. *Residential Baseline Report Final*. Prepared for the Indiana Demand Side Management Coordination Committee Core Programs. November 2, 2012.

Resistance	N/A	N/A	1.00

3,412 = Conversion from Btuh to kW

ESF_{HEAT} = Heating energy savings fraction (= 0.125)[197]

For example, the energy heating savings in a home in Indianapolis with 6.8 HSPF heat pump with 100,000 Btu/hr of heating capacity would be:

$$\Delta \text{kWh} = 1{,}341 * \frac{100{,}000}{2.0 * 3{,}412} * 0.125 = 2{,}456 \text{ kWh}$$

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.

Fossil Fuel Impact Descriptions and Calculation

$$\Delta \text{MMBtu} = FLH_{HEAT} * \frac{Btuh_{FF}}{1{,}000{,}000} * ESF_{HEAT}$$

Where:

$Btuh_{FF}$ = Heating capacity of fossil fuel equipment in Btuh (= actual; otherwise assume 77,386 Btuh)[198]

1,000,000 = Conversion from Btu to MMBtu

For example, the fossil fuel savings from a home in Indianapolis with a 100,000 Btu/hr, 84 AFUE natural gas furnace would be:

$$\Delta \text{MMBtu} = 1{,}341 * \frac{100{,}000}{1{,}000{,}000} * 0.125 = 16.763 \text{ MMBtu}$$

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[197] RLW Analytics. *Validating the Impact of Programmable Thermostats.* 2007.

[198] TecMarket Works, et al. *Residential Baseline Report Final*. Prepared for the Indiana Demand Side Management Coordination Committee Core Programs. November 2, 2012.

Condensing Furnaces-Residential (Time of Sale)

	Measure Details
Official Measure Code	Res-HVAC-Furn-1
Measure Unit	Per furnace
Measure Category	HVAC
Sector(s)	Residential
Annual Energy Savings (kWh)	0
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	Varies by location
Lifetime Energy Savings (kWh)	0
Lifetime Fossil Fuel Savings (MMBtu)	Varies by location
Water Savings (gal/yr)	0
Effective Useful Life (years)	15
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is a new, ENERGY STAR-qualified, high-efficiency natural gas-fired condensing furnace for residential space heating. High-efficiency features may include improved heat exchangers and modulating multi-stage burners.

Definition of Efficient Equipment

The efficient condition is a furnace with an AFUE rating ≥ 90% and with < 225,000 Btuh input energy.

Definition of Baseline Equipment

The baseline condition is a non-condensing furnace with the federal AFUE baseline of 78%.[199] A review of GAMA shipment data indicates that a more suitable market baseline is 80% AFUE.

Deemed Lifetime of Efficient Equipment

The lifetime of this measure is 15 years.[200]

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[199] Starting on November 19, 2015, savings should be based on using an 80% AFUE for residential furnaces (as indicated in the Electronic Code of Federal Regulations, Title 10, Chapter II, Subchapter D, Part 430, Subpart C, Section 430.32).

[200] http://www.cee1.org/resrc/facts/gs-ht-fx.pdf

Deemed Measure Cost

The incremental measure cost is based on the material cost alone, because the labor of the efficient measure is comparable to the labor cost of the baseline measure, and is dependent on the unit AFUE as outlined in the table below.[201]

Incremental Cost for Measure by AFUE

AFUE	Incremental Cost
90%	$325.68
92%	$379.96
94%	$856.59
96%	$910.87

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Savings are calculated using the difference in the amount of natural gas required based on the efficiency of the furnace and the average annual heating load. There is no change in the distribution system efficiency when the inclusion of a fan motor is assumed.

Energy Savings

There are no energy savings associated with this measure.

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.

Fossil Fuel Impact Descriptions and Calculation

$$\Delta\text{MMBtu} = EFLH_{HEAT} * Btuh * \left(\frac{AFUE_{EFF}}{AFUE_{BASE}} - 1\right) * 10^{-6}$$

Where:

$EFLH_{HEAT}$ = Equivalent full load heating hours (= actual; dependent on location, see table below)

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[201] Itron, Inc. *2010-2012 WO017 Ex Ante Measure Cost Study Final Report*. Submitted to the California Public Utilities Commission. May 27, 2014.

Equivalent Full Load Heating Hours by City

Location	$EFLH_{HEAT}$*
Indianapolis	1,341
South Bend	1,427
Evansville	982
Ft. Wayne	1,356
Terre Haute	804

* Heating EFLH extracted from simulations. See Appendix B.

Btuh = Size of equipment in Btuh input capacity (= actual)

$AFUE_{BASE}$ = Annual fuel utilization efficiency percentage of baseline equipment (= 0.80)

$AFUE_{EFF}$ = Annual fuel utilization efficiency percentage of efficient equipment (= actual)

10^{-6} = Conversion from Btu to MMBtu

For example, the fossil fuel savings from installing a 100,000 Btuh (input) furnace rated at 96 AFUE in Indianapolis would be:

$$\Delta MMBtu = 1{,}341 * 100{,}000 * \left(\frac{0.96}{0.80} - 1\right) * 10^{-6} = 26.820\ \mathrm{MMBtu}$$

Boilers (Time of Sale)

	Measure Details
Official Measure Code	Res-HVAC-Boiler-1
Measure Unit	Per unit
Measure Category	HVAC
Sector(s)	Residential
Annual Energy Savings (kWh)	0
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	Varies by location
Lifetime Energy Savings (kWh)	0
Lifetime Fossil Fuel Savings (MMBtu)	Varies by location
Water Savings (gal/yr)	0
Effective Useful Life (years)	18
Incremental Cost	Varies by location
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is a new, ENERGY STAR-qualified, high-efficiency natural gas-fired boiler installed for residential space heating.

Definition of Efficient Equipment

The efficient condition is a boiler with an AFUE rating ≥ 85% and with <300,000 Btuh energy input.

Definition of Baseline Equipment

The baseline condition is the federal standard AFUE for boilers of 80%.

Deemed Lifetime of Efficient Equipment

The lifetime of this measure is 18 years.[202]

Deemed Measure Cost

The incremental measure cost, based on materials and installation costs, are a function of the unit AFUE as outlined in the table below.[203]

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[202] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. "Appliance and Equipment Standards Program."
http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/fb_fr_tsd/appendix_e.pdf

[203] Ibid.

Incremental Cost for Measure by AFUE

AFUE	Incremental Cost
85-90	$216.00
≥91	$422.00

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Savings are calculated as the difference in required natural gas, based on the efficiency of the boiler and the average annual heating load. No changes in the distribution system efficiency (including circulator motor) are assumed.

Energy Savings

There are no energy savings associated with this measure.

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.

Fossil Fuel Impact Descriptions and Calculation

$$\Delta\text{MMBtu} = EFLH_{HEAT} * Btuh * \left(\frac{AFUE_{EFF}}{AFUE_{BASE}} - 1\right) * 10^{-6}$$

Where:

$EFLH_{HEAT}$ = Equivalent full load heating hours (= actual; dependent on location, see table below)

Equivalent Full Load Heating Hours by City

Location	$EFLH_{HEAT}$*
Indianapolis	1,341
South Bend	1,427
Evansville	982
Ft. Wayne	1,356
Terre Haute	804

* Heating EFLH extracted from simulations. See Appendix A.

Btuh = Size of new equipment in Btuh input capacity (= actual)

$AFUE_{BASE}$= Annual fuel utilization efficiency percentage of baseline equipment (= 0.80)

$AFUE_{EFF}$ = Annual fuel utilization efficiency percentage of efficient equipment (= actual)

For example: the fossil fuel savings from installing a 100,000 Btuh boiler rated at AFUE 85% in Indianapolis would be:

$$\Delta MMBtu = 1{,}341 * 100{,}000 * \left(\frac{0.85}{0.80} - 1\right) * 10^{-6} = 8.381\ MMBtu$$

Lighting

Residential ENERGY STAR Lighting (CFL and LED)

	Measure Details
Official Measure Code	Res-Ltg-CFL-TOS-1
Measure Unit	Per lamp
Measure Category	Lighting
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by program
Peak Demand Reduction (kW)	Varies by program
Annual Fossil Fuel Savings (MMBtu)	Varies by program
Lifetime Energy Savings (kWh)	Varies by program
Lifetime Fossil Fuel Savings (MMBtu)	Varies by program
Water Savings (gal/yr)	0
Effective Useful Life (years)	Varies by program
Incremental Cost	Varies by program
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

Compact Fluorescent Lamps Time-of-Sale

This measure is a low-wattage, ENERGY STAR-qualified CFL being purchased through a retail outlet in place of an incandescent screw-in bulb. The incremental cost of the CFL compared to the incandescent light bulb is offset via either a rebate or upstream markdowns. Assumptions are based on a time-of-sale purchase, not as retrofit or direct install.

The measure savings are based on the CFL being installed in a residential location. Where the implementation strategy does not allow for the installation location to be known, and absent verifiable evaluation data to support an appropriate residential versus commercial split, it is recommended to use this residential characterization for all purchases, leading to appropriately conservative savings assumptions.

Compact Fluorescent Lamps Direct Install (Early Replacement)

This measure is a low-wattage, ENERGY STAR-qualified CFL being installed by an auditor, contractor, or member of utility staff in a residential location in place of an existing incandescent screw-in bulb through a direct install program. The savings are based on protocols being implemented that guide the bulb installation to high-use locations. The CFL is provided at no cost to the end user.

Residential Light-Emitting Diode Lamps

This measure is a low-wattage, ENERGY STAR-qualified LED screw-in lamp being installed in place of an incandescent screw-in lamp. The incremental cost of the LED compared to the incandescent lamp is offset via either a rebate coupon or upstream markdowns.

Definition of Efficient Equipment

The high-efficiency equipment must be a standard ENERGY STAR-qualified CFL or LED.

Definition of Baseline Equipment

The baseline equipment is an incandescent light bulb, making adjustments to the baseline lamp wattage based on the Lifetime of the LED replacement lamp.

Deemed Lifetime of Efficient Equipment

The expected lifetime of CFLs is 5 years.[204] The expected lifetime of screw-in LED lamps is 15 years.

Deemed Measure Cost

Compact Fluorescent Lamps Time-of-Sale

The incremental cost for a time-of-sale CFL measure is $3.41.[205]

Compact Fluorescent Lamps Direct Install (Early Replacement)

The full cost for a direct-install (early replacement) CFL measure equals the actual cost for implementation and installation (i.e., the cost of the product and the labor for installation).

Residential Light-Emitting Diode Lamps

The incremental cost for a time-of-sale LED measure is $30.91.[206]

Deemed O&M Cost Adjustments

In order to account for the shift in baseline due to federal legislation, the levelized baseline replacement cost over the lifetime of the CFL is calculated using the key assumptions documented in the table below.

Replacement Cost and Component Life by Type of Bulb

	Standard Incandescent	Halogen
Replacement Cost	$0.50	$2.00
Component Life (years; based on lamp life / assumed annual run hours)	1	3

The calculated net present value of the baseline replacement costs based on CFL type is $4.52.

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[204] This value was calculated using the average rated CFL life of 10,000 hours, including a switching adjustment factor of 0.523 (10,000/1,040 * 0.523 = 5 years) from: California Public Utilities Commission. *Database for Energy Efficient Resources.* 2008. Available online: www.deeresources.com.

[205] Itron, Inc. *2010-2012 WO017 Ex Ante Measure Cost Study Final Report*. Submitted to the California Public Utilities Commission. May 27, 2014.

[206] Ibid.

Savings Algorithms for this Measure

Energy Savings

$$\Delta kWh = \left(\frac{\text{watts}_{BASE} - \text{watts}_{EFF}}{1{,}000}\right) * ISR * HOURS * (1 + WHF_E)$$

Where:

$\text{watts}_{\text{BASE}}$ = Wattage of baseline lamp (= actual; if missing, see table below for CFL[207] and LED wattage)[208]

$\text{watts}_{\text{EFF}}$ = Wattage of efficient lamp (= actual; if missing, see table below)

Efficient Technology	$\text{watts}_{\text{EFF}}$	$\text{watts}_{\text{BASE}}$
CFL	15W or less	3.05 * $\text{watts}_{\text{EFF}}$
	16W - 20W	3.00 * $\text{watts}_{\text{EFF}}$
	21W or more	3.06 * $\text{watts}_{\text{EFF}}$
LED	9W or less	3.38* $\text{watts}_{\text{EFF}}$
	10W – 17W	3.41 * $\text{watts}_{\text{EFF}}$
	18W or more	4.04 * $\text{watts}_{\text{EFF}}$

ISR = In-service rate, or percentage of rebated units that get installed (= use table below)

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[207] Duke Energy. *Ohio Residential Smart Saver CFL Program* June 2010. Average CFL is 15.47 watts, with average replacement incandescent bulb of 65.8 watts, for a ratio of 4.25 to 1. (note: the study only includes data from respondents who reported both the wattage removed and wattage replaced). Federal legislation stemming from EISA required that all general purpose light bulbs between 40 watts and 100 watts be approximately 30% more energy efficient than incandescent bulbs by 2014, in essence beginning the phase out of standard incandescent bulbs. $\text{Watts}_{\text{BASE}}$ was calculated by finding the new baseline after the incandescent bulb wattage was reduced (from 100 watts to 72 watts, 75 watts to 53 watts, 60 watts to 43 watts, and 40 watts to 29 watts). For example, an average CFL size replacing a 60-watt incandescent is 60/ (4.25) = 14.1 watts; so when the 60-watt incandescent is replaced by a 43-watt halogen, the multiplier is 43/14.1 = 3.05.

[208] U.S. Environmental Protection Agency. "ENERGY STAR-Certified Light Bulbs." http://www.energystar.gov/productfinder/product/certified-light-bulbs/results. EISA baseline adjustments made to the watts multiplier (which is based on weighted averages) according to lumen range requirements set by ENERGY STAR (https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Lamps%20V1%201_Specification.pdf). For example, a 100-watt equivalent bulb needs to output between 1,600 lumens and 1,999 lumens. The average LED in this lumen range is 17.8 watts, so the watts multiplier is 72/17.8 = 4.04.

In-Service Rate by Bulb Type

Program Type	ISR
CFL*	0.89
LED**	1.00

* Based on Duke Energy ISR data for direct install programs. Note: the ISR does not account for stored lamps that may be installed later, and assumes that uninstalled direct install lamps have been permanently removed.

** There is currently no research regarding LED ISR; therefore an ISR of 1.0 is assigned.

HOURS = Average hours of use per year (= based on program type; see table below)

Annual Hours of Use by Program Type*

Program Type	Annual Hours
Time of Sale	902
Direct Install	902
School Kit	1,135
Specialty Lighting	1,190
Multifamily Common Areas	5,950

* TecMarket Works, et al. *Indiana Core Lighting Logger Hours of Use (HOU) Study*. July 29, 2013. Annual hours of use for specialty bulbs and multifamily common areas are from: Illinois Technical Reference Manual, Version 4.0. 2015.

WHF_E = Waste heat factor for energy to account for HVAC interactions with efficient lighting (= depending on location; see table below)

Weighted Average Waste Heat Factors by City*

City	WHF_E	WHF_D	WHF_G
Indianapolis	-0.061	0.055	-0.0018
South Bend	-0.070	0.038	-0.0019
Evansville	-0.034	0.092	-0.0017
Ft Wayne	-0.082	0.038	-0.0019
Terre Haute	-0.048	0.061	-0.0018
Statewide	**-0.059**	**0.057**	**-0.0018**

* See Appendix B for supporting calculations.

For example, the energy savings from direct install 20-watt CFL using the statewide average for HVAC interactive effects would be:

$$\Delta kWh = \left(\frac{(3.00 * 20) - 20}{1{,}000}\right) * 0.89 * 902 * (1 - .059) \;= 30\; kWh$$

Summer Peak Coincident Demand Reduction

$$\Delta kW = \left(\frac{\text{watts}_{BASE} - \text{watts}_{EFF}}{1{,}000}\right) * \ ISR \ * \ (1 + WHF_D) \ * \ CF$$

Where:

WHF$_D$ = Waste heat factor for demand to account for HVAC interactions with efficient lighting (= depending on location; see table above)

CF = Summer peak coincidence factor (= 0.11)[209]

For example, the demand reduction from a direct install 10-watt LED in Indianapolis would be:

$$\Delta kW = \left(\frac{(3.41 * 10) - 10}{1{,}000}\right) * \ 1.0 * \ (1 + 0.055) \ * \ 0.11 \ = \ 0.003 \ kW$$

Fossil Fuel Impact Descriptions and Calculation

$$\Delta MMBtu_{WH} = \left(\frac{\text{watts}_{BASE} - \text{watts}_{EFF}}{1{,}000}\right) * \ ISR \ * \ HOURS \ * \ WHF_G$$

Where:

ΔMMBtu$_{WH}$ = Gross customer annual heating MMBtu fuel increased usage from the reduction in lighting heat

WHF$_G$ = Waste heat factor for fossil fuels to account for HVAC interactions with efficient lighting (= depending on location; see table above)

For example, the fossil fuel savings from a 20-watt, time-of-sale CFL in Terre Haute would be:

$$\Delta MMBtu_{WH} = \left(\frac{(3.00*20)-20}{1{,}000}\right) * \ 0.89 * \ 902 \ * \ -0.0018 = \ -0.058 \ MMBtu$$

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[209] Nexus Market Research, RLW Analytics, and GDS Associates. *New England Residential Lighting Markdown Impact Evaluation.* January 20, 2009.

LED Night Lights

	Measure Details
Official Measure Code	Res-Ltg-NiteLite-1
Measure Unit	Per night light
Measure Category	Lighting
Sector(s)	Residential
Annual Energy Savings (kWh)	14
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	224
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	16
Incremental Cost	$3.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is a night light with an LED light source replacing an incandescent night light.

Definition of Efficient Equipment

The efficient condition is an LED night light.

Definition of Baseline Equipment

The baseline condition is an incandescent night light.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 16 years.[210]

Deemed Measure Cost

The first cost for this measure is $3.00.[211]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

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[210] Franklin Energy Systems. *FES-L6a LED and Specialty Lighting – Residential*. Duke Energy work papers. July 1, 2010.

[211] Ibid.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = \frac{Watt_{BASE} - Watt_{LED}}{1{,}000} * ISR * Hours$$

Where:

$Watt_{BASE}$ = Wattage of incandescent night light (= 5)

$Watt_{LED}$ = Wattage of LED night light (= 0.33)

ISR = In-service rate, or percentage of rebated units that get installed (= 1.0)

HOURS = Average hours of use per year (= 2,920, or 8 hours per day)

LED night light savings are calculated as follows:

$$\Delta \text{kWh} = \frac{5 - 0.33}{1{,}000} * 1.0 * 2{,}920 = 14 \text{ kWh}$$

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

ENERGY STAR Torchiere (Time of Sale)

	Measure Details
Official Measure Code	Res-Ltg-Torchiere-1
Measure Unit	Per unit
Measure Category	Lighting
Sector(s)	Residential
Annual Energy Savings (kWh)	113
Peak Demand Reduction (kW)	0.008
Annual Fossil Fuel Savings (MMBtu)	-0.137
Lifetime Energy Savings (kWh)	791
Lifetime Fossil Fuel Savings (MMBtu)	-0.959
Water Savings (gal/yr)	0
Effective Useful Life (years)	7
Incremental Cost	$5.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is a high-efficiency ENERGY STAR fluorescent torchiere being purchased in place of a baseline mix of halogen and incandescent torchieres, then installed in a residential setting. The savings assumptions are based on a time-of-sale purchase, not as a retrofit or direct install installation.

Definition of Efficient Equipment

The efficient condition is a fluorescent torchiere that meets the ENERGY STAR efficiency standards.

Definition of Baseline Equipment

The baseline condition is a mix of halogen and incandescent torchieres.

Deemed Lifetime of Efficient Equipment

The lifetime of the measure is 7 years.[212]

Deemed Measure Cost

The incremental cost for this measure is $5.00.[213]

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[212] U.S. Environmental Protection Agency. ENERGY STAR value for this measure. Available online: www.energystar.gov.

[213] California Public Utilities Commission. *Database for Energy Efficient Resources.* 2008. Available online: www.deeresources.com; and Efficiency Vermont. *Technical Reference Manual*. August 9, 2013

Deemed O&M Cost Adjustments

The annual O&M cost adjustment savings is $2.52, based on the component costs and lifetimes shown in the table below.

Deemed Cost Adjustments*

	Efficient Measure		Baseline Measures	
Component	Cost	Life (years)	Cost	Life (years)
Lamp	$7.50	8.87**	$6.00	1.83***

* Efficiency Vermont. *Technical Reference Manual*. August 9, 2013.

** Calculated using the assumed 9,710 hour average rated life of ENERGY STAR CFL torchieres (9,710/1,095= 8.87 years; http://downloads.energystar.gov/bi/qplist/fixtures_prod_list.xls.

** Based on assumption of baseline bulb mix of incandescent and halogen having average rated life of 2,000 hours.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = \frac{\Delta Watts_{TORCH}}{1{,}000} * ISR * Hours * (1 + WHF_E)$$

Where:

$\Delta \text{Watts}_{\text{TORCH}}$ = Average delta watts per purchased ENERGY STAR torchiere (= 73)[214]

ISR = In-service rate, or percentage of units rebated that get installed (= 0.95)[215]

HOURS = Average hours of use per year (= 1,095, or 3 hours per day)[216]

WHF_E = Waste heat factor for energy to account for HVAC interactions with efficient lighting (= -0.059, the weighted average value across all HVAC systems and cities; see Appendix B)

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[214] Nexus Market Research. *Impact Evaluation of the Massachusetts, Rhode Island and Vermont 2003 Residential Lighting Programs*. Final Report. p. 43 (Table 4-9). October 1, 2004. Value adjusted to conform to EISA baseline reduction, and reduced delta watts multipliers to 63% in 2015.

[215] Nexus Market Research and RLW Analytics. *Impact Evaluation of the Massachusetts, Rhode Island, and Vermont 2003 Residential Lighting Programs*. Table 6-3 on page 63 indicates that 86% of torchieres were installed, and 9% more would be installed. Table 6-7 on page 67 indicates that no torchieres are purchased as spares, so savings are based on all bulbs being installed in first year.

[216] Nexus Market Research. *Impact Evaluation of the Massachusetts, Rhode Island and Vermont 2003 Residential Lighting Programs*. Final Report. p. 104 (Table 9-7). October 1, 2004.

For example, the energy savings from installing an ENERGY STAR torchiere using statewide average HVAC interactive effects would be:

$$\Delta \text{kWh} = \frac{73}{1{,}000} * 0.95 * 1{,}095 * (1 - 0.059) = 71 \text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = \frac{\Delta Watts_{TORCH}}{1{,}000} * ISR * (1 + WHF_D) * CF$$

Where:

WHF_D = Waste heat factor for demand to account for HVAC interactions with efficient lighting (= 0.057 as weighted average value across all HVAC systems and cities; see Appendix B)

CF = Summer peak coincidence factor (= 0.11)[217]

For example, the demand reduction from installing an ENERGY STAR torchiere using statewide average HVAC interactive effects would be:

$$\Delta \text{kW} = \frac{73}{1{,}000} * 0.95 * (1 + 0.057) * 0.11 = 0.008 \text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

$$\Delta \text{MMBtu}_{WH} = \frac{\Delta Watts_{TORCH}}{1{,}000} * ISR * Hours * WHF_G$$

Where:

ΔMMBtu_{WH} = Gross increase in customer annual heating MMBtu fuel usage from the reduction in lighting heat

WHF_G = Waste heat factor for fossil fuels to account for HVAC interactions with efficient lighting (= -0.0018 as weighted average value across all HVAC systems and cities; see Appendix B)

For example, the fossil fuel savings from installing an ENERGY STAR torchiere using statewide average HVAC interactive effects would be:

$$\Delta \text{MMBtu}_{WH} = \frac{73}{1{,}000} * 0.95 * 1{,}095 * -0.0018 = \text{- 0. 137 MMBtu}$$

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[217] Nexus Market Research, RLW Analytics, and GDS Associates. *New England Residential Lighting Markdown Impact Evaluation*. January 20, 2009.

Dedicated Pin Based Compact Fluorescent Lamp (CFL) Table Lamp (Time of Sale)

	Measure Details
Official Measure Code	Res-Ltg-CFLTable-1
Measure Unit	Per unit
Measure Category	Lighting
Sector(s)	Residential
Annual Energy Savings (kWh)	24
Peak Demand Reduction (kW)	0.003
Annual Fossil Fuel Savings (MMBtu)	-0.046
Lifetime Energy Savings (kWh)	192
Lifetime Fossil Fuel Savings (MMBtu)	-0.368
Water Savings (gal/yr)	0
Effective Useful Life (years)	8
Incremental Cost	$8.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is a dedicated, pin-based, low-wattage CFL table lamp being purchased through a retail outlet in place of an equivalent incandescent lamp. The incremental cost of the CFL lamp compared to an incandescent lamp is offset via either rebate coupons or upstream markdowns. Savings assumptions are based on a time-of-sale purchase, not as a retrofit or direct install installation, and based on the CFL being installed in a residential location.

Definition of Efficient Equipment

The high-efficiency equipment is a dedicated, pin-based, low-wattage CFL table lamp.

Definition of Baseline Equipment

The baseline equipment is an incandescent table lamp.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 8 years.[218]

Deemed Measure Cost

The incremental cost for this measure is $8.00.

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[218] GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

Deemed O&M Cost Adjustments

In order to account for the shift in baseline due to federal legislation, the levelized baseline replacement cost over the lifetime of the CFL is calculated using the key assumptions outlined in the table below.

Key Assumptions for Deemed Cost Adjustments

	Standard Incandescent	Halogen
Replacement Cost	$0.50	$2.00
Component Life (years, based on lamp life / assumed annual run hours)	1*	3

* Assumes a rated life for incandescent bulb of approximately 1,000 hours.

The calculated net present value of the baseline replacement costs based on CFLs is $4.97.

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = \frac{\Delta Watts}{1{,}000} * ISR * Hours * (1 + WHF_E)$$

Where:

ΔWatts = Difference in wattage between CFL and incandescent bulb (= 28.8)[219]

ISR = In-service rate, or percentage of units rebated that get installed (= 1.0)

HOURS = Average hours of use per year (= 901)[220]

WHF_E = Waste heat factor for energy to account for HVAC interactions with efficient lighting (=- 0.059 as weighted average value across all HVAC systems and cities; see Appendix B)

For example, the energy savings from installing a CFL table lamp using statewide average HVAC interactive effects would be:

$$\Delta\text{kWh} = \frac{28.8}{1{,}000} * 1.0 * 901 * (1 - 0.059) = 24\text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW} = \frac{\Delta Watts}{1{,}000} * ISR * (1 + WHF_D) * CF$$

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[219] RLW Analytics. *New England Residential Lighting Markdown Impact Evaluation*. January 20, 2009. Value adjusted to conform to the EISA baseline reduction. Delta watts multiplier reduced to 63% in 2015.

[220] Nexus Market Research, RLW Analytics, and GDS Associates. *New England Residential Lighting Markdown Impact Evaluation*. p. 50. January 20, 2009.

Where:

WHF_D = Waste heat factor for demand to account for HVAC interactions with efficient lighting (= 0.057 as weighted average value across all HVAC systems and cities; see Appendix B)

CF = Summer peak coincidence factor (= 0.11)[221]

For example, the demand reduction from installing a CFL table lamp using statewide average HVAC interactive effects would be:

$$\Delta\text{kW} = \frac{28.8}{1{,}000} * 1.0 * (1 + 0.057) * 0.11 = 0.003 \text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

$$\Delta\text{MMBtu}_{\text{WH}} = \frac{\Delta Watts}{1{,}000} * ISR * Hours * WHF_G$$

Where:

$\Delta\text{MMBtu}_{\text{WH}}$ = Gross increase in customer annual heating MMBtu fuel usage from the reduction in lighting heat

WHF_G = Waste heat factor for fossil fuels to account for HVAC interactions with efficient lighting (= -0.0018 as weighted average value across all HVAC systems and cities; see Appendix B)

For example, the fossil fuel savings from installing a CFL table lamp using statewide average HVAC interactive effects would be:

$$\Delta\text{MMBtu}_{\text{WH}} = \frac{28.8}{1{,}000} * 1.0 * 901 * -0.0018 = \text{- } 0.046 \text{ MMBtu}$$

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[221] Ibid.

Ceiling Fan with ENERGY STAR Light Fixture (Time of Sale)

	Measure Details
Official Measure Code	Res-Appl-CeilFan-1
Measure Unit	Per unit
Measure Category	Lighting/Appliances
Sector(s)	Residential
Annual Energy Savings (kWh)	108
Peak Demand Reduction (kW)	0.013
Annual Fossil Fuel Savings (MMBtu)	-0.194
Lifetime Energy Savings (kWh)	~1,080
Lifetime Fossil Fuel Savings (MMBtu)	~-1.94
Water Savings (gal/yr)	0
Effective Useful Life (years)	10
Incremental Cost	$86.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing an ENERGY STAR ceiling fan with a high-efficiency motor and CFLs in place of a standard fan with incandescent bulbs.

Definition of Efficient Equipment

The efficient equipment is an ENERGY STAR-certified ceiling fan with CFLs.

Definition of Baseline Equipment

The baseline equipment is a standard fan with incandescent bulbs.

Deemed Lifetime of Efficient Equipment

The measure life is 10 years.[222]

Deemed Measure Cost

The incremental cost for the ENERGY STAR ceiling fan is $86.00.[223]

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[222] U.S. Environmental Protection Agency. "ENERGY STAR Ceiling Fan Savings Calculator." http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Ceiling_Fan_Savings_Calculator_Consumer.xls

[223] Ibid.

Deemed O&M Cost Adjustments

In order to account for the shift in baseline due to federal legislation, the levelized baseline replacement cost over the lifetime of the CFL is calculated using the key assumptions shown in the table below.

Key Assumptions for Calculating Levelized Baseline Replacement Costs

	Standard Incandescent	Efficient Incandescent
Replacement Cost	\$0.50	\$2.00
Component Life (years, based on lamp life / assumed annual run hours)	1*	3

* Based on a rated life for incandescent bulb of approximately 1,000 hours.

The calculated net present value of the baseline replacement costs minus the CFL replacement cost (i.e., three bulbs) is \$7.45.

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = (\%low * (LowkW_{BASE} - LowkW_{EE}) + \%med * (MedkW_{BASE} - MedkW_{EE}) + \%high * (HighkW_{BASE} - HighkW_{EE})) * Hours_{FAN}) + (InckW - CFLkW) * Hours_{LIGHT} * (1 + WHF_{E})$$

Where:[224]

%low = Percentage of time on low speed (= 40%)

%med = Percentage of time on medium speed (= 40%)

%high = Percentage of time on high speed (= 20%)

$\text{LowWatt}_{\text{BASE}}$ = Low speed baseline ceiling fan wattage (= 0.0152 kW)

$\text{LowWatt}_{\text{EE}}$ = Low speed ENERGY STAR ceiling fan wattage (= 0.0117 kW)

$\text{MedWatt}_{\text{BASE}}$ = Medium speed baseline ceiling fan wattage (= 0.0348 kW)

$\text{MedWatt}_{\text{EE}}$ = Medium speed ENERGY STAR ceiling fan wattage (= 0.0314 kW)

$\text{HighWatt}_{\text{BASE}}$ = High speed baseline ceiling fan wattage (= 0.0725 kW)

$\text{HighWatt}_{\text{EE}}$ = High speed ENERGY STAR ceiling fan wattage (= 0.0715 kW)

$\text{HOURS}_{\text{FAN}}$ = Typical fan operating hours (= 1,022 at 2.8 hours per day)

InckW = Incandescent bulb kilowatts (= 0.129, assumes three 43-watt bulbs)

CFLkW = CFL kilowatts (= 0.042, assumes three 14-watt bulbs)

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[224] All data points (unless otherwise noted) came from: U.S. Environmental Protection Agency. "ENERGY STAR Ceiling Fan Savings Calculator." http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Ceiling_Fan_Savings_Calculator_Consumer.xls

$\text{HOURS}_{\text{LIGHT}}$ = Typical lighting operating hours (= 1,277.5 at 3.5 hours per day)

WHF_{E} = Waste heat factor for energy to account for HVAC interactions with efficient lighting (= -0.059 as weighted average value across all HVAC systems and cities; see Appendix B)

For example, the energy savings from installing an ENERGY STAR ceiling fan (using statewide average HVAC interactive effects) would be:

$$\Delta\text{kWh} = ((0.4 * (0.0152 - 0.0117) + 0.4 * (0.0348 - 0.0314) + 0.2 * (0.0725 - 0.0715)) * 1{,}022) + ((0.129 - 0.042) * 1{,}277.5 * (1 - 0.059)) = 108 \text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW} = \%low * (LowkW_{BASE} - LowkW_{EE}) + \%med * (MedkW_{BASE} - MedkW_{EE}) + \%high * (HighkW_{BASE} - HighkW_{EE}) + (InckW - CFLkW) * (1 + WHF_D) * CF$$

Where:

WHF_{D} = Waste heat factor for demand to account for HVAC interactions with efficient lighting (= 0.057 as weighted average across all HVAC systems and cities; see Appendix B)

CF = Summer peak coincidence factor (= 0.11)[225]

For example, the demand reduction from installing an ENERGY STAR ceiling fan (using statewide average HVAC interactive effects) would be:

$$\Delta\text{kW} = ((0.4 * (0.0152 - 0.0117) + 0.4 * (0.0348 - 0.0314) + 0.2 * (0.0725 - 0.0715)) + ((0.129 - 0.042) * (1 + 0.057)) * 0.11 = 0.013 \text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

$$\Delta\text{MMBtu}_{\text{WH}} = \Delta kWh * WHF_G$$

Where:

$\Delta\text{MMBtu}_{\text{WH}}$ = Gross increase in customer annual heating MMBtu fuel usage from the reduction in lighting heat

WHF_{G} = Waste heat factor for fossil fuels to account for HVAC interactions with efficient lighting (= -0.0018 as weighted average across all HVAC systems and cities; see Appendix B)

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[225] Nexus Market Research, RLW Analytics, and GDS Associates. *New England Residential Lighting Markdown Impact Evaluation.* January 20, 2009.

Miscellaneous

Residential Two Speed / Variable Speed Pool Pumps (Time of Sale)

	Measure Details
Official Measure Code	Res-Pool-Pump-1
Measure Unit	Per unit
Measure Category	Miscellaneous
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by speed control type
Peak Demand Reduction (kW)	Varies by speed control type
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by speed control type
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	10
Incremental Cost	Varies by speed control type
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is purchasing and installing an efficient two speed or variable speed residential pool pump motor in place of a standard single speed motor of equivalent horsepower.

Definition of Efficient Equipment

The high efficiency equipment is a two speed or variable speed residential pool pump.

Definition of Baseline Equipment

The baseline equipment is a single speed residential pool pump.

Deemed Lifetime of Efficient Equipment

The estimated useful life for a variable speed pool pump is 10 years.

Deemed Measure Cost

The incremental cost is estimated as $175.00 for a two speed motor and $750.00 for a variable speed motor.[226]

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[226] Lockheed Martin. Pump retail price data. July 2009.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = \frac{hp * LF * 0.746}{\eta_{PUMP}} * \frac{Hrs}{day} * \frac{Days}{yr} * ESF$$

Where:[227]

hp = Horsepower of pump motor (= 1.5)

LF = Load factor of pump motor (= 0.66)

0.746 = Conversion of hp to kW

η_{PUMP} = Efficiency of pump motor (= 0.325)

Hrs/day = Assumed hours of pump operation per day (= 6)[228]

Days/yr = Assumed number of days pool in use (= 100)[229]

ESF = Energy savings factor (= depending on pump type)

$$ESF_{\text{TWO SPEED}} = 0.322$$

$$ESF_{\text{VARIABLE SPEED}} = 0.86$$

$$\Delta \text{kWh}_{\text{TWO SPEED}} = \frac{1.5 * 0.66 * 0.746}{0.325} * 6 * 100 * 0.32 = 436 \text{ kWh}$$

$$\Delta \text{kWh}_{\text{VARIABLE SPEED}} = \frac{1.5 * 0.66 * 0.746}{0.325} * 6 * 100 * 0.86 = 1{,}173 \text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = \frac{HP * LF * 0.746}{\eta Pump} * CF * DSF$$

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[227] Unless otherwise stated, all assumptions from: First Energy. *Residential Swimming Pool Pumps memo.*

[228] Consortium for Energy Efficiency. *Pool Pump Exploration Memo*. June 2009.

[229] Assumes pool operation from Memorial Day to Labor Day.

Where:

DSF = Demand savings factor (= dependent on pump type)

$$DSF_{\text{TWO SPEED}} = 0.59$$

$$DSF_{\text{VARIABLE SPEED}} = 0.91$$

CF = Summer peak coincidence factor (= 0.83)[230]

$$\Delta kW_{\text{TWO SPEED}} = \frac{1.5 * 0.66 * 0.746}{0.325} * 0.83 * 0.59 = 1.113 \text{ kW}$$

$$\Delta kW_{\text{VARIABLE SPEED}} = \frac{1.5 * 0.66 * 0.746}{0.325} * 0.83 * 0.91 = 1.716 \text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[230] Efficiency Vermont. TRM August, 9, 2013. Coincidence factor based on market feedback about the typical run pattern for pool pumps, which revealed that most people run the pump during the day, and set a timer to turn the pump off during the night.

Residential Premium Efficiency Pool Pump Motor (Time of Sale)

	Measure Details
Official Measure Code	Res-Pool-Motor-1
Measure Unit	Per unit
Measure Category	Miscellaneous
Sector(s)	Residential
Annual Energy Savings (kWh)	404
Peak Demand Reduction (kW)	0.559
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	4,040
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	10
Incremental Cost	$50.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is purchasing and installing a residential, 1.5 HP, premium efficiency, single speed pool pump motor in place of a standard single speed motor of equivalent horsepower.

Definition of Efficient Equipment

The high-efficiency equipment is a residential, 1.5 HP, premium efficiency, single speed pool pump motor.

Definition of Baseline Equipment

The baseline equipment is a residential, 1.5 HP, standard, single speed pool pump motor.

Deemed Lifetime of Efficient Equipment

The estimated useful life for a pump is 10 years.

Deemed Measure Cost

The incremental cost for this measure is $50.00.[231]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

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[231] Franklin Energy Services. *M4 – HE Swimming Pool Pumps – Residential*.

Savings Algorithm

Energy Savings

$$\Delta kWh = hp * 0.746 * \frac{Hrs}{Day} * \frac{Days}{Yr} * \left(\frac{LF_{BASE}}{\eta_{BASE}} - \frac{LF_{EFF}}{\eta_{EFF}}\right)$$

Where:[232]

hp = Horsepower of motors (= 1.5)

0.746 = Conversion from horsepower to kilowatts

LF_{BASE} = Load factor of baseline motor (= 0.66)

LF_{EFF} = Load factor of efficient motor (= 0.65)

$\eta Pump_{BASE}$ = Efficiency of baseline motor (= 0.325)

$\eta Pump_{EFF}$ = Efficiency of premium efficiency motor (= 0.455)

Hrs/Day = Assumed hours of pump operation per day (= 6)[233]

Days/Yr = Assumed number of days pool in use (= 100 days)[234]

$$\Delta kWh = 1.5 * 0.746 * 6 * 100 * \left(\frac{0.66}{0.325} - \frac{0.65}{0.455}\right) = 404\ kWh$$

Summer Peak Coincident Demand Reduction

$$\Delta kW = hp * 0.746 * CF * \left(\frac{LF_{BASE}}{\eta_{BASE}} - \frac{LF_{EFF}}{\eta_{EFF}}\right)$$

Where:

CF = Summer peak coincidence factor (= 0.83)[235]

$$\Delta kWh = 1.5 * 0.746 * 0.83 * \left(\frac{0.66}{0.325} - \frac{0.65}{0.455}\right) = 0.559\ kW$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[232] Unless otherwise stated, all assumptions from: First Energy. *Residential Swimming Pool Pumps Memo.*

[233] Consortium for Energy Efficiency. *Pool Pump Exploration Memo*. June 2009.

[234] Assumes pool operation from Memorial Day to Labor Day.

[235] Efficiency Vermont. TRM. August 9, 2013. Coincidence factor based on market feedback about the typical run pattern for pool pumps, which revealed that most people run the pump during the day, and set a timer to turn the pump off during the night.

Residential New Construction

	Measure Details
Official Measure Code	Res-WB-RNC-1
Measure Unit	Per project
Measure Category	Miscellaneous
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	Varies by project
Lifetime Energy Savings (kWh)	Varies by project
Lifetime Fossil Fuel Savings (MMBtu)	Varies by project
Water Savings (gal/yr)	Varies by project
Effective Useful Life (years)	Varies by project
Incremental Cost	
Important Comments	
Effective Date	
End Date	

Description

This measure is residential new construction for homes built in Indiana. The savings are based on using accredited HERS software that complies with the Mortgage Industry National Home Energy Rating Systems Accreditation Standards developed by RESNET.

Energy savings and demand reduction are estimated per home for heating, cooling, hot water, lighting, ceiling fans, and appliances, including refrigerators and dishwashers. To avoid double-counting savings, this measure savings should not also be included as savings under another program. However, savings for efficient products installed in the home other than those listed above and that are not claimed under the program may be captured through another program.

Definition of Efficient and Baseline Equipment

The following assumptions underlie the measure savings calculation methodology:

1. Program implementers are using REM/Rate™ or another RESNET-approved software to conduct HERS ratings on each efficient new home built. For recommendations on estimating savings using a rating tool other than REM/Rate™, see the Other Software section.
2. Program administrators will employ the User Defined Reference Home (UDRH) feature provided in REM/Rate™ to estimate savings. This allows for comparing the energy consumption of a rated home with a UDRH.

The UDRH is an exact replica of the rated home in size, structure, and climate zone, but the energy characteristics are defined by local code or building practices. Until a formal study characterizing baseline building practices is completed for Indiana, the UDRH shall be defined by the residential energy efficiency section of the prevailing Indiana building code.

Deemed Lifetime of Efficient Equipment

The estimated useful life varies by equipment installed.

Deemed Measure Cost

More program detail is needed to determine incremental costs.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

Energy savings, including fossil fuel savings, for heating, cooling, hot water, lighting, and appliances are based on the direct output of REM/Rate™ (or other RESNET-approved energy modeling software). Energy savings are determined on a per-home basis with the following calculation:

Energy savings = UDRH energy consumption – Rated home energy consumption

The UDRH shall be defined by the most recent code, with some supplemental clarifications (see the table in the User Defined Reference Home Specifications section below).

For residential new construction projects that participate through a RESNET-approved sampling protocol, energy savings shall be determined based on the savings from the model home, linearly adjusted based on the floor square footage compared to all other homes included in that sample set. Chapter 6 of the RESNET Mortgage Industry National Home Energy Rating Standards provides technical guidelines on the sampling protocol.

Summer Peak Coincident Demand Reduction

Demand reduction for heating, cooling, hot water, lighting, and appliances are based on the direct output of REM/Rate™ (or other RESNET-approved energy modeling software). System peak electric demand reduction is calculated on a per-home basis using the following calculation:

$$\text{Peak coincident demand reduction} = (UDRH\ electric\ demand - Rated\ home\ electric\ demand) * CF$$

The demand reduction from right-sizing mechanical equipment is calculating using the following equation:

$$\text{Peak coincident demand reduction} = (UDRH\ electric\ demand * OFUDRH - Rated\ home\ electric\ demand * OFr) * CF$$

Where:

CF = Coincidence factor; equates the installed HVAC system demand to its demand during system peak

OFUDRH = Over-sizing factor for the HVAC unit in the UDRH home

OF_R = Over-sizing factor for the HVAC unit in the rated home

Rated Home = Rated home electric demand output as determined from REM/Rate™

UDRH = User defined reference home electric demand output (= see table below)

Peak Demand Variable Definitions

Variable	Type	Value	Sources
OFUDRH	Fixed	1.60	Public Service Electric and Gas. *Residential New Construction Baseline Study*. 1997. Long Island Power Authority. *Residential New Construction Technical Baseline Study.* 2004. Reports use over-sizing values of 155% to 172%.
OF_R	Fixed	1.15	Program guideline for rated home.
CF	Fixed	0.50	Energy Center of Wisconsin. *Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research.* p. 32. May 2008.

Fossil Fuel Impact Descriptions and Calculation

The fossil fuel impacts from this measure are outlined as part of the Energy Savings section.

User Defined Reference Home (UDRH) Specifications

The following table provides inputs for a UDRH based on the 2009 IECC, with some supplemental clarifications.

2009 IECC UDRH Specifications

Data Point	Value		Unit	Source	Comment
	Zone 4	Zone 5			
Building Thermal Envelope					
Fenestration	0.40	0.35	U-factor	2009 IECC Table 402.1.3	
Skylight	0.60	0.60	U-factor	2009 IECC Table 402.1.3	
Glazed Fenestration SHGC	0.40	0.40	SHGC	2009 IECC Table 404.5.2(1)	No prescriptive requirement.
Ceiling	0.030	0.030	U-factor	2009 IECC Table 402.1.3	
Wood Frame Wall	0.082	0.057	U-factor	2009 IECC Table 402.1.3	
Rim and Band Joists	0.082	0.060	U-factor		Code requirement for wood frame wall.
Mass Wall	0.141	0.082	U-factor	2009 IECC Table 402.1.3	
Frame Floor	0.047	0.033	U-factor	2009 IECC Table 402.1.3	
Basement Wall	0.059	0.059	U-factor	2009 IECC Table 402.1.3	

Data Point	Value		Unit	Source	Comment
	Zone 4	Zone 5			
Slab, Unheated	10, 2	10, 2	R-value, feet	2009 IECC Table 402.1.1	Feet from top of slab edge below grade.
Slab, Heated	15, 2	15, 2	R-value, feet	2009 IECC Table 402.1.1	Feet from top of slab edge below grade.
Crawlspace Wall	0.065	0.065	U-factor	2009 IECC Table 402.1.3	
Air Infiltration Rate	0.0036	0.0036	SLA	2009 IECC Table 404.5.2(1)	Approximately 7 to 8 ACH50.
Mechanical Systems					
Furnace	80		AFUE	Federal Standard	Standard is 78 AFUE, 80 AFUE is adopted based on typical minimum availability and practice.
Boiler	80		AFUE	Federal Standard	
Heat Pump, Heating	7.7		HSPF	Federal Standard	All heat pumps shall be characterized as an ASHP.
Central Air Conditioning	13		SEER	Federal Standard	
Heat Pump, Cooling	13		SEER	Federal Standard	
Water Heating, Natural Gas	0.58		EF	Federal Standard	Federal requirements vary based on tank size. The UDRH feature does not allow adjustments to efficiency values based on tank size, therefore the UDRH reference efficiency shall be based on minimum federal efficiency requirements for a 50 gallon tank.
Water Heating, Oil	0.50		EF	Federal Standard	See Water Heating, Natural Gas.
Water Heating, Electric	0.90		EF	Federal Standard	See Water Heating, Natural Gas.
Integrated Space/Water Heating, Heating	80		AFUE	Federal Standard, Boiler	Combination space and water heating units shall reference the minimum federal standard boiler efficiency for the heating portion of unit.
Integrated Space/Water Heating, Water	0.58 (natural gas) 0.50 (oil) 0.90 (electric)		EF	Federal Standard, Water Heating	Combination space and water heating units shall reference the minimum federal standard water heating efficiency for the water heating portion of unit.
Thermostat, Type	Manual			2009 IECC Table 404.5.2(1)	

Data Point	Value		Unit	Source	Comment
	Zone 4	Zone 5			
Thermostat, Cooling Set Point	75		°F	2009 IECC Table 404.5.2(1)	
Thermostat, Heating Set Point	72		°F	2009 IECC Table 404.5.2(1)	
Duct Insulation	8		R-Value	2009 IECC 403.2.1	
Duct Insulation, Floor Truss	6		R-Value	2009 IECC 403.2.1	
Duct Leakage	0.88		DSE	2009 IECC Table 404.5.2(1)	
Mechanical Ventilation	N/A				Ventilation is not required by code. The UDRH shall not reference ventilation. The program home will see no energy savings or energy penalty from ventilation.
Lights and Appliances					
Efficient Lighting	50		%	IECC 2009 Section 404.1	
Refrigerator	585		kWh/yr	Vermont Energy Investment Corporation	Based on weighted average of NAECA baseline kWh/yr installed in Vermont of 5,000 hours/year.
Dishwasher	0.46		EF	RESNET Standard	
Ceiling Fan	None			RESNET Standard	

Definitions and Acronyms

HERS Provider - A firm or organization that develops, manages, and operates a home energy rating system and is currently accredited by RESNET.

Home Energy Rater or Rater – The person trained and certified by a HERS provider to inspect and analyze a home to evaluate the minimum rated features and prepare an energy efficiency rating.

IECC - International Energy Conservation Code

Rated Home - The specific home being evaluated using the rating procedures contained in the National Home Energy Rating Technical Guidelines.

Rating Tool - A procedure for calculating a home energy efficiency rating, annual energy consumption, and annual energy costs, and which is listed in the "National Registry of Accredited Rating Software Programs" as posted on the RESNET website.

Reference Home - A hypothetical home configured in accordance with the specifications set forth in the National Home Energy Rating Technical Guidelines for the purpose of calculating rating scores

REM/Rate™ - RESNET-approved residential energy analysis, code compliance, and rating software supported by the Architectural Energy Corporation.

RESNET - Residential Energy Services Network, the national standards-making body for the building energy efficiency rating system, www.resnet.us.

UDRH - User Defined Reference Home*,* a feature of REM/Rate™ that enables HERS providers to create other reference buildings based on local construction practice, local code, etc. to compare to the rated home.

Lighting and Appliances

REM/Rate™ offers two input modes for Lights and Appliances: simplified and detailed. The simplified input mode (Lights & Appliances – HERS) is the default and is used to calculate a HERS Index. The detailed input mode (Lights & Appliances – AUDIT) is used to capture additional lighting and appliance data. Since only the simplified input mode is used when calculating a HERS Index, the simplified mode shall be used when calculating energy savings and demand reduction for new construction programs.

Energy savings and demand reduction shall be estimated per home for heating, cooling, hot water, lighting, ceiling fans, and appliances, including refrigerators and dishwashers. To avoid double-counting of savings, measures included in new construction program savings should not also be included in savings for another program. However, savings for efficient products installed in the home other than those listed above and that are not claimed through the residential new construction program may be captured through another program.

User Defined Reference Home (UDRH) Feature

The UDRH feature in REM/Rate™ provides a home-by-home comparison of energy consumption against a user-defined reference home. REM/Rate™ allows for modifying the thermal and energy performance features of the rated home to the specifications provided by the UDRH, leaving the rated home's building size, structure, and climate zone. This allows for comparing the energy consumption of the rated home to the energy consumption of the same home built to different specifications.

The UDRH shall be defined by the residential energy efficiency section of the prevailing Indiana building code. As of April 2012, the Indiana building code is based on the 2009 International Energy Conservation Code (IECC). Therefore, energy savings and demand reduction in Indiana will be based on the difference in estimated energy consumption of the program home, compared to that same home built to 2009 (or any subsequently-updated) IECC specifications.

For REM/Rate™, the UDRH specifications are contained in an ASCII script file that follows a specific syntax. Details on creating a UDRH file are in the REM/Rate™ Help module. Inputs for a UDRH file based on 2009 IECC (with supplemental clarifications) are in Table 3 of the User Defined Reference Home (UDRH) Specifications section.

A UDRH report may be run singly for each home, or in batch mode for multiple homes. Data from the UDRH report may also be exported from REM/Rate™ to an Access database for additional data manipulation and to calculate savings. Additional information on using the UDRH batch export feature is in the REM/Rate™ Help module.

Indiana Climate Zones

Climate zones from the figure below shall be used to determine the applicable energy requirements for the UDRH.

Indiana Climate Zones Map

Active Solar & Photovoltaics

Solar systems installed for water and/or space heating and photovoltaic systems installed to meet electricity demand are not addressed in the 2006 IECC. However, they need to be addressed in the UDRH.

If savings for the residential new construction program can be claimed from the use of active solar or PV systems, these systems should be eliminated from the UDRH so that their savings can be quantified in comparison to the rated home. If savings for the residential new construction program *cannot* be claimed from the use of active solar or PV systems, these systems should not be included in the UDRH. When a system is not referenced in the UDRH, that system will be the same in both the rated and reference homes. This way, the energy consumption for the rated home and the UDRH will be estimated assuming both configurations have the solar or PV system installed, so no savings will be reported. The specific syntax for this is provided in the REM/Rate™ UDRH Syntax Report.

Whole-House Residential Retrofit

	Measure Details
Official Measure Code	Res-WB-WWRetro-1
Measure Unit	Varies by project
Measure Category	Miscellaneous
Sector(s)	Residential
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	Varies by project
Lifetime Energy Savings (kWh)	Varies by project
Lifetime Fossil Fuel Savings (MMBtu)	Varies by project
Water Savings (gal/yr)	Varies by project
Effective Useful Life (years)	20
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

Whole-house retrofit programs, such as home performance with ENERGY STAR and low-income weatherization initiatives, may include a variety of treatments, including building shell and HVAC upgrades and the direct installation of energy-efficient products. This protocol describes how building energy modeling of each individual home treated through a program may be used to estimate savings for the building shell (e.g., air sealing, insulation) and HVAC (e.g., duct sealing, central heating and/or cooling system replacements) measures installed in those homes. Savings from other measures such as efficient lighting, appliances, or water heating should be estimated using deemed values or deemed calculations provided for such measures elsewhere in this TRM.

The alternative to using building energy modeling to develop energy savings for the shell and HVAC measures would be to use the deemed measure savings calculations found elsewhere in this TRM for each installed measures (air sealing, insulation, duct sealing, etc.). Deemed savings calculations are easier to administer and implement but may be less precise because they are based on some assumed average characteristics of homes (such as average heating system efficiencies) and do not capture interactive effects between some measures.

Definition of Efficient Equipment

The efficient condition is a house that was treated by installing building shell and HVAC measures. Savings from installed measures outside of these categories should follow the appropriate measure-specific characterizations.

Definition of Baseline Equipment

The baseline condition is a house before being retrofitted with installed measures. The only exception is that the assumed baseline efficiency of a heating system or central air conditioner that is being replaced should be consistent with the current minimum federal efficiency standards for such equipment, unless it is clear that the equipment would not have been replaced at that particular time were it not for program influence (i.e., to claim a baseline efficiency lower than the current federal minimum, there must be program documentation that the old equipment would otherwise not have been replaced).

Deemed Lifetime of Efficient Equipment

The average savings-weighted lifetime for this measure is 20 years, based on an anticipated mixture of building shell and HVAC measures ranging from 15 years to 25 years.[236]

Deemed Measure Cost

The actual costs for procuring and installing the equipment, materials, and/or services should be used as the deemed measure cost.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

The requirements for a model-based approach to savings claims are delineated in part through adherence with at least one of the following national standards for whole-house savings calculations:

- RESNET-approved rating software (http://resnet.us)
- Software energy simulation performance exceeding the requirements of National Renewable Energy Laboratory's Home Energy Rating System, BESTEST (http://www.nrel.gov/docs/legosti/fy96/7332b.pdf)
- U.S. Department of Energy Weatherization Assistance Program approval (http://www.waptec.org)

Proper savings estimates from modeling software also require that uninsulated wall or ceiling baseline conditions are modeled as no less than R-5. In addition, software tools must be calibrated against actual consumption data for each treated home or from a sample sized for a 90% confidence interval with ±10% margin of statistical precision error. These requirements address concerns that modeling software can overestimate savings, particularly cooling savings.

The software tools must provide outputs that separately account for heating and cooling energy and peak demand reduction so that demand and fuel-related economic savings may be properly addressed.

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[236] A review of measures installed could be used to assess whether to adjust the savings-weighted average in accordance with a measure distribution that favors longer (insulation) or shorter (air sealing) lifetimes.

Commercial & Industrial Market Sector

Building Shell

Cool Roof (Retrofit – New Equipment)

	Measure Details
Official Measure Code	CI-Shell-CoolRoof-1
Measure Unit	Per unit
Measure Category	Building Shell
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	Varies by project
Lifetime Energy Savings (kWh)	Varies by project
Lifetime Fossil Fuel Savings (MMBtu)	Varies by project
Water Savings (gal/yr)	0
Effective Useful Life (years)	15
Incremental Cost	$8,454.67 per 1,000 square feet
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the installation of cool roof roofing materials in commercial buildings. A cool roof is assumed to have a solar absorbance of 0.3[237] compared to a standard roof with a solar absorbance of 0.8.[238] Energy savings and demand reduction are realized through reductions in the building cooling loads. The approach uses DOE-2.2 simulations on a series of commercial prototypical building models. Energy and demand impacts are normalized per thousand square feet of roof space.

Definition of Efficient Equipment

The efficient condition is a roof with a solar absorbance of 0.30.

Definition of Baseline Equipment

The baseline condition is a roof with a solar absorbance of 0.80.

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[237] Maximum value to meet cool roof standards under California’s Title 24.

[238] Itron. *2004-2005 Database for Energy Efficiency Resources (DEER) Update Study.* December 2005.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 15 years.[239]

Deemed Measure Cost

The full installed cost for retrofit applications is $8,454.67 per 1,000 square feet (kSF).[240]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = \frac{SF}{1{,}000} * \Delta\, kWh_{kSF}$$

Where:

SF = Square footage of the roof (= actual; to be collected with the incentive form)

ΔkWh_{kSF} = Unit energy savings per 1,000 square feet of roof (= see table in Reference Tables section)

For example, the energy savings from an assembly building in Indianapolis with 1,000 square feet of roof would be:

$$\Delta \text{kWh} = \frac{1{,}000}{1{,}000} * 197 = 197 \text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = \frac{SF}{1{,}000} * \Delta kW_{kSF} * CF$$

Where:

ΔkW_{kSF} = Unit demand reduction per 1,000 square foot of roof area (= see table in Reference Tables section)

CF = Summer peak coincident factor (= 0.74)[241]

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[239] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. “Effective/Remaining Useful Life Values.” December 16, 2008.

[240] California Public Utilities Commission. *2005 Database for Energy-Efficiency Resources (DEER), Version 2005.2.01*. “Technology and Measure Cost Data.” October 26, 2005.

[241] Duke Energy supplied the coincidence factor for the commercial HVAC end uses (pending verification based on information from the utilities).

For example, the demand reduction from an assembly building in Indianapolis with 1,000 square feet of roof would be:

$$\Delta \text{kW} = \frac{1{,}000}{1{,}000} * 0.141 * 0.74 = 0.104 \text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

$$\Delta \text{MMBtu} = \frac{SF}{1{,}000} * \Delta MMBtu_{kSF}$$

Where:

$\Delta \text{MMBtu}_{\text{kSF}}$ = Unit natural gas savings per 1,000 square feet of roof space (= see table in Reference Tables section)

For example, the fossil fuel impacts from an assembly building in Indianapolis with 1,000 square feet of roof would be:

$$\Delta \text{MMBtu} = \frac{1{,}000}{1{,}000} * -1.451 = \text{-1.45 MMBtu}$$

Reference Tables

Energy Savings and Demand Reduction Factors for Small Commercial Applications

Building	City	$\Delta \text{kWh}_{\text{kSF}}$	$\Delta \text{kW}_{\text{kSF}}$	$\Delta \text{MMBtu}_{\text{kSF}}$
Assembly	Evansville	263	0.159	-1.44
	Ft. Wayne	154	0.091	-1.63
	Indianapolis	197	0.141	-1.45
	South Bend	157	0.003	-1.41
	Terre Haute	203	0.156	-1.44
Big Box Retail	Evansville	223	0.126	-0.90
	Ft. Wayne	152	0.080	-1.16
	Indianapolis	183	0.125	-1.09
	South Bend	155	0.078	-1.02
	Terre Haute	215	0.122	-1.02
Fast Food Restaurant	Evansville	253	0.050	-1.90
	Ft. Wayne	140	0.050	-2.10
	Indianapolis	189	0.050	-2.05
	South Bend	146	0.00	-2.05
	Terre Haute	170	0.003	-2.05
Full Service Restaurant	Evansville	233	0.150	-1.55
	Ft. Wayne	152	0.100	-1.80
	Indianapolis	187	0.150	-1.78
	South Bend	152	0.050	-1.83
	Terre Haute	184	0.100	-1.43
Light Industrial	Evansville	197	0.094	-1.57
	Ft. Wayne	104	0.081	-1.63

Building	City	ΔkWh_{kSF}	ΔkW_{kSF}	$\Delta MMBtu_{kSF}$
	Indianapolis	137	0.063	-1.70
	South Bend	108	0.045	-1.66
	Terre Haute	162	0.064	-1.34
Primary School	Evansville	404	0.678	-2.86
	Ft. Wayne	241	0.506	-2.97
	Indianapolis	328	0.698	-3.01
	South Bend	240	0.636	-2.88
	Terre Haute	359	0.492	-2.34
Small Office	Evansville	230	0.060	-0.84
	Ft. Wayne	156	0.020	-1.02
	Indianapolis	187	0.020	-0.98
	South Bend	157	0.060	-0.98
	Terre Haute	189	0.080	-0.90
Small Retail	Evansville	260	0.125	-1.36
	Ft. Wayne	172	0.078	-1.61
	Indianapolis	210	0.125	-1.58
	South Bend	170	0.031	-1.64
	Terre Haute	245	0.094	-1.16
Warehouse	Evansville	688	0.794	-4.88
	Ft. Wayne	104	0.081	-1.63
	Indianapolis	546	0.594	-5.13
	South Bend	471	0.025	-4.49
	Terre Haute	162	0.064	-1.34

Energy Savings and Demand Reduction Factors for Hospitals

HVAC System	City	ΔkWh_{kSF}	ΔkW_{kSF}	$\Delta MMBtu_{kSF}$
Constant Volume Reheat Economizer with Air Cooled Chiller	Evansville	124	0.104	-1.57
	Indianapolis	104	0.158	-1.37
	South Bend	89	0.001	-1.19
	Ft. Wayne	107	0.085	-0.75
	Terre Haute	116	0.162	-0.71
Constant Volume Reheat Economizer with Water Cooled Chiller	Evansville	86	0.046	-1.57
	Indianapolis	78	0.042	-1.38
	South Bend	67	0.001	-1.19
	Ft. Wayne	81	0.047	-0.75
	Terre Haute	74	0.049	-0.71
Constant Volume Reheat No Economizer with Air Cooled Chiller	Evansville	188	0.104	-1.76
	Indianapolis	167	0.158	-1.56
	South Bend	145	0.001	-1.39
	Ft. Wayne	167	0.085	-0.85
	Terre Haute	166	0.162	-0.81

HVAC System	City	ΔkWh_{kSF}	ΔkW_{kSF}	$\Delta MMBtu_{kSF}$
Constant Volume Reheat No Economizer with Water Cooled Chiller	Evansville	130	0.046	-1.76
	Ft. Wayne	123	0.047	-0.85
	Indianapolis	123	0.046	-1.54
	South Bend	108	0.001	-1.36
	Terre Haute	111	0.049	-0.81
Variable Air Volume Reheat Economizer with Air Cooled Chiller	Evansville	200	0.163	-0.66
	Indianapolis	174	0.176	-0.55
	South Bend	146	0.270	-0.95
	Ft. Wayne	152	0.077	-0.80
	Terre Haute	183	0.192	-0.24
Variable Air Volume Reheat Economizer with Water Cooled Chiller	Evansville	151	0.097	-0.66
	Indianapolis	121	0.059	-0.57
	South Bend	106	0.020	-0.90
	Ft. Wayne	120	0.071	-0.83
	Terre Haute	139	0.047	-0.24

Energy Savings and Demand Reduction Factors for Hotels

HVAC System	City	ΔkWh_{kSF}	ΔkW_{kSF}	$\Delta MMBtu_{kSF}$
Constant Volume Reheat Economizer with Air Cooled Chiller	Indianapolis	528	0.177	-0.10
	South Bend	563	0.151	-0.09
	Evansville	771	0.135	-0.16
	Ft. Wayne	453	0.109	-0.17
	Terre Haute	544	0.198	-0.15
Constant Volume Reheat Economizer with Water Cooled Chiller	Indianapolis	526	0.177	-0.10
	South Bend	561	0.151	-0.09
	Evansville	772	0.135	-0.16
	Ft. Wayne	453	0.114	-0.17
	Terre Haute	545	0.198	-0.15
Constant Volume Reheat No Economizer with Air Cooled Chiller	Indianapolis	537	0.177	-0.07
	South Bend	574	0.151	-0.07
	Evansville	782	0.135	-0.15
	Ft. Wayne	464	0.109	-0.17
	Terre Haute	556	0.198	-0.14
Constant Volume Reheat No Economizer with Water Cooled Chiller	Evansville	781	0.135	-0.15
	Ft. Wayne	464	0.114	-0.16
	Indianapolis	531	0.177	-0.07
	South Bend	570	0.151	-0.07
	Terre Haute	556	0.198	-0.14
Variable Air Volume Reheat Economizer	Indianapolis	535	0.177	-0.06
	South Bend	569	0.151	-0.05
	Evansville	789	0.135	-0.07

HVAC System	City	ΔkWh_{kSF}	ΔkW_{kSF}	$\Delta MMBtu_{kSF}$
with Air Cooled Chiller	Ft. Wayne	470	0.114	-0.10
	Terre Haute	559	0.203	-0.07
Variable Air Volume Reheat Economizer with Water Cooled Chiller	Indianapolis	533	0.177	-0.06
	South Bend	567	0.146	-0.05
	Evansville	787	0.135	-0.07
	Ft. Wayne	467	0.114	-0.10
	Terre Haute	557	0.203	-0.07

Energy Saving and Demand Reduction Factors for Large Offices

HVAC System	City	ΔkWh_{kSF}	ΔkW_{kSF}	$\Delta MMBtu_{kSF}$
Constant Volume Reheat Economizer with Air Cooled Chiller	Evansville	149	0.120	-1.63
	Ft. Wayne	95	0.00	-1.99
	Indianapolis	153	0.00	-2.06
	South Bend	120	0.143	-2.59
	Terre Haute	136	0.103	-1.40
Constant Volume Reheat Economizer with Water Cooled Chiller	Evansville	101	0.00	-1.64
	Ft. Wayne	57	0.00	-1.99
	Indianapolis	120	0.00	-2.20
	South Bend	110	0.00	-2.61
	Terre Haute	95	0.00	-1.43
Constant Volume Reheat No Economizer with Air Cooled Chiller	Evansville	249	0.109	-1.47
	Ft. Wayne	167	0.103	-1.93
	Indianapolis	250	0.057	-1.77
	South Bend	188	0.149	-1.85
	Terre Haute	266	0.103	-1.56
Constant Volume Reheat No Economizer with Water Cooled Chiller	Evansville	184	0.051	-1.46
	Ft. Wayne	143	0.046	-1.93
	Indianapolis	205	0.034	-1.78
	South Bend	152	0.086	-1.85
	Terre Haute	153	0.034	-1.56
Variable Air Volume Reheat Economizer with Air Cooled Chiller	Evansville	297	0.154	-0.27
	Ft. Wayne	190	0.120	-0.87
	Indianapolis	405	0.006	0.58
	South Bend	347	0.126	-0.01
	Terre Haute	422	0.291	0.37
Variable Air Volume Reheat Economizer with Water Cooled Chiller	Evansville	220	0.029	-0.27
	Ft. Wayne	183	0.023	-0.74
	Indianapolis	350	0.00	0.58
	South Bend	252	0.069	-0.18
	Terre Haute	334	0.017	0.37

Commercial Window Film (Retrofit – New Equipment)

	Measure Details
Official Measure Code	CI-Shell-WinFilm-1
Measure Unit	Per square foot
Measure Category	Building Shell
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	Varies by project
Lifetime Energy Savings (kWh)	Varies by project
Lifetime Fossil Fuel Savings (MMBtu)	Varies by project
Water Savings (gal/yr)	0
Effective Useful Life (years)	10
Incremental Cost	$267.00 per 100 square feet of window
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the installation of reflective window film in commercial buildings. The baseline condition is double-pane clear glass with a solar heat gain coefficient (SHGC) of 0.73 and a U-value of 0.72 Btu/hr-SF-°F. The window film is assumed to provide a SHGC of 0.40 or less. Energy savings and demand reduction are realized through reductions in the building cooling loads. The approach uses DOE-2.2 simulations on a series of commercial prototypical building models. The commercial simulation models are adapted from the California DEER, with changes to reflect Indiana climate and building practices. Energy and demand impacts are normalized per 100 square feet of window.

Definition of Efficient Equipment

The efficient condition is double-pane clear glass windows with standard window film. The standard window film will lower the SHGC to 0.40.

Definition of Baseline Equipment

The baseline condition is double-pane clear glass windows without any window film, with a U-value of 0.72, and a SHGC of 0.73.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 10 years.[242]

Deemed Measure Cost

This is a retrofit-only measure. The actual installed cost should be used, but for analysis purposes, the full installed cost including labor is $267.00 per 100 square feet of window.[243]

Deemed O&M Cost Adjustments

There are no expected O&M savings associated with this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = \frac{SF}{100} * \Delta kWh_{100SF}$$

Where:

SF = Glazing surface area of installed window film in square feet, not including frame

$\Delta \text{kWh}_{100SF}$ = Unit energy savings per 100 square feet of window film (= see table in Reference Table section)

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = \frac{SF}{100} * \Delta kW_{100SF} * \text{CF}$$

Where:

ΔkW_{100SF} = Unit demand reduction per 100 square feet of window film (= see table in Reference Table section)

CF = Summer peak coincident factor (= 0.74)[244]

Since this is a retrofit measure that only applies to existing buildings with clear, double-pane windows, future code adjustments should not affect projected savings.

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[242] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. "Effective/Remaining Useful Life Values." December 16, 2008.

[243] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. "Cost Values and Summary Documentation." December 16, 2008.

[244] Duke Energy provided the coincidence factor for the commercial HVAC end-use (pending verification based on information from the utilities).

Fossil Fuel Impact Descriptions and Calculation

$$\Delta \text{MMBtu} = \frac{SF}{100} * \Delta MMBtu_{100SF}$$

Where:

$\Delta \text{MMBtu}_{100SF}$ = Unit heating fossil fuel savings per 100 square feet of window film (= see table in Reference Table section)

Reference Table

Energy Saving and Demand Reduction Factors for Window Film

Building Type	$\Delta \text{kWh}_{100SF}$*	ΔkW_{100SF}*	$\Delta \text{MMBtu}_{100SF}$*
Indianapolis			
Assembly	426	0.15	-3.96
Big Box Retail	350	0.12	-3.39
Fast Food Restaurant	317	0.14	-5.06
Full Service Restaurant	304	0.17	-7.07
Light Industrial	285	0.14	-4.00
Primary School	498	0.22	-7.40
Small Office	309	0.13	-2.70
Small Retail	323	0.15	-4.48
Warehouse	285	0.14	-4.00
Other	344	0.00	-4.67
South Bend			
Assembly	352	0.01	-3.68
Big Box Retail	319	0.08	-2.91
Fast Food Restaurant	260	0.02	-5.21
Full Service Restaurant	260	0.08	-7.02
Light Industrial	231	0.14	-4.25
Primary School	421	0.26	-6.62
Small Office	280	0.12	-2.62
Small Retail	289	0.12	-4.63
Warehouse	231	0.14	-4.25
Other	294	0.00	-4.58
Evansville			
Assembly	586	0.15	-3.12
Big Box Retail	457	0.16	-2.43
Fast Food Restaurant	391	0.14	-4.20
Full Service Restaurant	376	0.17	-5.64
Light Industrial	329	0.14	-3.59
Primary School	537	0.18	-6.76
Small Office	369	0.13	-1.92
Small Retail	416	0.16	-3.38
Warehouse	329	0.14	-3.59

Building Type	ΔkWh_{100SF}*	ΔkW_{100SF}*	$\Delta MMBtu_{100SF}$*
Other	421	0.00	-3.85
Ft. Wayne			
Assembly	335	0.15	-4.12
Big Box Retail	305	0.16	-3.35
Fast Food Restaurant	258	0.14	-5.11
Full Service Restaurant	254	0.19	-7.43
Light Industrial	199	0.16	-4.34
Primary School	442	0.39	-6.83
Small Office	265	0.14	-2.91
Small Retail	273	0.16	-4.79
Warehouse	199	0.16	-4.34
Other	281	0.00	-4.80
Terre Haute			
Assembly	417	0.13	-4.20
Big Box Retail	382	0.09	-2.13
Fast Food Restaurant	306	0.14	-4.20
Full Service Restaurant	310	0.17	-5.47
Light Industrial	273	0.09	-3.41
Primary School	505	0.20	-5.53
Small Office	304	0.11	-1.91
Small Retail	352	0.11	-3.07
Warehouse	273	0.09	-3.41
Other	347	0.00	-3.70

* Unit energy savings, demand reductions, and natural gas savings data are based on a series of prototypical small commercial building simulation runs. The prototypes are based on the California DEER study prototypes, modified for local construction practices. Simulations were run using TMY3 weather data for each of the cities listed. Building prototypes used in the energy modeling are described in Appendix A - Prototypical Building Energy Simulation Model Development.

Roof Insulation (Retrofit – New Equipment)

	Measure Details
Official Measure Code	CI-Shell-RoofInsul-1
Measure Unit	Per square foot
Measure Category	Building Shell
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	Varies by project
Lifetime Energy Savings (kWh)	Varies by project
Lifetime Fossil Fuel Savings (MMBtu)	Varies by project
Water Savings (gal/yr)	0
Effective Useful Life (years)	20
Incremental Cost	$1.36 per square foot
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is improvements to the roof insulation in commercial buildings. The roof insulation R-value is assumed to increase to R-18 from the baseline level for each building type. Energy savings and demand reduction are realized through reductions in the building heating and cooling loads. The approach uses DOE-2.2 simulations on a series of commercial prototypical building models. The commercial simulation models are adapted from the California DEER study, with changes to reflect Indiana climate and building practices. Energy and demand impacts are normalized per 1,000 square feet of installed insulation.

Definition of Efficient Equipment

The efficient condition is R-18 insulation on the roof.

Definition of Baseline Equipment

The baseline condition by building type is shown in the table below.

Baseline Condition by Building Type

Building Type	Baseline R-Value
Assembly	R-12
Big Box Retail	R-13.5
Fast Food	R-13.5
Full Service Restaurant	R-13.5
Light Industrial	R-12
School	R-13.5
Small Office	R-13.5
Small Retail	R-13.5

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 20 years.[245]

Deemed Measure Cost

The full installed cost for retrofit applications is $1.36 per square foot.[246]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = \frac{SF}{1{,}000} * \Delta kWh_{kSF}$$

Where:

SF = Square footage of the roof (to be collected with the incentive form)

$\Delta \text{kWh}_{\text{kSF}}$ = Energy savings per 1,000 square feet of roof area (= dependent on building type and region; see table in Reference Table section)

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = \frac{SF}{1{,}000} * \Delta kW_{kSF} * CF$$

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[245] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. "Effective/Remaining Useful Life Values." December 16, 2008.

[246] Ibid. "Cost Values and Summary Documentation."

Where:

ΔkW_{kSF} = Demand reduction per 1,000 square feet of roof area (= dependent on building type and region; see table in Reference Table section)

CF = Summer peak coincident factor (= 0.74)[247]

There are no expected future code changes to affect this measure.

Fossil Fuel Impact Descriptions and Calculation

$$\Delta \text{MMBtu} = \frac{SF}{1{,}000} * \Delta MMBtu_{kSF}$$

Where:

$\Delta MMBtu_{kSF}$ = Unit natural gas savings per 1,000 square feet of roof space (= dependent on building type and region; see table in Reference Table section)

Reference Table

Energy Saving and Demand Reduction Factors for Roof Insulation*

Building	City	ΔkWh_{kSF}*	ΔkW_{kSF}*	$\Delta MMBtu_{kSF}$*
Assembly	Evansville	40	0.074	2.07
	Ft. Wayne	39	0.050	4.17
	Indianapolis	48	0.074	3.36
	South Bend	31	0.00	3.26
	Terre Haute	53	0.082	3.60
Big Box Retail	Evansville	6	0.045	1.90
	Ft. Wayne	4	0.025	3.12
	Indianapolis	5	0.041	2.55
	South Bend	1	0.022	2.52
	Terre Haute	1	0.022	2.67
Fast Food Restaurant	Evansville	80	0.00	3.40
	Ft. Wayne	39	0.050	3.80
	Indianapolis	60	0.050	3.75
	South Bend	38	0.00	3.40
	Terre Haute	77	0.050	4.3
Full Service Restaurant	Evansville	72	0.050	3.20
	Ft. Wayne	75	0.025	5.15
	Indianapolis	84	0.050	4.95
	South Bend	72	0.025	5.08

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[247] Duke Energy provided the coincidence factor for the commercial HVAC end-use (pending verification based on information from the utilities).

Building	City	ΔkWh_{kSF}*	ΔkW_{kSF}*	$\Delta MMBtu_{kSF}$*
	Terre Haute	66	0.025	3.58
Light Industrial	Evansville	73	0.022	2.87
	Ft. Wayne	53	0.014	4.41
	Indianapolis	65	0.019	3.96
	South Bend	58	0.019	4.16
	Terre Haute	65	0.019	3.30
Primary School	Evansville	196	0.298	4.52
	Ft. Wayne	106	0.232	4.48
	Indianapolis	135	0.116	4.23
	South Bend	110	0.108	4.33
	Terre Haute	181	0.110	5.05
Small Office	Evansville	57	0.040	2.02
	Ft. Wayne	38	0.06	3.12
	Indianapolis	50	0.04	2.76
	South Bend	39	0.04	2.84
	Terre Haute	50	0.040	2.48
Small Retail	Evansville	84	0.062	3.20
	Ft. Wayne	68	0.05	4.66
	Indianapolis	84	0.08	4.20
	South Bend	72	0.05	4.50
	Terre Haute	81	0.047	3.77
Warehouse	Evansville	73	0.022	2.87
	Ft. Wayne	54	0.02	4.34
	Indianapolis	60	0.121	7.53
	South Bend	23	0.011	7.32
	Terre Haute	65	0.019	3.30

* Unit energy savings, demand reductions, and natural gas savings data are based on a series of prototypical small commercial building simulation runs. The prototypes are based on the California DEER study prototypes, modified for local construction practices. Simulations were run using TMY3 weather data for each of the cities listed. Building prototypes used in the energy modeling are described in Appendix A - Prototypical Building Energy Simulation Model Development.

High Performance Glazing (Retrofit – Early Replacement)

	Measure Details
Official Measure Code	CI-Shell-HPGlaz-1
Measure Unit	Per square foot
Measure Category	Building Shell
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	Varies by project
Lifetime Energy Savings (kWh)	Varies by project
Lifetime Fossil Fuel Savings (MMBtu)	Varies by project
Water Savings (gal/yr)	0
Effective Useful Life (years)	20
Incremental Cost	$54.82 per square foot of window
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the installation of high performance glazing in commercial buildings. The baseline condition is double-pane clear glass with a solar heat gain coefficient (SHGC) of 0.73 and U-value of 0.72 Btu/hr-SF-°F. The efficient glazing must have a SHGC of 0.40 or less and U-value of 0.57 Btu/hr-SF-°F or less. Energy savings and demand reduction are realized through reductions in the building heating and cooling loads. The approach uses DOE-2.2 simulations on a series of commercial prototypical building models. The commercial simulation models are adapted from the California DEER study, with changes to reflect Indiana climate and building practices. Energy and demand impacts are normalized per 100 square feet of window.

Definition of Efficient Equipment

The efficient condition is a window with a U-value of 0.57 and a SHGC of 0.4.

Definition of Baseline Equipment

The baseline condition is a window with a U-value of 0.72 and a SHGC of 0.73.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 20 years.[248]

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[248] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. "Effective/Remaining Useful Life Values." December 16, 2008.

Deemed Measure Cost

The full installed cost for retrofit applications is $54.82 per square foot of window.[249]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = \frac{SF}{100} * \Delta kWh_{100SF}$$

Where:

SF = Glazing surface area of installed window in square feet, not including frame (= actual)

ΔkWh_{100SF} = Energy savings per 100 square feet of window space (= see table in Table Reference section)

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW} = \frac{SF}{100} * \Delta kW_{100SF} * CF$$

Where:

ΔkW_{100SF} = Demand reduction per 100 square feet of window space (= see table in Table Reference section)

CF = Summer peak coincident factor (= 0.74)[250]

Baseline Adjustment

There are no expected future code changes to affect this measure.

Fossil Fuel Impact Descriptions and Calculation

$$\Delta\text{MMBtu} = \frac{SF}{100} * \Delta MMBtu_{100SF}$$

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[249] Efficiency Vermont. *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions*. February, 19, 2010. Value derived from Efficiency Vermont project experience and conversations with suppliers.

[250] Duke Energy supplied the coincidence factor for the commercial HVAC end-use (pending verification based on information from the utilities).

Where:

$\Delta MMBtu_{100SF}$ = Unit natural gas savings per 100 square feet of window space (= see table in Table Reference section)

Reference Table

Energy Saving and Demand Reduction Factors for High Performance Windows

Building Type	ΔkWh_{100SF}*	ΔkW_{100SF}*	$\Delta MMBtu_{100SF}$*
Indianapolis			
Assembly	376	0.15	-0.67
Big Box Retail	317	0.12	-0.81
Fast Food Restaurant	316	0.14	-0.84
Full Service Restaurant	331	0.17	-0.99
Light Industrial	272	0.14	-1.69
Primary School	535	0.23	-2.97
Religious Worship	210	0.19	-0.25
Small Office	300	0.14	-0.57
Small Retail	326	0.16	-1.13
Warehouse	272	0.14	-1.69
Other	326	0.00	-1.16
South Bend			
Assembly	301	0.01	-0.96
Big Box Retail	291	0.09	-0.81
Fast Food Restaurant	266	0.03	-0.43
Full Service Restaurant	289	0.08	-0.52
Light Industrial	212	0.14	-1.83
Primary School	450	0.26	-2.44
Small Office	273	0.13	-0.42
Small Retail	298	0.13	-0.88
Warehouse	212	0.14	-1.83
Other	288	0.00	-1.03
Evansville			
Assembly	510	0.15	-1.00
Big Box Retail	406	0.17	-0.78
Fast Food Restaurant	378	0.15	-0.91
Full Service Restaurant	389	0.17	-1.08
Light Industrial	320	0.14	-1.85
Primary School	574	0.19	-3.09
Small Office	351	0.13	-0.46
Small Retail	404	0.16	-1.04
Warehouse	320	0.14	-1.85
Other	406	0.00	-1.34

Building Type	ΔkWh_{100SF}*	ΔkW_{100SF}*	$\Delta MMBtu_{100SF}$*
Ft. Wayne			
Assembly	287	0.16	-0.74
Big Box Retail	280	0.17	-0.11
Fast Food Restaurant	263	0.14	-0.40
Full Service Restaurant	289	0.19	-0.72
Light Industrial	215	0.16	-1.26
Primary School	470	0.20	-2.35
Small Office	261	0.14	-0.47
Small Retail	285	0.17	-0.79
Warehouse	215	0.16	-1.26
Other	285	0.00	-0.90
Terre Haute			
Assembly	362	0.14	-0.52
Big Box Retail	338	0.10	-0.20
Fast Food Restaurant	306	0.14	-0.22
Full Service Restaurant	327	0.17	-0.17
Light Industrial	283	0.11	-0.90
Primary School	539	0.21	-1.81
Small Office	292	0.11	-0.14
Small Retail	344	0.11	-0.43
Warehouse	283	0.11	-0.90
Other	342	0.00	-0.47

* Unit energy savings, demand reduction, and natural gas savings data are based on a series of prototypical small commercial building simulation runs. The prototypes are based on the California DEER study prototypes, modified for local construction practices. Simulations were run using TMY3 weather data for each of the cities listed. Building prototypes used in the energy modeling are described in Appendix A - Prototypical Building Energy Simulation Model Development.

Domestic Hot Water

Heat Pump Water Heaters (New Construction, Retrofit)

	Measure Details
Official Measure Code	CI-SHW-HPWH-1
Measure Unit	Per water heater
Measure Category	Domestic Hot Water
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by location
Peak Demand Reduction (kW)	Varies by location
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by location
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	10
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing a HPWH in place of a standard electric water heater. HPWHs can be added to existing DHW systems to improve the overall efficiency. HPWHs use refrigerants (like an ASHP) and have much higher energy factors than standard electric water heaters. HPWHs remove waste heat from surrounding air sources and preheat the DHW supply system. HPWHs come in a variety of sizes and the choice will depend on the desired temperature output and amount of hot water needed by application. The savings from HPWH will depend on the design, size (capacity), water heating requirements, building application, and climate. This measure could relate to either a retrofit or a new installation.

Definition of Efficient Equipment

The efficient equipment is a HPWH with or without an auxiliary water heating system.

Definition of Baseline Equipment

The baseline equipment is a standard electric storage tank-type water heater. This measure does *not* apply to natural gas-fired water heaters.

Deemed Lifetime of Efficient Equipment

The expected measure life is 10 years.[251]

Deemed Measure Cost

Due to the complexity of HPWH systems, incremental capital costs should be determined on a case-by-case basis. High capacity HPWHs typically have a supplemental heating source, such as an electric resistance heater. For new construction applications, the incremental capital cost for this measure should be calculated as the difference between the installed cost of the entire HPWH system (including any auxiliary heating systems) and the installed cost of a standard electric storage tank water heater of comparable capacity. For retrofit applications, the total installed cost of HPWH should be used.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = \frac{GPD * 365 * 8.3 * (T_{OUT} - T_{IN})}{3{,}412} * \left(\frac{1}{EF_{BASE}} - \frac{1}{EF_{EE}}\right)$$

Where:

GDP = Average daily gallons of hot water consumption (= determined from site-specific data)

365 = Days of operation per year

8.3 = Specific weight of water (8.3 lbs/gal) multiplied by the specify heat of water $(1.0 \frac{Btu}{lb*°F})$

T_{OUT} = Water heater set point (= actual; otherwise assume 130°F)[252]

T_{In} = Cold water temperature entering the DWH system (= depending on climate; see table below)

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[251] Estimates of measure life from utilities in the Northeast and the U.S. Department of Energy vary from 10 to 15 years. Assume 10 years as a conservative estimate. http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

[252] National Association of Home Builders Research Center. *Performance Comparison of Residential Hot Water Systems.* Prepared for the National Renewable Energy Laboratory. 2002.

Groundwater Temperature (T_{IN}) by Location*

City	Groundwater Temperature (°F)
Indianapolis	58.1
South Bend	57.4
Terre Haute	60.5
Evansville	62.8
Ft Wayne	55.6

* Burch, J. and C. Christensen, National Renewable Energy Laboratory. *Towards Development of an Algorithm for Mains Water Temperature*. 2007. American Solar Energy Society, Colorado.

3,412 = Conversion factor (Btu/kWh)

EF_{BASE} = Baseline water heater energy factor (= depending on tank size; see table below)

Federal Standard Energy Factors for Water Heaters*

Tank Volume	EF_{BASE}
≤ 55 gallons	0.960−(0.003 × Rated Storage Volume in gallons)
< 55 gallons	2.057−(0.00113 × Rated Storage Volume in gallons)

* Minimum federal standard for capacity range. 2015 Federal Energy Conservation Standard for electric water heaters (e-CFR Title 10, Chapter II, Subchapter D, Part 430, Subpart C, Section 430.32)

EF_{EE} = Energy factor of HPWH system (= actual)

Summer Peak Coincident Demand Reduction

$$\Delta kW = \frac{GPH * 8.33 * (T_{OUT} - T_{IN})}{3{,}412} * \left(\frac{1}{EF_{BASE}} - \frac{1}{EF_{EE}}\right) * CF$$

Where:

GPH = Hot water consumption in gallons per hour (= determined from site-specific data)

CF = Summer peak coincidence factor (= 0.06)[253]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.[254]

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[253] "Technical Reference Manual (TRM) for Ohio Senate Bill 221 Energy Efficiency and Conservation Program and 09-512-GE- UNC." October 15, 2009. Based on Ohio utility supply profiles.

[254] The interactive effects between space heating and cooling requirements and HPWH have been neglected for this characterization but are candidates for future study. Heat pumps remove waste heat from surrounding air sources, which can reduce cooling loads and increase heating loads for HPWHs located in a conditioned space.

High Efficiency Storage Tank Water Heater (Time of Sale, Retrofit – Early Replacement)

	Measure Details
Official Measure Code	CI-SHW-StorWH-1
Measure Unit	Per water heater
Measure Category	Domestic Hot Water
Sector(s)	Commercial
Annual Energy Savings (kWh)	0
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	Varies by project
Lifetime Energy Savings (kWh)	0
Lifetime Fossil Fuel Savings (MMBtu)	Varies by project
Water Savings (gal/yr)	0
Effective Useful Life (years)	12
Incremental Cost	$300.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

Stand-alone, or tank-type heaters, run off natural gas. These water heaters consist of a storage tank with an attached heat source; in this case, a high-efficiency natural gas burner. This measure achieves energy savings through the use of efficient heating equipment and superior tank insulation.

Definition of Efficient Equipment

The efficient case is a natural gas-fired tank-type water heater exceeding the efficiency requirements as mandated ASHRAE 90.1-2007.

Definition of Baseline Equipment

The baseline condition is a natural gas-fired tank-type water heater meeting the efficiency requirements as mandated by ASHRAE 90.1-2007.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 12 years.[255]

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[255] The interactive effects between space heating and cooling requirements and HPWH have been neglected for this characterization but are candidates for future study. Heat pumps remove waste heat from surrounding air sources, which can reduce cooling loads and increase heating loads for HPWHs located in a conditioned space.

Deemed Measure Cost

The deemed measure cost is $300.00.[256]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

There are no expected energy savings associated with this measure.

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.

Fossil Fuel Impact Descriptions and Calculation

$$\Delta\text{MMBtu} = \frac{GPD * 365 * 8.3 * (T_{OUT} - T_{IN})}{1{,}000{,}000} * \left(\frac{1}{\eta_{BASE}} - \frac{1}{\eta_{EE}}\right) + \frac{8{,}760 * (STBY_{BASE} - STBY_{EE})}{1{,}000{,}000}$$

Where:

GPD = Water use of equipment in gallons per day (= see table in Reference Table section)

365 = Days of water heater operation per year

8.3 = Specific weight of water (8.3 lbs/gal) multiplied by the specify heat of water (1.0 $\frac{Btu}{lb*°F}$)

T_{OUT} = Water heater set point (= actual; otherwise assume 130°F)[257]

T_{IN} = Cold water temperature entering the DWH system (= depending on climate; see table below)

Groundwater Temperature (T_{IN}) by Location*

City	Groundwater Temperature (°F)
Indianapolis	58.1
South Bend	57.4
Terre Haute	60.5
Evansville	62.8
Ft Wayne	55.6

* Burch, J. and C. Christensen, National Renewable Energy Laboratory. *Towards Development of an Algorithm for Mains Water Temperature*. 2007. American Solar Energy Society, Colorado.

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[256] Ibid.

[257] National Association of Home Builders Research Center. *Performance Comparison of Residential Hot Water Systems.* Prepared for the National Renewable Energy Laboratory. 2002.

η_{BASE} = Rated efficiency (%) of baseline water heater expressed as energy factor or thermal efficiency (= see table below)

Efficiency of Baseline Water Heater by Size*

Equipment Type	Size Category (Input)	η_{BASE}	$STBY_{BASE}$
Storage water heaters, natural gas	≤ 155,000 Btu/h	0.80	$(Q/800) + 110V^{1/2}$
	> 155,000 Btu/h	0.80	$(Q/800) + 110V^{1/2}$

* Minimum federal standard for capacity range. 2015 Federal Energy Conservation Standard for electric water heaters (e-CFR Title 10, Chapter II, Subchapter D, Part 430, Subpart C, Section 430.32)

V = Rated tank volume in gallons (= actual)

Q = Nameplate input rate in Btu/hr (= actual)

η_{EE} = Rated efficiency (%) of efficient water heater expressed as energy factor or thermal efficiency (= actual)

8,760 = Hours per year

$STBY_{BASE}$ = Standby losses of baseline water heater in Btu/hr (= see table above)

$STBY_{EE}$ = Standby losses of efficient water heater in Btu/hr (= actual; note: for unit rated with energy factor, $STBY_{BASE}$ = 0)

1,000,000= Conversion factor from Btu to MMBtu

Reference Table

Rated Efficiency of Baseline Water Heater by Building Type

Building Type	GPD	Rate	Notes	Source
Assembly	150	5 per seat	Water not HOT water; assume 10% hot water, 300 seats	http://www.p2pays.org/ref/42/41980.pdf
Big Box	100		Assume like Small Office	Staff estimate
Fast Food	630	0.7 GPD per meal	50 meals per hour, 18 hours per day	NY TRM
Full Service Restaurant	1,152	2.4 GPD per meal	40 meals per hour, 18 hours per day	NY TRM
Grocery	200		Assume 2x Big Box	Staff estimate
Hospital	12,000	300 GDP per bed	Water not HOT water; assume 50% hot water, 80 beds	http://www.p2pays.org/ref/42/41980.pdf
Large Office	500	1.0 GPD per person	Assume 500 people	NY TRM
Light Industrial	1,250	25 GPD per person per shift	Water not HOT water; assume 50% hot water, 100 people per day	http://www.p2pays.org/ref/42/41980.pdf

Building Type	GPD	Rate	Notes	Source
Multifamily High-Rise	920	46 GPD per unit	20 units (2 people per unit, refer to table on page 66 of SF manual 12/16/09)	NY TRM
Multifamily Low-Rise	276	46 GPD per unit	6 units (2 people per unit, refer to table on page 66 of SF manual 12/16/09)	NY TRM
Primary School	300	0.6 GPD per student	500 students; reduce days per year to reflect school calendar	NY TRM
Small Office	100	1.0 GPD per person	100 people	NY TRM
Small Retail	50		Half of Big Box	Staff estimate
Auto repair	29		1-person household	Staff estimate
Community College	1,440		Assume like Secondary School	Staff estimate
Dormitory	14,700		Single-person household – 500 students	Staff estimate
Heavy Industrial	1,250	25 GPD per person per shift	Water not HOT water; assume 50% hot water, 100 people per day	http://www.p2pays.org/ref/42/41980.pdf
Hotel	9,000		75% of hotel	Staff estimate
Industrial Refrigeration	29		Assume like Auto Repair	Staff estimate
Motel	4,500		Assume half of Hotel – laundry done on site	Staff estimate
Multi Story Retail	75		150% of Small Retail	Staff estimate
Religious	150		Assume like Assembly	Staff estimate
Secondary School	1,440	1.8 GPD per student	800 students; reduce days per year to reflect school calendar	NY TRM
University	3,450	69 GPD per student	Water not HOT water; assume 10% hot water, 500 students	http://www.p2pays.org/ref/42/41980.pdf
Warehouse	100		Assume like Small Office	Staff estimate

Tankless Water Heaters (Time of Sale, Retrofit – Early Replacement)

	Measure Details
Official Measure Code	CI-SHW-TanklessWH-1
Measure Unit	Per water heater
Measure Category	Domestic Hot Water
Sector(s)	Commercial
Annual Energy Savings (kWh)	0
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	Varies by project
Lifetime Energy Savings (kWh)	0
Lifetime Fossil Fuel Savings (MMBtu)	Varies by project
Water Savings (gal/yr)	0
Effective Useful Life (years)	20
Incremental Cost	$871.47
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing a natural gas-fired tankless or instantaneous water heater. Tankless water heaters essentially function like regular water heaters without the storage tank. When there is demand for hot water, the natural gas burner fires and heats water as it passes through the heater to the demand source. Because the water heater must heat water at the rate of flow through the device, tankless water heaters are not well suited to serve sources of significant demand. Tankless water heaters achieve savings by eliminating the standby losses that occur from stand-alone or tank-type water heaters.

Definition of Efficient Equipment

The efficient condition is a tankless natural gas-fired water heater exceeding the efficiency requirements as mandated by the 2006 International Energy Conservation Code, Table 504.2.

Definition of Baseline Equipment

The baseline condition is a natural gas-fired tank-type water heater meeting the efficiency requirements as mandated by the 2006 International Energy Conservation Code, Table 504.2.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 20 years.[258]

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[258] CenterPoint Energy. *Triennial CIP/DSM Plan 2010-2012 Report.*

Deemed Measure Cost

The deemed measure cost for full installation is $871.74.[259] The incremental material cost is $433.72.

Deemed O&M Cost Adjustments

The expected O&M cost adjustment for this measure is $9.60.[260]

Savings Algorithm

Energy Savings

There are no expected energy savings associated with this measure.

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.

Fossil Fuel Impact Descriptions and Calculation

$$\Delta \text{MMBtu} = \frac{GPD * 365 * 8.3 * (T_{OUT} - T_{IN})}{1{,}000{,}000} * \left(\frac{1}{\eta_{BASE}} - \frac{1}{\eta_{EE}}\right) + \frac{8{,}760 * STBY_{BASE}}{1{,}000{,}000}$$

Where:

GPD = Water use for equipment in gallons per day (= see table in Reference Table section)

365 = Days of water heater operation per year

8.3 = Specific weight of water (8.3 lbs/gal) multiplied by the specific heat of water $(1.0 \frac{Btu}{lb * °\text{F}})$

T_{OUT} = Water heater set point (= actual; otherwise assume 130°F)[261]

T_{IN} = Cold water temperature entering the DWH system (= depending on climate; see table below)

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[259] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. “Cost Values and Summary Documentation.” December 16, 2008.

[260] CenterPoint Energy. *Triennial CIP/DSM Plan 2010-2012 Report.*

[261] National Association of Home Builders Research Center. *Performance Comparison of Residential Hot Water Systems.* Prepared for the National Renewable Energy Laboratory. 2002.

Groundwater Temperature (T_{IN}) by Location*

City	Groundwater Temperature (°F)
Indianapolis	58.1
South Bend	57.4
Terre Haute	60.5
Evansville	62.8
Ft Wayne	55.6

* Burch, J. and C. Christensen, National Renewable Energy Laboratory. *Towards Development of an Algorithm for Mains Water Temperature.* 2007. American Solar Energy Society, Colorado.

η_{BASE} = Rated efficiency (%) of baseline water heater expressed as energy factor or thermal efficiency (= see table below)

Efficiency of Baseline Water Heater by Size*

Equipment Type	Size Category (Input)	η_{BASE}	$STBY_{BASE}$
Storage water heaters, natural gas	≤ 155,000 Btu/h	0.80	$(Q/800) + 110V^{1/2}$
	> 155,000 Btu/h	0.80	$(Q/800) + 110V^{1/2}$

* Minimum federal standard for capacity range. 2015 Federal Energy Conservation Standard for electric water heaters (e-CFR Title 10, Chapter II, Subchapter D, Part 430, Subpart C, Section 430.32)

V = Rated tank volume in gallons (= actual)

Q = Nameplate input rate in Btu/hr (= actual)

η_{EE} = Rated efficiency (%) of efficient water heater expressed as energy factor or thermal efficiency (= actual)

8,760 = Hours of standby loss per year

$STBY_{BASE}$ = Standby losses of baseline water heater in Btu/hr (= see table above)

1,000,000= Conversion factor from Btu to MMBtu

Reference Table

Rated Efficiency of Baseline Water Heater by Building Type

Building Type	GPD	Rate	Notes	Source
Assembly	150	5 per seat	Water not HOT water; assume 10% hot water, 300 seats	http://www.p2pays.org/ref/42/41980.pdf
Big Box	100		Assume like Small Office	Staff estimate
Fast Food	630	0.7 GPD per meal	50 meals per hour, 18 hours per day	NY TRM
Full Service Restaurant	1,152	2.4 GPD per meal	40 meals per hour, 18 hours per day	NY TRM
Grocery	200		Assume 2x Big Box	Staff estimate

Building Type	GPD	Rate	Notes	Source
Hospital	12,000	300 GDP per bed	Water not HOT water; assume 50% hot water, 80 beds	http://www.p2pays.org/ref/42/41980.pdf
Large Office	500	1.0 GPD per person	Assume 500 people	NY TRM
Light Industrial	1,250	25 GPD per person per shift	Water not HOT water; assume 50% hot water, 100 people per day	http://www.p2pays.org/ref/42/41980.pdf
Multifamily High-Rise	920	46 GPD per unit	20 units (2 people per unit, refer to table on page 66 of SF manual 12/16/09)	NY TRM
Multifamily Low-Rise	276	46 GPD per unit	6 units (2 people per unit, refer to table on page 66 of SF manual 12/16/09)	NY TRM
Primary School	300	0.6 GPD per student	500 students; reduce days per year to reflect school calendar	NY TRM
Small Office	100	1.0 GPD per person	100 people	NY TRM
Small Retail	50		Half of Big Box	Staff estimate
Auto repair	29		1-person household	Staff estimate
Community College	1,440		Assume like Secondary School	Staff estimate
Dormitory	14,700		Single-person household – 500 students	Staff estimate
Heavy Industrial	1,250	25 GPD per person per shift	Water not HOT water; assume 50% hot water, 100 people per day	http://www.p2pays.org/ref/42/41980.pdf
Hotel	9,000		75% of hotel	Staff estimate
Industrial Refrigeration	29		Assume like Auto Repair	Staff estimate
Motel	4,500		Assume half of Hotel – laundry done on site	Staff estimate
Multi Story Retail	75		150% of Small Retail	Staff estimate
Religious	150		Assume like Assembly	Staff estimate
Secondary School	1,440	1.8 GPD per student	800 students; reduce days per year to reflect school calendar	NY TRM
University	3,450	69 GPD per student	Water not HOT water; assume 10% hot water, 500 students	http://www.p2pays.org/ref/42/41980.pdf
Warehouse	100		Assume like Small Office	Staff estimate

Food Service

Spray Nozzles for Food Service (Retrofit)

	Measure Details
Official Measure Code	CI-SHW-PRSV-1
Measure Unit	Per nozzle
Measure Category	Food Service
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	Varies by project
Lifetime Energy Savings (kWh)	Varies by project
Lifetime Fossil Fuel Savings (MMBtu)	Varies by project
Water Savings (gal/yr)	Varies by project
Effective Useful Life (years)	5
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

Pre-rinse valves use a spray of water to remove food waste from dishes prior to cleaning in a dishwasher. They reduce water consumption, water heating cost, and waste water (sewer) charges. Pre-rinse spray valves include a nozzle, squeeze lever, and dish guard bumper. The spray valves usually have a clip to lock the handle in the “on” position, and are inexpensive and easily interchangeable with different manufacturers’ assemblies. The primary impacts of this measure will be water savings. Energy savings depend on the type of water heating fuel; if the facility does not have electric water heating, there are no electric savings for this measure; if the facility does not have fossil fuel water heating, there are no MMBtu savings for this measure.

Definition of Efficient Equipment

The efficient equipment is a pre-rinse spray valve with a flow rate of 1.6 gallons per minute, and with a rate of cleaning performance of 26 seconds per plate or less.

Definition of Baseline Equipment

The baseline equipment is a spray valve with a flow rate of 3 gallons per minute.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 5 years.[262]

Deemed Measure Cost

The actual measure installation cost should be used (including material and labor).

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

If water heating is electric-based:

$$\Delta kWh = \Delta Water * HOT_{\%} * 8.3 * (\mathrm{T}_{OUT} - \mathrm{T}_{IN}) * \frac{1}{EFF_E * 3{,}412}$$

Where:

ΔWater = Water savings in gallons (= see calculation in Water Impact Descriptions and Calculation section)

$HOT_{\%}$ = Percentage of water used by pre-rinse spray valve that is heated (= 69%)[263]

8.3 = Specific weight of water (8.3 lbs/gal) multiplied by the specific heat of water $(1.0\,\frac{Btu}{lb*°\mathrm{F}})$

T_{OUT} = Water heater set point (= actual; otherwise assume 130°F)[264]

T_{IN} = Cold water temperature entering the DWH system (= depending on climate; see table below)

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[262] Federal Energy Management Program. *How to Buy a Low-Flow Pre-Rinse Spray Valve*. 2004. Used common assumption across efficiency programs.

[263] Navigant Consulting. *Measures and Assumptions for DSM Planning.* Prepared for the Ontario Energy Board. 2009. This factor is a candidate for future improvement through evaluation.

[264] National Association of Home Builders Research Center. *Performance Comparison of Residential Hot Water Systems.* Prepared for the National Renewable Energy Laboratory. 2002.

Groundwater Temperature (T_{IN}) by Location*

City	Groundwater Temperature (°F)
Indianapolis	58.1
South Bend	57.4
Terre Haute	60.5
Evansville	62.8
Ft Wayne	55.6

* Burch, J. and C. Christensen, National Renewable Energy Laboratory. *Towards Development of an Algorithm for Mains Water Temperature*. 2007. American Solar Energy Society, Colorado.

EFF_E = Water heater thermal efficiency (= 0.97)[265]

3,412 = Factor to convert from Btu to kWh

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure since there is insufficient peak coincident data.

Fossil Fuel Impact Descriptions and Calculation

If water heating is fossil fuel-based:

$$\Delta\text{MMBtu} = \Delta Water * HOT_{\%} * 8.33 * (\mathrm{T}_{OUT} - \mathrm{T}_{IN}) * \frac{1}{EFF_G} * 10^{-6}$$

Where:

ΔWater = Water savings in gallons (= see calculation in Water Impact Descriptions and Calculation section)

$HOT_{\%}$ = Percentage of water used by pre-rinse spray valve that is heated (= 69%)

EFF_G = Water heater thermal efficiency (= 0.58)[266]

10^{-6} = Factor to convert Btu to MMBtu

Water Impact Descriptions and Calculation

$$\Delta\text{Water} = (FLO_{BASE} - FLO_{EFF}) * 60 * \mathrm{H} * 365$$

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[265] ASHRAE 90.1-2007. Performance requirement for electric resistance water heaters.

[266] This is the baseline natural gas water heater thermal efficiency submitted in the natural gas utilities' 2009 proposed predetermined values and protocols to the Ohio Public Utility Commission (case no. 09-512-GE-UNC).

Where:

FLO_{BASE} = Flow rate of baseline spray nozzle (= 3 gallons per minute)

FLO_{EFF} = Flow rate of efficient equipment (= 1.6 gallons per minute)

60 = Minutes per hour

365 = Days per year

H = Hours used per day (= depending on facility type; see table below)

Hours per Day by Facility Type*

Facility Type	Hours of Pre-Rinse Spray Valve Use per Day
Full Service Restaurant	4
Other	2
Limited Service (Fast Food) Restaurant	1

* Pacific Gas & Electric savings estimates, algorithms, and sources from 2005.

ENERGY STAR Hot Food Holding Cabinet (Time of Sale)

	Measure Details
Official Measure Code	CI-Food-HoldCab-1
Measure Unit	Per cabinet
Measure Category	Food Services
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by size
Peak Demand Reduction (kW)	Varies by size
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by size
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	12
Incremental Cost	$1,110.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

Commercial insulated hot food holding cabinet models that meet program requirements incorporate better insulation reduced heat loss, and may offer additional energy-saving devices such as magnetic door electric gaskets, auto-door closures, or Dutch doors. The insulation of the cabinet also offers better temperature uniformity within the cabinet from top to bottom. This means that qualified hot food holding cabinets are more efficient at maintaining food temperature while using less energy.

Definition of Efficient Equipment

The efficient equipment is an ENERGY STAR-qualified hot food holding cabinet with an idle energy rate of 0.04 kW per cubic foot.

Definition of Baseline Equipment

The baseline equipment is a standard hot food holding cabinet with an idle energy rate of 0.1 kW per cubic foot.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 12 years.[267]

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[267] Food Service Technology Center. Default value from life cycle cost calculator. Available online: http://www.fishnick.com/saveenergy/tools/calculators/holdcabcalc.php

Deemed Measure Cost

The incremental cost for ENERGY STAR hot food holding cabinet is $1,110.00.[268]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = \frac{W_{FOOT\ BASE} - W_{FOOT\ EFF}}{1,000} * V * HOURS$$

Where:

$W_{FOOT\ BASE}$ = Electrical demand per cubic foot of baseline equipment (= use table below)

$W_{FOOT\ EFF}$ = Electrical demand per cubic foot of efficient equipment (= actual; otherwise, use table below)[269]

1,000 = Conversion from watts to kW

V = Internal volume of the holding cabinet in cubic feet (= actual)

HOURS = Annual operating hours (= 5,475)[270]

Parameters Based on Cabinet Size

Parameter	Small	Medium	Large
V	V < 13	13 ≤ V < 28	28 ≤ V
$W_{FOOT\ BASE}$	40	40	40
$W_{FOOT\ EFF}$	21.5 * V	(2 * V) + 254	(3.8 * V) + 203.5

* Food Service Technology Center. Default value from life cycle cost calculator. Available online: http://www.fishnick.com/saveenergy/tools/calculators/holdcabcalc.php

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[268] New York State Energy Research and Development Authority. *Deemed Savings Database.*

[269] ENERGY STAR requirements: http://www.energystar.gov/index.cfm?c=hfhc.pr_crit_hfhc

[270] Food Service Technology Center. Based on assumption that restaurant is open 15 hours a day, 365 days a year.

Summer Peak Coincident Demand Reduction

$$\Delta \mathrm{kW} = \frac{W_{FOOT\ BASE} - W_{FOOT\ EFF}}{1,000} * VOLUME * CF$$

Where:

CF = Summer peak coincidence factor (= 0.84)[271]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[271] RLW Analytics. *Coincidence Factor Study – Residential and Commercial Industrial Lighting Measures.* Spring 2007.

Steam Cookers (Time of Sale)

	Measure Details
Official Measure Code	CI-Food-StmCook-1
Measure Unit	Per steam cooker
Measure Category	Food Services
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by pan quantity
Peak Demand Reduction (kW)	Varies by pan quantity
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by pan quantity
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	Varies by pan quantity
Effective Useful Life (years)	12
Incremental Cost	$3,500.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

Energy-efficient steam cookers that have earned the ENERGY STAR designation offer shorter cook times, higher production rates, and reduced heat loss due to better insulation and a more efficient steam delivery system. Energy usage calculations are based on 12 hours a day, 365 days per year, with one preheat and cooking 100 pounds of food per day.

Definition of Efficient Equipment

The efficient condition is installing an ENERGY STAR-qualified steam cooker.

Definition of Baseline Equipment

The baseline condition is a conventional boiler-style steam cooker meeting minimum federal standards for electricity and water consumption.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 12 years.[272]

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[272] Food Service Technology Center. Default value from life cycle cost calculator. Available online: http://www.fishnick.com/saveenergy/tools/calculators/esteamercalc.php

Deemed Measure Cost

The incremental cost of an ENERGY STAR steam cooker is $3,500.00.[273]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = kWh_{BASE} - kWh_{EFF}$$

$$kWh_{BASE} = \left(\frac{LB * E_{FOOD}}{EFF} + IDLE * \left(HOURS_{DAY} - \frac{LB}{PC} - \frac{PRE_{TIME}}{60}\right) + PRE_{ENERGY}\right) * DAYS$$

$$kWh_{EFF} = \left(\frac{LB * E_{FOOD}}{EFF} + IDLE * \left(HOURS_{DAY} - \frac{LB}{PC} - \frac{PRE_{TIME}}{60}\right) + PRE_{ENERGY}\right) * DAYS$$

Where:

kWh_{BASE} = Annual energy usage of baseline equipment

kWh_{EFF} = Annual energy usage of efficient equipment

$HOURS_{DAY}$ = Daily operating hours (= 12)[274]

PRE_{TIME} = Preheat time for a steamer to reach operating temperature when turned on (= 15 minutes/day)[275]

PRE_{ENERGY} = Preheat energy (= 1.5 kWh/day)[276]

E_{FOOD} = American Society for Testing Materials (ASTM) Energy to Food; the amount of energy absorbed by the food during cooking (= 0.0308 kWh/lb)

DAYS = Operating days per year (= 365)

The following variables are dependent on the pan capacity of efficient equipment, which is site specific (see table below).

EFF = Heavy load cooking energy efficiency percentage

IDLE = Idle energy rate

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[273] Average of New York State Energy Research and Development Authority *Deemed Savings Database* and ENERGY STAR website.

[274] Food Service Technology Center. Based on assumption that restaurant is open 12 hours a day, 365 days a year.

[275] Food Service Technology Center. *Commercial Cooking Appliance Technology Assessment.* Chapter 8: Steamers. 2002.

[276] Ibid.

PC = Production capacity (lbs/hr)

LB = Pounds of food cooked per day (lbs/day)

Parameters that Vary by Number of Pans*

Number of Pans	Parameter	Baseline Model	Efficient Model
3	Idle Energy Rate (kW)*	1	0.24
	Production Capacity (lb/hr)	70	50
	Pounds of Food Cooked per Day	100	100
	Heavy Load Cooking Energy Efficiency**	20%	59%
4	Idle Energy Rate (kW)	1.325	0.27
	Production Capacity (lb/hr)	87	67
	Pounds of Food Cooked per Day	128	128
	Heavy Load Cooking Energy Efficiency**	20%	52%
5	Idle Energy Rate (kW)	1.675	0.24
	Production Capacity (lb/hr)	103	83
	Pounds of Food Cooked per Day	160	160
	Heavy Load Cooking Energy Efficiency**	20%	62%
6	Idle Energy Rate (kW)	2	0.31
	Production Capacity (lb/hr)	120	100
	Pounds of Food Cooked per Day	192	192
	Heavy Load Cooking Energy Efficiency**	20%	62%

* Values for ASTM parameters for baseline and efficient conditions (unless otherwise noted) were determined by FSTC according to ASTM F1484, the Standard Test Method for Performance of Steam Cookers. These parameters include the three of the four listed in the table below: Idle Energy Rate, Production Capacity, and Heavy Load Cooking Efficiency.

** Efficient values calculated from a list of ENERGY STAR qualified products. See “ES Steam Cooker Analysis.xls” for details.

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW} = \frac{\Delta kWh}{HOURS} * CF$$

Where:

ΔkWh = Annual energy savings

HOURS = Equivalent full load hours (= 4,380)

CF = Summer peak coincidence factor (= 0.84)[277]

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[277] RLW Analytics. *Coincidence Factor Study – Residential and Commercial Industrial Lighting Measures*. Spring 2007.

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

Water Impact Descriptions and Calculation

$$\Delta\text{Water} = (Rate_{BASE} - Rate_{EFF}) * EFLH = 30 * \text{EFLH}$$

Where:

ΔWater = Annual water savings in gallons

$\text{Rate}_{\text{BASE}}$ = Water consumption rate of baseline equipment (= 40 gal/hr)[278]

Rate_{EFF} = Water consumption rate of efficient equipment (= 10 gal/hr)[279]

EFLH = Equivalent full load hours (= 4,380)

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[278] Food Service Technology Center. *Commercial Cooking Appliance Technology Assessment.* Chapter 8: Steamers. 2002.

[279] Ibid.

ENERGY STAR Fryers (Time of Sale)

	Measure Details
Official Measure Code	CI-Food-Fryer-1
Measure Unit	Per fryer
Measure Category	Food Service
Sector(s)	Commercial
Annual Energy Savings (kWh)	983
Peak Demand Reduction (kW)	0.22
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	11,796
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	12
Incremental Cost	$500.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

Commercial fryers that have earned the ENERGY STAR designation offer shorter cook times and higher production rates through advanced burner and heat exchanger designs. Fry pot insulation reduces standby losses, resulting in a lower idle energy rate. ENERGY STAR fryers are up to 30% more efficient than standard models. Energy savings estimates are based on a 15-inch fryer.

Definition of Efficient Equipment

The efficient equipment is an ENERGY STAR-qualified electric fryer.

Definition of Baseline Equipment

The baseline equipment is a standard electric fryer with a heavy load efficiency of 75%.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 12 years.[280]

Deemed Measure Cost

The incremental cost for commercial combination ovens is $500.00.[281]

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[280] Food Service Technology Center. Default value from lifecycle cost calculator. Available online: http://www.fishnick.com/saveenergy/tools/calculators/efryer.php

[281] New York State Energy Research and Development Authority. *Deemed Savings Database*.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = kWh_{BASE} - kWh_{EFF}$$

$$\text{kWh}_{\text{BASE}} = \left(\frac{LB * E_{FOOD}}{EFF} + \frac{IDLE}{1{,}000} * \left(HOURS_{DAY} - \frac{LB}{PC} - \frac{PRE_{TIME}}{60}\right) + PRE_{ENERGY}\right) * DAYS$$

$$\text{kWh}_{\text{EFF}} = \left(\frac{LB * E_{FOOD}}{EFF} + \frac{IDLE}{1{,}000} * \left(HOURS_{DAY} - \frac{LB}{PC} - \frac{PRE_{TIME}}{60}\right) + PRE_{ENERGY}\right) * DAYS$$

Where:

kWh_{BASE} = Annual energy usage of baseline equipment

kWh_{EFF} = Annual energy usage of efficient equipment

$\text{HOURS}_{\text{DAY}}$ = Daily operating hours (= 16)[282]

PRE_{TIME} = Preheat time for a fryer to reach operating temperature when turned on (= 15 min/day)[283]

E_{FOOD} = ASTM Energy to Food; the amount of energy absorbed by the food during cooking (= 0.167 kWh/lb)[284]

LB = Pounds of food cooked per day (= 150 lbs/day)[285]

DAYS = Days of operation in year (= 365)

EFF = Heavy load cooking energy efficiency

IDLE = Idle energy rate (kW)

PC = Production capacity (lbs/hr)

$\text{PRE}_{\text{ENERGY}}$ = Preheat energy kilowatt-hours per day (= see table below)

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[282] Food Service Technology Center. Based on assumption that restaurant is open 16 hours a day, 365 days a year.

[283] Food Service Technology Center. *Commercial Cooking Appliance Technology Assessment.* Chapter 7: Fryers. 2002.

[284] American Society for Testing and Materials. *Industry Standard for Commercial Ovens.*

[285] Food Service Technology Center. Default value from lifecycle cost calculator. Available online: http://www.fishnick.com/saveenergy/tools/calculators/ecombicalc.php

Performance Metrics: Baseline and Efficient Values

Metric	Baseline Model*	Energy Efficient Model**
PRE_{ENERGY}	2.3	1.7
IDLE	1.05	0.84
EFF	75%	84%
PC	65	70

* Food Service Technology Center. Default value from life cycle cost calculator. Available online: http://www.fishnick.com/saveenergy/tools/calculators/ecombicalc.php

** For calculation, use actual values for these metrics if available. Table is populated with efficient values that reflect averages from a list of qualifying models found on the ENERGY STAR website.

Summer Peak Coincident Demand Reduction

$$\Delta kW = \frac{\Delta kWh}{HOURS} * CF$$

Where:

ΔkWh = Annual energy savings

HOURS = Equivalent full load hours (= 5,840)

CF = Summer peak coincidence factor (= 0.84)[286]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[286] RLW Analytics. *Coincidence Factor Study – Residential and Commercial Industrial Lighting Measures*. Spring 2007.

ENERGY STAR Combination Oven (Time of Sale)

	Measure Details
Official Measure Code	CI-Food-CombiOven-1
Measure Unit	Per oven
Measure Category	Food Services
Sector(s)	Commercial
Annual Energy Savings (kWh)	18,432
Peak Demand Reduction (kW)	3.53
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	221,184
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	87,600 gallons per year
Effective Useful Life (years)	12
Incremental Cost	$2,125.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

A combination oven is a convection oven that includes the added capability to inject steam into the oven cavity, and which typically offers at least three distinct cooking modes.

Definition of Efficient Equipment

The efficient equipment is an electric combination oven with a heavy load cooking energy efficiency of at least 60%.

Definition of Baseline Equipment

The baseline equipment is a typical low-efficiency oven with a heavy load efficiency of 44%.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 12 years.[287]

Deemed Measure Cost

The incremental cost for commercial combination ovens is $2,125.00.[288]

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[287] Food Service Technology Center. Default value from lifecycle cost calculator. Available online: http://www.fishnick.com/saveenergy/tools/calculators/ecombicalc.php

[288] New York State Energy Research and Development Authority. *Deemed Savings Database*.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = kWh_{BASE} - kWh_{EFF}$$

$$\text{kWh}_{\text{BASE}} = \left(\frac{LB * E_{FOOD}}{EFF} + IDLE * \left(HOURS_{DAY} - \frac{LB}{PC} - \frac{PRE_{TIME}}{60}\right) + PRE_{ENERGY}\right) * DAYS$$

$$\text{kWh}_{\text{EFF}} = \left(\frac{LB * E_{FOOD}}{EFF} + IDLE * \left(HOURS_{DAY} - \frac{LB}{PC} - \frac{PRE_{TIME}}{60}\right) + PRE_{ENERGY}\right) * DAYS$$

Where:

kWh_{BASE} = Annual energy usage of baseline equipment

kWh_{EFF} = Annual energy usage of efficient equipment

$\text{HOURS}_{\text{DAY}}$ = Daily operating hours (= 12)[289]

DAYS = Days per year of operation (= 365)

PRE_{TIME} = Preheat time for a steamer to reach operating temperature when turned on (= 15 min/day)[290]

E_{FOOD} = ASTM Energy to Food; the amount of energy absorbed by the food during cooking (= 0.0732 kWh/lb)[291]

LB = Pounds of food cooked per day (= 200)[292]

EFF = Heavy load cooking energy efficiency

IDLE = Idle energy rate (kW))

PC = Production capacity (lb/hr)

$\text{PRE}_{\text{ENERGY}}$ = Preheat energy kilowatt-hours per day (= see table below)

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[289] Food Service Technology Center. Based on assumption that restaurant is open 12 hours a day, 365 days a year.

[290] Food Service Technology Center. *Commercial Cooking Appliance Technology Assessment.* Chapter 7: Ovens. 2002.

[291] American Society for Testing and Materials. *Industry Standard for Commercial Ovens.*

[292] Food Service Technology Center. Default value from lifecycle cost calculator. Available online: http://www.fishnick.com/saveenergy/tools/calculators/ecombicalc.php

Performance Metrics: Baseline and Efficient Values*

Metric	Baseline Model	Energy-Efficient Model
PRE_{ENERGY} (kWh)	3	1.5
IDLE (kW)	7.5	3
EFF	44%	60%
PC (lb/hr)	80	100

* Food Service Technology Center. Default value from lifecycle cost calculator. Available online: http://www.fishnick.com/saveenergy/tools/calculators/ecombicalc.php

Summer Peak Coincident Demand Reduction

$$\Delta kW = \frac{\Delta kWh}{HOURS} * CF$$

Where:

ΔkWh = Annual energy savings

HOURS = Equivalent full load hours (= 4,380)

CF = Summer peak coincidence factor (= 0.84)[293]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

Water Impact Descriptions and Calculation

The water savings for commercial combination ovens are 87,600 gallons per year.[294]

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[293] RLW Analytics. *Coincidence Factor Study – Residential and Commercial Industrial Lighting Measures*. Spring 2007.

[294] Food Service Technology Center. Based on assumption that baseline ovens use water at an average rate of 40 gallons per hour while efficient models use water at an average rate of 20 gallons per hour.

ENERGY STAR Convection Oven (Time of Sale)

	Measure Details
Official Measure Code	CI-Food-ConvOven-1
Measure Unit	Per oven
Measure Category	Food Service
Sector(s)	Commercial
Annual Energy Savings (kWh)	3,235
Peak Demand Reduction (kW)	0.62
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	38,820
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	12
Incremental Cost	$1,113.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

Commercial convection ovens that are ENERGY STAR-certified have higher heavy load cooking efficiencies and lower idle energy rates, making them an average of 20% more efficient than standard models. Energy savings estimates are for ovens using full size (18-inch x 36-inch) sheet pans.

Definition of Efficient Equipment

The efficient equipment is an ENERGY STAR-qualified electric convection oven.

Definition of Baseline Equipment

The baseline equipment is a standard convection oven with a heavy load efficiency of 65%.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 12 years.[295]

Deemed Measure Cost

The incremental cost for commercial convection ovens is $1,113.00.[296]

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[295] Food Service Technology Center. Default value from lifecycle cost calculator. Available online: http://www.fishnick.com/saveenergy/tools/calculators/ecombicalc.php

[296] New York State Energy Research and Development Authority. *Deemed Savings Database.*

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = kWh_{BASE} - kWh_{EFF}$$

$$kWh_{BASE} = \left(\frac{LB*E_{FOOD}}{EFF} + \frac{IDLE}{1{,}000} * \left(HOURS_{DAY} - \frac{LB}{PC} - \frac{PRE_{TIME}}{60}\right) + PRE_{ENERGY}\right) * DAYS$$

$$kWh_{EFF} = \left(\frac{LB*E_{FOOD}}{EFF} + \frac{IDLE}{1{,}000} * \left(HOURS_{DAY} - \frac{LB}{PC} - \frac{PRE_{TIME}}{60}\right) + PRE_{ENERGY}\right) * DAYS$$

Where:

kWh_{BASE} = Annual energy usage of baseline equipment

kWh_{EFF} = Annual energy usage of efficient equipment

$HOURS_{DAY}$ = Daily operating hours (= 12)[297]

DAYS = Days per year of operation (= 365)

PRE_{TIME} = Preheat time for a steamer to reach operating temperature when turned on (= 15 min/day)[298]

E_{FOOD} = ASTM Energy to Food; the amount of energy absorbed by the food during cooking (= 0.0732 kWh/lb)[299]

LB = Pounds of food cooked (= 100 lb/day)[300]

EFF = Heavy load cooking energy efficiency percentage (= see table below)

IDLE = Idle energy rate (= see table below)

PC = Production capacity in pounds per hour (= see table below)

PRE_{ENERGY} = Preheat energy in kilowatt-hours per day (= see table below)

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[297] Food Service Technology Center. Based on assumption that restaurant is open 12 hours a day, 365 days a year.

[298] Food Service Technology Center. *Commercial Cooking Appliance Technology Assessment*. Chapter 7: Ovens. 2002.

[299] American Society for Testing and Materials. *Industry Standard for Commercial Ovens*.

[300] Food Service Technology Center. Default value from lifecycle cost calculator. Available online: http://www.fishnick.com/saveenergy/tools/calculators/ecombicalc.php

Performance Metrics: Baseline and Efficient Values*

Metric	Baseline Model	Energy-Efficient Model
PRE$_{ENERGY}$ (kWh)	1.5	1
IDLE (kW)	2	1.3**
EFF	65%	74%**
PC (lb/hr)	70	80

* Food Service Technology Center. Default value from lifecycle cost calculator. Available online: http://www.fishnick.com/saveenergy/tools/calculators/ecombicalc.php

** For calculation, use actual values for these metrics, if available. Table is populated with efficient values which reflect averages from a list of qualifying models found on the ENERGY STAR website.

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = \frac{\Delta\, kWh}{HOURS} * CF$$

Where:

ΔkWh = Annual energy savings

HOURS = Equivalent full load hours (= 4,380)

CF = Summer peak coincidence factor (= 0.84)[301]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[301] RLW Analytics. *Coincidence Factor Study – Residential and Commercial Industrial Lighting Measures*. Spring 2007.

ENERGY STAR Griddle (Time of Sale)

	Measure Details
Official Measure Code	CI-Food-Griddle-1
Measure Unit	Per griddle
Measure Category	Food Service
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	
Lifetime Fossil Fuel Savings (MMBtu)	
Water Savings (gal/yr)	0
Effective Useful Life (years)	12
Incremental Cost	$2,090.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

ENERGY STAR-qualified commercial griddles have higher cooking energy efficiency and lower idle energy rates than standard equipment. This results in more energy being absorbed by the food compared with the total energy use, and less wasted energy when the griddle is in standby mode.

Definition of Efficient Equipment

The efficient equipment is an ENERGY STAR-qualified griddle with a cooking energy efficiency greater than 70%.

Definition of Baseline Equipment

The baseline equipment is a conventional electric griddle with a cooking energy efficiency of 60%.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 12 years.[302]

Deemed Measure Cost

The incremental cost of an ENERGY STAR griddle is $2,090.00.[303]

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[302] Food Service Technology Center. Default value from lifecycle cost calculator. Available online: http://www.fishnick.com/saveenergy/tools/calculators/egridcalc.php

[303] New York State Energy Research and Development Agency. *Deemed Savings Database, Rev. 12*. 2008.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = kWh_{BASE} - kWh_{EE}$$

$$kWh_{BASE} = \left(\frac{LB * E_{FOOD}}{\eta_{BASE}} + \mathrm{IE}_{BASE} * \left(H - \frac{LB}{PC_{BASE}} - \frac{T_P}{60}\right) + E_{P,BASE}\right) * DAYS$$

$$kWh_{EFF} = \left(\frac{LB * E_{FOOD}}{\eta_{EFF}} + \mathrm{IE}_{EFF} * \left(H - \frac{LB}{PC_{EFF}} - \frac{T_{PRE}}{60}\right) + E_{P,EFF}\right) * DAYS$$

Where:

kWh_{BASE} = Annual energy usage of baseline equipment

kWh_{EFF} = Annual energy usage of efficient equipment

LB = Pounds of food cooked per day (= actual; otherwise = 100)

E_{FOOD} = ASTM Energy to Food; the amount of energy absorbed by the food during cooking (= 0.139 kWh/lb)[304]

η_{BASE} = Heavy load cooking energy efficiency of baseline griddle (= see table below)

IE_{BASE} = Idle energy rate of baseline griddle (= see table below)

H = Daily operating hours (= actual; otherwise = 12)[305]

PC_{BASE} = Production capacity of baseline griddle (= see table below)

T_P = Preheat time for a steamer to reach operating temperature when turned on (= actual; otherwise 15 min/day)[306]

60 = Minutes per hour

$E_{P,BASE}$ = Preheat energy per day for baseline griddle (= see table below)

DAYS = Operating days per year (= actual; otherwise = 365)

η_{EFF} = Heavy load cooking energy efficiency of efficient griddle (= actual, otherwise, see table below)

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[304] American Society for Testing and Materials. Industry Standard.

[305] Food Service Technology Center. Based on assumption that restaurant is open 12 hours a day, 365 days a year.

[306] Food Service Technology Center. *Commercial Cooking Appliance Technology Assessment*. Chapter 3: Griddles. 2002.

IE_{EFF} = Idle energy rate of efficient griddle (= see table below)

PC_{EFF} = Production capacity of efficient griddle (= see table below)

$E_{P,EFF}$ = Preheat energy per day for efficient griddle (= see table below)

Efficient Griddle Performance Metrics: Baseline and Efficient Values*

Parameter	Baseline Model	Efficient Model
η (%)	60%	75%
IE (kW)	2.4	0.05
PC (lb/hr)	35	51
E_{PRE} (kWh/day)	4	2

* An average pan width of 3 feet has been assumed based on a survey of available equipment. Baseline values based on assumptions from FSTC lifecycle cost calculator. Efficient values reflect averages from a list of qualifying models found on the ENERGY STAR website (accessed June 2015).

Summer Peak Coincident Demand Reduction

$$\Delta kW = \frac{\Delta kWh}{HOURS} * CF$$

Where:

ΔkWh = Annual energy savings

HOURS = Annual operating hours (= 4,380)

CF = Summer peak coincidence factor (= 0.84)[307]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[307] Verification of summer peak coincidence factor is pending further information from the utilities.

HVAC

Electric Chiller (Time of Sale)

	Measure Details
Official Measure Code	CI-HVAC-chiller-1
Measure Unit	Per chiller
Measure Category	HVAC
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by equipment type and location
Peak Demand Reduction (kW)	Varies by equipment type and location
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by equipment type and location
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	20
Incremental Cost	Varies by equipment type and location
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure relates to the installation of a new electric chiller meeting the efficiency standards presented below. This measure could relate to replacing an existing unit at the end of its useful life, or installing a new system in an existing building (i.e., time of sale). Only single-chiller applications should be assessed with this methodology. Multiple chiller projects should be evaluated on a custom basis.

Definition of Efficient Equipment

The efficient equipment is assumed to exceed the efficiency requirements of ASHRAE Standard 90.1-2007 Table 6.8.1.

Definition of Baseline Equipment

The baseline equipment is assumed to meet the efficiency requirements of the ASHRAE Standard 90.1-2007 Table 6.8.1.

Deemed Lifetime of Efficient Equipment

The expected measure life is 20 years.[308]

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[308] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05.* Effective/Remaining Useful Life Values. December 16, 2008. Available online: http://deeresources.com/deer0911planning/downloads/EUL_Summary_10-1-08.xls

Deemed Measure Cost

The incremental capital cost for this measure is provided below.

Incremental Capital Cost by Equipment Type

Equipment Type	Size Category	IPLV	COP	Incremental Cost ($/ton)
Air-Cooled Electrically Operated	All Capacities	3.36	3.08	$58.58
		3.66	3.36	$106.23
Water-Cooled Screw Chiller	<150 Ton	5.58	4.95	$55.63
		6.28	5.58	$111.25
	150 - 300 Ton	6.17	5.41	$39.76
		6.89	6.17	$79.52
	>300 Ton	6.89	6.06	$27.94
		7.64	6.89	$55.87
Water-Cooled Centrifugal Chiller	<150 Ton	5.86	5.58	$83.05
		6.63	6.28	$166.10
	150 - 300 Ton	6.51	6.17	$61.44
		7.33	6.89	$122.87
	>300 Ton	7.18	6.76	$46.11
		7.99	7.64	$92.22

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = TONS * \left(\frac{3.516}{IPLV_{BASE}} - \frac{3.516}{IPLV_{EE}}\right) * EFLH$$

Where:

TONS = Chiller nominal cooling capacity in tons (= actual; 1 ton = 12,000 Btu/hr)

3.516 = Conversion factor to express integrated part load value in kW per ton

$IPLV_{BASE}$ = Efficiency of baseline equipment expressed as integrated part load value (= dependent on chiller type; see table below)

Baseline Efficiency Values by Chiller Type and Capacity

Equipment Type	Size Category	Baseline Efficiency ($IPLV_{BASE}$, COP_{BASE})
Air cooled, with condenser, electrically operated	All capacities	3.05 IPLV, 2.80 COP
Air cooled, without condenser, electrically operated	All capacities	3.45 IPLV, 3.10 COP
Water cooled, electrically operated, positive displacement (reciprocating)	All capacities	5.05 IPLV, 4.20 COP
Water cooled, electrically operated, positive displacement (rotary screw and scroll)	< 150 tons	5.20 IPLV, 4.45 COP
	≥ 150 tons and < 300 tons	5.60 IPLV, 4.90 COP
	≥ 300 tons	6.15 IPLV, 5.50 COP
Water cooled, electrically operated, centrifugal	< 150 tons	5.25 IPLV, 5.00 COP
	≥ 150 tons and < 300 tons	5.90 IPLV, 5.55 COP
	≥ 300 tons	6.40 IPLV, 6.10 COP

Source: ASHRAE 90.1-2007 Table 6.8.1B.

$IPLV_{EE}$ = Efficiency of high-efficiency equipment expressed as integrated part load value (= actual)[309]

EFLH = Equivalent full load hours (= dependent on location and building type, see table below)

Equivalent Full Load Hours by Building Type and Location

Building	System	Indianapolis	South Bend	Evansville	Ft. Wayne	Terre Haute
Community College	Constant Volume No Economizer	1,314	1,090	1,632	1,124	1,320
	Constant Volume Economizer	966	840	1,167	821	955
	Variable Air Volume Economizer	736	621	881	642	680
Hotel	Constant Volume No Economizer	3,999	3,766	4,424	3,999	4,240
	Constant Volume Economizer	3,786	3,541	4,238	3,786	4,034
	Variable Air Volume Economizer	3,732	3,480	4,161	3,732	3,899
Large Retail	Constant Volume No Economizer	2,065	1,899	2,243	2,006	2,164
	Constant Volume Economizer	1,289	1,118	1,545	1,183	1,405
	Variable Air Volume Economizer	1,065	904	1,297	969	1,196
University	Constant Volume No Economizer	1,927	1,805	2,140	1,958	1,833
	Constant Volume Economizer	727	739	917	754	682
	Variable Air Volume Economizer	950	927	1,157	884	795

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[309] Integrated Part Load Value is simply a seasonal average efficiency rating calculated in accordance with ARI Standard 550/590. It may be calculated using any measure of efficiency (EER, kW/ton, COP), but for consistency with IECC 2006, it is expressed in terms of COP here.

Building	System	Indianapolis	South Bend	Evansville	Ft. Wayne	Terre Haute
Large Office	Constant Volume No Economizer	3,302	2,786	3,300	3,107	3,197
	Constant Volume Economizer	876	897	1,118	916	981
	Variable Air Volume Economizer	992	864	1,042	801	999
High School	Constant Volume No Economizer	1,039	1,003	1,125	995	979
	Constant Volume Economizer	558	519	696	513	570
	Variable Air Volume Economizer	426	359	505	397	383
Hospital	Constant Volume No Economizer	3,777	3,199	4,267	3,538	3,870
	Constant Volume Economizer	2,182	1,830	2,684	1,997	2,416
	Variable Air Volume Economizer	1,554	1,365	1,860	1,442	1,746

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW} = TONS * \left(\frac{3.516}{COP_{BASE}} - \frac{3.516}{COP_{EE}}\right) * CF$$

Where:

COP_{BASE} = Efficiency of baseline equipment (= dependent on chiller type; see table above)

COP_{ee} = Efficiency of high-efficiency equipment (= actual)

CF = Summer peak coincidence factor (= 74%)[310]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[310] The summer peak coincidence factor has been preserved from the *Technical Reference Manual (TRM) for Ohio Senate Bill 221 Energy Efficiency and Conservation Program and 09-512-GE-UNC*, dated October 15, 2009. This is likely a conservative estimate, and is recommended for further study.

Chiller Tune-Up

	Measure Details
Official Measure Code	CI-HVAC-ChillerTune-1
Measure Unit	Per Unit
Measure Category	HVAC
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by equipment type and location
Peak Demand Reduction (kW)	Varies by equipment type and location
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by equipment type and location
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	5
Incremental Cost	Varies by equipment type and location
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the tune-up of an existing air-cooled or water-cooled chiller. The tune-up consists of tube cleaning, chilled and condenser water temperature adjustments, and reciprocating compressor unloading switch adjustments.

Definition of Efficient Equipment

The efficient condition is an existing chiller post tune-up.

Definition of Baseline Equipment

The baseline condition is an existing chiller pre tune-up.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 5 years.

Deemed Measure Cost

The incremental cost for this measure varies.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = TONS * \frac{3.516}{IPLV_{BASE}} * EFLH * ESF$$

Where:

TONS = Chiller nominal cooling capacity in tons (= actual; 1 ton = 12,000 Btu/hr)

3.516 = Conversion factor to express integrated part load value in kW per ton

$IPLV_{BASE}$ = Efficiency of existing equipment expressed as integrated part load value (= dependent on chiller type; see table below)

Baseline Efficiency Values by Chiller Type and Capacity

Equipment Type	Size Category	Baseline Efficiency ($IPLV_{BASE}$, COP_{BASE})
Air cooled, with condenser, electrically operated	All capacities	3.05 IPLV, 2.80 COP
Air cooled, without condenser, electrically operated	All capacities	3.45 IPLV, 3.10 COP
Water cooled, electrically operated, positive displacement (reciprocating)	All capacities	5.05 IPLV, 4.20 COP
Water cooled, electrically operated, positive displacement (rotary screw and scroll)	< 150 tons	5.20 IPLV, 4.45 COP
	≥ 150 tons and < 300 tons	5.60 IPLV, 4.90 COP
	≥ 300 tons	6.15 IPLV, 5.50 COP
Water cooled, electrically operated, centrifugal	< 150 tons	5.25 IPLV, 5.00 COP
	≥ 150 tons and < 300 tons	5.90 IPLV, 5.55 COP
	≥ 300 tons	6.40 IPLV, 6.10 COP

Source: ASHRAE 90.1-2007 Table 6.8.1B.

ESF = Energy savings factor (= 0.08)

EFLH = Equivalent full load hours (= dependent on location and building type;[311] see table below)

Equivalent Full Load Hours by Building Type and Location

Building	System	Indianapolis	South Bend	Evansville	Ft. Wayne	Terre Haute
Community College	CAV no econ	1,314	1,090	1,632	1,124	1,320
	CAV econ	966	840	1,167	821	955
	VAV econ	736	621	881	642	680
Hotel	CAV no econ	3,999	3,766	4,424	3,999	4,240
	CAV econ	3,786	3,541	4,238	3,786	4,034

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[311] EFLH data were derived from building energy simulation models. See Appendix A.

Building	System	Indianapolis	South Bend	Evansville	Ft. Wayne	Terre Haute
	VAV econ	3,732	3,480	4,161	3,732	3,899
Large Retail	CAV no econ	2,065	1,899	2,243	2,006	2,164
	CAV econ	1,289	1,118	1,545	1,183	1,405
	VAV econ	1,065	904	1,297	969	1,196
University	CAV no econ	1,927	1,805	2,140	1,958	1,833
	CAV econ	727	739	917	754	682
	VAV econ	950	927	1,157	884	795
Large Office	CAV no econ	3,302	2,786	3,300	3,107	3,197
	CAV econ	876	897	1,118	916	981
	VAV econ	992	864	1,042	801	999
High School	CAV no econ	1,039	1,003	1,125	995	979
	CAV econ	558	519	696	513	570
	VAV econ	426	359	505	397	383
Hospital	CAV no econ	3,777	3,199	4,267	3,538	3,870
	CAV econ	2,182	1,830	2,684	1,997	2,416
	VAV econ	1,554	1,365	1,860	1,442	1,746

For example, energy savings for the tune-up of a 300-ton chiller with an IPLV of 6.0 serving an office with a variable air volume system in Indianapolis is calculated as:

$$\Delta\text{kWh} = TONS * \frac{3.516}{IPLV_{BASE}} * EFLH * ESF = 300 * \frac{3.516}{6.0} * 992 * 0.08 = 13{,}951\ \text{kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW} = TONS * \frac{3.516}{COP_{BASE}} * CF * DSF$$

Where:

COP_{BASE} = Efficiency of baseline equipment (= dependent on chiller type; see table below)

Baseline Efficiency Values by Chiller Type and Capacity

Equipment Type	Size Category	Baseline Efficiency ($IPLV_{BASE}$, COP_{BASE})
Air cooled, with condenser, electrically operated	All capacities	3.05 IPLV, 2.80 COP
Air cooled, without condenser, electrically operated	All capacities	3.45 IPLV, 3.10 COP
Water cooled, electrically operated, positive displacement (reciprocating)	All capacities	5.05 IPLV, 4.20 COP
Water cooled, electrically operated, positive displacement (rotary screw and scroll)	< 150 tons	5.20 IPLV, 4.45 COP
	≥ 150 tons and < 300 tons	5.60 IPLV, 4.90 COP
	≥ 300 tons	6.15 IPLV, 5.50 COP
Water cooled, electrically operated, centrifugal	< 150 tons	5.25 IPLV, 5.00 COP
	≥ 150 tons and < 300 tons	5.90 IPLV, 5.55 COP
	≥ 300 tons	6.40 IPLV, 6.10 COP

Source: ASHRAE 90.1-2007 Table 6.8.1B.

CF = Summer peak coincidence factor (= 74%)
DSF = Demand savings factor (= 0.08)

For example, demand reduction for the tune-up of a 300-ton chiller with a COP of 5.0 is calculated as:

$$\Delta\text{kW} = TONS * \frac{3.516}{COP_{BASE}} * CF * DSF = 300 * \frac{3.516}{5} * 0.74 * 0.08 = 12.489 \text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

ENERGY STAR Room Air Conditioner for Commercial Use (Time of Sale)

	Measure Details
Official Measure Code	CI-HVAC-RAC-1
Measure Unit	Per unit
Measure Category	HVAC
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by capacity and location
Peak Demand Reduction (kW)	Varies by capacity and location
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by capacity and location
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	12
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure relates to the purchase and installation of a room air conditioning unit that meets either the ENERGY STAR[312] or Consortium for Energy Efficiency Super-Efficient Home Appliances Initiative Tier 1[313] minimum qualifying efficiency specifications, in place of a baseline unit meeting minimum federal standard efficiency ratings. Applicable units are with and without louvered sides, and without reverse cycle (i.e., heating) or casement.

Definition of Efficient Equipment

To qualify for this measure, the new room air conditioning unit must meet either the ENERGY STAR or Consortium for Energy Efficiency Super-Efficient Home Appliances Initiative Tier 1 efficiency standards.

Definition of Baseline Equipment

The baseline assumption is a new room air conditioning unit that meets the current minimum federal efficiency standard.

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[312] U.S. Environmental Protection Agency. ENERGY STAR Program Requirements for Room Air Conditioners, Partner Commitments." Accessed July 17, 2010. http://www.energystar.gov/ia/partners/product_specs/program_reqs/room_air_conditioners_prog_req.pdf

[313] Consortium for Energy Efficiency. "CEE Super-Efficient Home Appliances Initiative – High-Efficiency Specifications for Room Air Conditioners." Accessed July 17, 2010. http://www.cee1.org/resid/seha/rm-ac/rm-ac_specs.pdf

Deemed Lifetime of Efficient Equipment

The measure life is 12 years.[314]

Deemed Measure Cost

The incremental cost for this measure is $40.00 for an ENERGY STAR unit and $80.00 for a Consortium for Energy Efficiency Tier 1 unit.[315]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = EFLH * Btuh * \frac{\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}}{1{,}000}$$

Where:

Btuh = Cooling capacity of the unit in Btuh (= actual)

EER_{BASE} = Energy efficiency ratio of the baseline equipment (= see table below)[316]

Federal Standards for Baseline Energy Efficiency Ratio

Capacity (Btuh)	With Louvered Sides	Without Louvered Sides	Casement Only	Casement Slider
< 8,000	≥ 11	≥ 10	≥ 8.7	≥ 9.5
8,000 to 13,999	≥ 10.9	≥ 9.6	≥ 8.7	≥ 9.5
14,000 to 19,999	≥ 10.7	≥ 9.3	≥ 8.7	≥ 9.5
≥ 20,000	≥ 9.4	≥ 9.4	≥ 8.7	≥ 9.5

EER_{EE} = Energy efficiency ratio of the energy-efficient equipment (= actual; otherwise, see table below)[317]

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[314] GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures.* June 2007. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

[315] Based on field study conducted by Efficiency Vermont.

[316] Minimum Federal Standard for capacity range. 2015 Federal Energy Conservation Standard for Room ACs (e-CFR Title 10, Chapter II, Subchapter D, Part 430, Subpart C, Section 430.32)

[317] ENERGY STAR standards from: http://www.energystar.gov/index.cfm?c=roomac.pr_crit_room_ac
CEE Tier 1 standards from:
http://library.cee1.org/sites/default/files/library/9296/CEE_ResApp_RoomAirConditionerSpecification_2003_Updated_Again.pdf

ENERGY STAR and CEE SEHA Standards for Efficient Equipment Energy Efficiency Ratio

Capacity (Btuh)	CEE SEHA Tier 1	ENERGY STAR			
	With Louvered Sides	With Louvered Sides	Without Louvered Sides	Casement Only	Casement Slider
< 8,000	≥ 11.2	≥ 11.2	≥ 10.4	≥ 10.0	≥ 10.9
8,000 to 13,999	≥ 11.3	≥ 11.3	≥ 9.8	≥ 10.0	≥ 10.9
14,000 to 19,999	≥ 11.2	≥ 11.2	≥ 9.8	≥ 10.0	≥ 10.9
≥ 20,000	≥ 9.8	≥ 9.8	≥ 9.8	≥ 10.0	≥ 10.9

EFLH = Cooling equivalent full load hours (= see table below)

Equivalent Full Load Hours by City

Building	Indianapolis	South Bend	Evansville	Ft Wayne	Terre Haute
Assembly	810	721	1,047	716	955
Auto Repair	538	484	721	431	675
Big Box Retail	1,123	1,006	1,422	1,056	1,251
Fast Food Restaurant	798	738	1,066	694	905
Full Service Restaurant	729	641	967	633	837
Grocery	1,123	1,006	1,422	1,056	1,251
Light Industrial	690	598	842	642	760
Primary School	514	456	573	454	503
Religious Worship	401	360	516	357	444
Small Office	1,096	1,015	1,299	1,035	1,151
Small Retail	1,032	906	1,294	977	1,142
Warehouse	690	598	842	642	760
Other	795	711	1,001	725	886

Summer Peak Coincident Demand Reduction

$$\Delta kW = Btuh * \frac{\frac{1}{EER_{BASE}} - \frac{1}{EER_{eEE}}}{1,000} * CF$$

Where:

CF = Summer peak coincidence factor (= 0.74)[318]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[318] Coincidence factor supplied by Duke Energy for the commercial HVAC end-use. Pending verification based on information from the utilities.

Single-Package and Split System Unitary Air Conditioners (Time of Sale, New Construction)

	Measure Details
Official Measure Code	CI-HVAC-AC-1
Measure Unit	Per unit
Measure Category	HVAC
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by system type and capacity
Peak Demand Reduction (kW)	Varies by system type and capacity
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by system type and capacity
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	15
Incremental Cost	$100.00 per ton
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the installation of high-efficiency unitary air-, water-, and evaporative cooled air conditioning equipment, both single-package and split systems. Air conditioning systems are a major consumer of electricity and systems that exceed baseline efficiencies can save considerable amounts of energy. This measure applies to the replacement of an existing unit at the end of its useful life or to the installation of a new unit in a new or existing building.

Definition of Efficient Equipment

The efficient equipment is a high-efficiency air-, water-, or evaporative cooled air conditioner that exceeds the energy efficiency requirements of ASHRAE 90.1-2007.

Definition of Baseline Equipment

The baseline equipment is assumed to be a standard-efficiency air-, water-, or evaporative cooled air conditioner that meets the energy efficiency requirements of ASHRAE 90.1-2007. The rating conditions for the baseline and efficient equipment efficiencies must be equivalent.

Deemed Lifetime of Efficient Equipment

The expected measure life is 15 years.[319]

Deemed Measure Cost

The incremental capital cost for this measure is $100.00 per ton.[320]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

For units with cooling capacities less than 65 kBtuh:

$$\Delta\text{kWh} = Btuh * \left(\frac{1}{SEER_{BASE}} - \frac{1}{SEER_{EE}}\right) * \frac{EFLH}{1{,}000}$$

For units with cooling capacities equal to or greater than 65 kBtuh:

$$\Delta\text{kWh} = Btuh * \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right) * \frac{EFLH}{1{,}000}$$

Where:

Btuh = Capacity of the cooling equipment actually installed (1 ton of cooling capacity equals 12 kBtuh)

$\text{SEER}_{\text{BASE}}$ = Seasonal energy efficiency ratio of the baseline equipment (= see table below)

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[319] GDS Associates, Inc. *Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007.

[320] Based on a review of TRM incremental cost assumptions from California, Vermont, and Wisconsin.

Seasonal Energy Efficiency Ratio by Equipment Size

Size Category	Subcategory	Baseline Condition ASHRAE 90.1-2007*
<65,000 Btuh	Split system	13.0 SEER
	Single package	13.0 SEER
≥65,000 Btuh and <135,000 Btuh	Split system	11.0 EER
	Single package	11.2 IEER
≥135,000 Btuh and <240,000 Btuh	Split system	10.8 EER
	Single package	11.0 IEER
≥240,000 Btuh and <760,000 Btuh	Split system	9.8 EER
	Single package	9.9 IEER
≥760,000 Btuh	Split system	9.5 EER
	Single package	9.6 IEER

* As mandated by federal equipment manufacturing standards: http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/74fr12058.pdf

$SEER_{EE}$ = Seasonal energy efficiency ratio of the energy efficient equipment (= actual)

$IEER_{BASE}$ = Integrated energy efficiency ratio of the baseline equipment (= see table above)

$IEER_{EE}$ = Integrated energy efficiency ratio of the energy efficient equipment (= actual)

EFLH = Cooling equivalent full load hours (= see table below)

Equivalent Full Load Hours by Building Type and City

Building	Indianapolis	South Bend	Evansville	Ft Wayne	Terre Haute
Assembly	810	721	1,047	716	955
Auto Repair	538	484	721	431	675
Big Box Retail	1,123	1,006	1,422	1,056	1,251
Fast Food Restaurant	798	738	1,066	694	905
Full Service Restaurant	729	641	967	633	837
Grocery	1,123	1,006	1,422	1,056	1,251
Light Industrial	690	598	842	642	760
Primary School	514	456	573	454	503
Religious Worship	401	360	516	357	444
Small Office	1,096	1,015	1,299	1,035	1,151
Small Retail	1,032	906	1,294	977	1,142
Warehouse	690	598	842	642	760
Other	795	711	1,001	725	886

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right) * \text{Btu} * \frac{CF}{1000}$$

Where:

EER_{BASE} = Energy efficiency ratio of baseline equipment (= see table above)

EER_{EE} = Energy efficiency ratio of energy-efficient equipment (= actual)

For air-cooled air conditioners < 65 kBtuh, if the actual EER is unknown, assume the following conversion from SEER to EER: EER = SEER/1.1.

CF = Summer peak coincidence factor (= 0.74)[321]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[321] Duke Energy supplied the coincidence factor for the commercial HVAC end-use (pending verification based on information from the utilities).

Heat Pump Systems (Time of Sale, New Construction)

	Measure Details
Official Measure Code	CI-HVAC-ASHP-1
Measure Unit	Per heat pump
Measure Category	HVAC
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by building type and location
Peak Demand Reduction (kW)	Varies by building type and location
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by building type and location
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	15
Incremental Cost	$100.00 per ton
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure applies to the installation of high-efficiency air cooled, water source, ground water source, and ground source heat pump systems. This measure could apply to replacing an existing unit at the end of its useful life or installing a new unit in a new or existing building.

Definition of Efficient Equipment

The efficient equipment is a high-efficiency air cooled, water source, ground water source, or ground source heat pump system that exceeds the energy efficiency requirements of ASHRAE 90.1-2007.

Definition of Baseline Equipment

The baseline equipment is a standard efficiency air cooled, water source, ground water source, or ground source heat pump system that meets the energy efficiency requirements of ASHRAE 90.1-2007. The rating conditions for the baseline and efficient equipment efficiencies must be equivalent.

Deemed Lifetime of Efficient Equipment

The expected measure life is 15 years.[322]

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[322] GDS Associates, Inc. *Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures.* June 2007.

Deemed Measure Cost

For analysis purposes, the incremental capital cost for this measure is $100.00 per ton for air-cooled units.[323] The incremental cost for all other equipment types should be determined on a site-specific basis.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

For air cooled units with cooling capacities less than 65 kBtuh:

$$\Delta \text{kWh} = \text{Annual kWh Savings}_{\text{COOL}} + \text{Annual kWh Savings}_{\text{HEAT}}$$

$$\text{Annual kWh Savings}_{\text{COOL}} = kBtuh_{COOL} \; * \; \left(\frac{1}{SEER_{BASE}} - \frac{1}{SEER_{EE}}\right) * EFLH_{COOL}$$

$$\text{Annual kWh Savings}_{\text{HEAT}} = kBtuh_{HEAT} \; * \; \left(\frac{1}{HSPF_{BASE}} - \frac{1}{HSPF_{EE}}\right) * EFLH_{HEAT}$$

For air cooled units with cooling capacities greater than or equal to 65 kBtuh:

$$\Delta \text{kWh} = \text{Annual kWh Savings}_{\text{COOL}} + \text{Annual kWh Savings}_{\text{HEAT}}$$

$$\text{Annual kWh Savings}_{\text{COOL}} = \left(\frac{1}{IEER_{BASE}} - \frac{1}{IEER_{EE}}\right) * EFLH_{COOL} * kBtuh_{COOL}$$

$$\text{Annual kWh Savings}_{\text{HEAT}} = \left(\frac{1}{COP_{BASE}} - \frac{1}{COP_{EE}}\right) * EFLH_{HEAT} * \frac{kBtuh_{HEAT}}{3.412}$$

Where:

$\text{kBtuh}_{\text{COOL}}$ = Cooling capacity of equipment in kBtu per hour (= actual; 1 ton of cooling capacity equals 12 kBtuh)

$\text{SEER}_{\text{BASE}}$ = Seasonal energy efficiency ratio of baseline equipment (= see table below)

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[323] Based on a review of TRM incremental cost assumptions from California, Vermont, and Wisconsin.

Baseline Efficiencies by Size

Size Category	Subcategory	Baseline Condition (ASHRAE 90.1-2007)
<65,000 Btuh	Split system	13.0 SEER / 7.7 HSPF
	Single package	13.0 SEER / 7.7 HSPF
≥65,000 Btuh and <135,000 Btuh	Split system and single package	11.0 EER / 11.2 IEER / 3.3 COP
≥135,000 Btuh and <240,000 Btuh	Split system and single package	10.8 EER / 11.0 IEER / 3.2 COP
≥240,000 Btuh	Split system and single package	9.8 EER / 9.9 IEER / 3.2 COP

$SEER_{EE}$ = Seasonal energy efficiency ratio of energy efficient equipment (= actual)

$EFLH_{COOL}$ = Cooling mode equivalent full load hours (= see table below)

Cooling Equivalent Full Load Hours by Building Type

Building	Indianapolis	South Bend	Evansville	Ft Wayne	Terre Haute
Assembly	810	721	1,047	716	955
Auto Repair	538	484	721	431	675
Big Box Retail	1,123	1,006	1,422	1,056	1,251
Fast Food Restaurant	798	738	1,066	694	905
Full Service Restaurant	729	641	967	633	837
Grocery	1,123	1,006	1,422	1,056	1,251
Light Industrial	690	598	842	642	760
Primary School	514	456	573	454	503
Religious Worship	401	360	516	357	444
Small Office	1,096	1,015	1,299	1,035	1,151
Small Retail	1,032	906	1,294	977	1,142
Warehouse	690	598	842	642	760
Other	795	711	1,001	725	886

$HSPF_{BASE}$ = Heating seasonal performance factor of baseline equipment (= see table above, “Baseline Efficiencies by Size”)

$HSPF_{EE}$ = Heating seasonal performance factor of energy efficient equipment (= actual)

$EFLH_{heat}$ = Heating mode equivalent full load hours (= see table below)

Heating Equivalent Full Load Hours by Building Type

Building	Indianapolis	South Bend	Evansville	Ft Wayne	Terre Haute
Assembly	874	954	611	1,009	659
Auto Repair	3,319	3,930	2,582	3,299	2,918
Big Box Retail	519	538	325	607	367
Fast Food Restaurant	1,253	1,383	824	1,463	907
Full Service Restaurant	1,164	1,396	768	1,441	893
Grocery	519	538	325	607	367
Light Industrial	1,113	1,205	718	1,289	775
Primary School	1,192	1,266	785	1,359	845
Religious Worship	923	1,070	677	1,085	779
Small Office	670	710	487	826	526
Small Retail	939	977	591	1,125	661
Warehouse	1,113	1,205	718	1,289	775
Other	1,133	1,264	784	1,283	873

$IEER_{BASE}$ = Integrated energy efficiency ratio of baseline equipment (= see table above, "Baseline Efficiencies by Size")

$IEER_{EE}$ = Integrated energy efficiency ratio of energy efficient equipment (= actual)

$kBtuh_{HEAT}$ = Heating capacity of the equipment in kBtu per hour (= actual)

3.412 = Btus per watt-hour

COP_{BASE} = Coefficient of performance of baseline equipment (= see table above)

COP_{EE} = Coefficient of performance of energy efficient equipment (= actual)

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = kBtuh_{COOL} * \left(\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right) * CF$$

Where:

EER_{BASE} = Energy efficiency ratio of baseline equipment (= see table above)

EER_{ee} = Energy efficiency ratio of energy efficient equipment (= actual)

CF = Summer peak coincidence factor (= 0.74)[324]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[324] Duke Energy provided the coincidence factor for the commercial HVAC end-use (pending information from the utilities).

Outside Air Economizer with Dual-Enthalpy Sensors (Time of Sale, Retrofit – New Equipment)

	Measure Details
Official Measure Code	CI-HVAC-Econ-1
Measure Unit	HVAC
Measure Category	Per HVAC system
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by building type and location
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by building type and location
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	10
Incremental Cost	$400.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is to upgrade the outside air dry-bulb economizer to a dual enthalpy controlled economizer. The new control system will continuously monitor the enthalpy of both the outside air and return air, controlling and adjusting the system dampers based on the two readings.

Definition of Efficient Equipment

The efficient equipment is a dual-enthalpy economizer on the HVAC system.

Definition of Baseline Equipment

The existing condition is an outside air dry-bulb economizer.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 10 years.[325]

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[325] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. “Effective/Remaining Useful Life Values.” December 16, 2008.

Deemed Measure Cost

The incremental cost for this measure is $400.00.[326]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = TONS * \Delta kWh_{TON}$$

Where:

TONS = Rated capacity of unit controlled by economizer (= actual; collect with application)

ΔkWh_{TON} = Energy savings per ton, based on building and region (see table below)

Dual Enthalpy Economizer Savings (kWh/Ton)*

Building	Indianapolis	South Bend	Evansville	Ft Wayne	Terre Haute
Assembly	22	21	24	23	32
Big Box Retail	137	125	145	139	215
Fast Food Restaurant	34	32	37	33	35
Full Service Restaurant	19	18	18	18	31
Hospital	1,014	1,033	1,125	1,212	1,149
Hotel	766	823	1,444	1,641	1,563
Large Office	996	947	999	980	1,056
Light Industrial	40	39	38	34	40
Primary School	54	47	50	50	84
Small Office	183	176	173	192	186
Small Retail	115	105	109	110	146
Warehouse	40	39	38	34	40
Other	285	290	350	367	380

* Unit energy savings, demand reduction, and natural gas savings data is based on a series of prototypical small commercial building simulation runs. The prototypes are based on the California DEER study prototypes, modified for local construction practices. Simulations were run using TMY3 weather data for each of the cities listed. Building prototypes used in the energy modeling are described in Appendix A - Prototypical Building Energy Simulation Model Development.

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[326] Efficiency Vermont. *Technical Reference Manual (TRM) Measure Savings Algorithms and Cost Assumptions*. February 19, 2010. Value derived from Efficiency Vermont project experience and conversations with suppliers.

For example, the energy savings from an economizer on a 10-ton air conditioning unit in a big-box retail building in Indianapolis would be:

$$\Delta \text{kWh} = 10 * 137 = 1{,}370 \text{ kWh}$$

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.

Fossil Fuel Impact Descriptions and Calculation

There are no expected fossil fuel impacts associated with this measure.

Demand Controlled Ventilation

	Measure Details
Official Measure Code	CI-HVAC-DCV-1
Measure Unit	Per square foot
Measure Category	HVAC
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by building type and location
Peak Demand Reduction (kW)	Varies by building type and location
Annual Fossil Fuel Savings (MMBtu)	Varies by building type and location
Lifetime Energy Savings (kWh)	Varies by building type and location
Lifetime Fossil Fuel Savings (MMBtu)	Varies by building type and location
Water Savings (gal/yr)	0
Effective Useful Life (years)	15
Incremental Cost	$115.00 per 1,000 square feet of floor area
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the installation of a demand controlled ventilation (DCV) systems with an air-side economizer with zone-level CO_2 sensor controls to packaged rooftop equipment. The savings represent the combined effect of the DCV and the air-side economizer.

Definition of Efficient Equipment

The efficient condition is an HVAC system with DCV systems added.

Definition of Baseline Equipment

The baseline condition is an HVAC system without DCV systems.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 15 years.

Deemed Measure Cost

The incremental cost for this measure is $115.00 per 1,000 square feet of floor area.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = \frac{SF}{1{,}000} * \Delta kWh_{kSF}$$

Where:

SF = Conditioned square footage served by system with DCV controls installed

$\Delta\text{kWh}_{\text{kSF}}$ = Energy savings per 1,000 square feet of conditioned floor area (= dependent on building type and region, see table in Reference Table section)

For example, the energy savings from a DCV system being installed on an HVAC system serving a 2,000 square foot small retail store in Indianapolis would be:

$$\Delta\text{kWh} = \frac{SF}{1{,}000} * \Delta kWh_{kSF} = \frac{2{,}000}{1{,}000} * 668 = 1{,}336\text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW} = \frac{SF}{1{,}000} * \Delta kW_{kSF} * CF$$

Where:

$\Delta\text{kW}_{\text{kSF}}$ = Demand reduction per 1,000 square feet of conditioned floor area (= dependent on building type and region, see table in Reference Table section)

CF = Summer peak coincident peak (= 0.74)

For example, the demand reduction from a DCV system being installed on an HVAC system serving a 2,000 square foot small retail store in Indianapolis would be:

$$\Delta\text{kW} = \frac{2{,}000}{1{,}000} * 0.109 * 0.74 = 0.161\text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

$$\Delta\text{MMBtu} = \frac{SF}{1{,}000} * \Delta MMBtu_{kSF}$$

Where:

$\Delta\text{MMBtu}_{\text{kSF}}$ = Unit natural gas savings per 1,000 square feet of conditioned floor space (= dependent on building type and region, see table in Reference Table section)

For example, the natural gas savings from a DCV system being installed on an HVAC system serving a 2,000 square foot small retail store in Indianapolis would be:

$$\Delta \text{MMBtu} = \frac{SF}{1{,}000} * \Delta MMBtu_{kSF} = \frac{2{,}000}{1{,}000} * 29.7 = 59.4 \text{ MMBtu}$$

Reference Table

Building	City	kWh	kW	MMBtu
Assembly	Evansville	747	0.394	78.2
	Ft. Wayne	536	0.129	98.0
	Indianapolis	599	0.138	97.4
	South Bend	629	0.224	100.1
	Terre Haute	614	0.181	98.8
Big Box Retail	Evansville	742	0.314	9.8
	Ft. Wayne	547	0.212	15.6
	Indianapolis	578	0.383	16.1
	South Bend	676	0.505	16.1
	Terre Haute	627	0.444	16.1
Fast Food Restaurant	Evansville	1,817	0.588	84.0
	Ft. Wayne	1,193	0.588	122.7
	Indianapolis	1,408	0.588	125.2
	South Bend	1,428	0.850	129.0
	Terre Haute	1,418	0.325	127.1
Full Service Restaurant	Evansville	1,046	0.325	62.7
	Ft. Wayne	739	0.325	91.9
	Indianapolis	836	0.175	93.3
	South Bend	874	0.475	97.0
	Terre Haute	855	0.325	95.2
Light Industrial	Evansville	129	0.040	7.6
	Ft. Wayne	105	0.032	11.5
	Indianapolis	124	0.033	11.8
	South Bend	101	0.069	12.0
	Terre Haute	113	0.051	11.9
Primary School	Evansville	668	1.122	39.5
	Ft. Wayne	412	0.616	56.1
	Indianapolis	496	1.322	55.9
	South Bend	519	1.986	58.9
	Terre Haute	508	1.654	57.4
Small Office	Evansville	732	0.00	5.9
	Ft. Wayne	644	0.00	8.9
	Indianapolis	658	0.00	9.2
	South Bend	670	0.00	9.6

Building	City	kWh	kW	MMBtu
	Terre Haute	664	0.00	9.4
Small Retail	Evansville	827	0.156	18.3
	Ft. Wayne	633	0.078	28.8
	Indianapolis	668	0.109	29.7
	South Bend	737	0.422	31.6
	Terre Haute	703	0.266	30.7
Warehouse	Evansville	11	0.003	0.6
	Ft. Wayne	14	0.004	1.5
	Indianapolis	20	0.005	1.9
	South Bend	24	0.016	2.9
	Terre Haute	22	0.010	2.3

Chilled Water Reset Controls (Retrofit – New Equipment)

	Measure Details
Official Measure Code	CI-HVAC-CHWReset-1
Measure Unit	Per reset
Measure Category	HVAC
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by system and location
Peak Demand Reduction (kW)	Varies by system and location
Annual Fossil Fuel Savings (MMBtu)	Varies by system and location
Lifetime Energy Savings (kWh)	Varies by system and location
Lifetime Fossil Fuel Savings (MMBtu)	Varies by system and location
Water Savings (gal/yr)	0
Effective Useful Life (years)	10
Incremental Cost	$681.34 per control
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the installation of chilled water reset controls in large commercial buildings with built-up HVAC systems. Reset controls allow the chillers to operate at a higher chilled water temperature during periods of low cooling loads. The baseline condition is a constant chilled water temperature of 45°F. The reset strategies use a 5°F reset.[327] Energy savings are realized through improved chiller efficiency. Data for both air-cooled and water-cooled chillers are shown. The approach uses DOE-2.2 simulations on a series of commercial prototypical building models, adapted from the California DEER study, with changes to reflect Indiana climate and building practices. Energy and demand impacts are normalized per ton of chiller capacity controlled.

Definition of Efficient Equipment

The efficient condition is a chilled water reset with the maximum chilled water temperature of 50°F.

Definition of Baseline Equipment

The baseline condition is a fixed chilled water temperature of 45°F.

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[327] ASHRAE 90.1 2007 requires chilled and hot water temperature resets for systems with a capacity greater than 300,000 Btu/hr. To avoid incenting code, this applies to smaller systems and retrofits only.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 10 years.[328]

Deemed Measure Cost

The full installed cost for this measure is $681.34 per control.[329]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = TONS * \Delta kWh_{TON}$$

Where:

TONS = Rated capacity of unit controlled by reset controller (= actual, to collect with application)

$\Delta \text{kWh}_{\text{TON}}$ = Energy savings per ton (= dependent on whether chiller is air cooled or water cooled, see tables in Reference Tables section).

For example, the energy savings from a chilled water reset on a 10-ton variable air volume, water-cooled chiller in an Indianapolis large office would be:

$$\Delta \text{kWh} = 10 \ * 102 = 1{,}020 \text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = TONS * \Delta kW_{TON} * CF$$

Where:

$\Delta \text{kW}_{\text{TON}}$ = Demand reduction per ton (=dependent on whether chiller is air cooled or water cooled, see tables in Reference Tables section)

CF = Summer peak coincident factor (= 0.74)[330]

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[328] 2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05, “Effective/Remaining Useful Life Values”, California Public Utilities Commission, December 16, 2008

[329] Efficiency Vermont Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions, February, 19, 2010. Value derived from Efficiency Vermont project experience and conversations with suppliers.

[330] Duke Energy provided the coincidence factor for the commercial HVAC end-use (pending information from the utilities).

For example, the demand reduction from a chilled water reset on a 10-ton variable air volume, water-cooled chiller in an Indianapolis large office:

$$\Delta\text{kW} = 10 * 0.023 * 0.74 = 0.17\ \text{kW}$$

Fossil Fuel Impact Descriptions and Calculation

$$\Delta\text{MMBtu} = TONS * \Delta MMBtu_{TON}$$

Where:

$\Delta\text{MMBtu}_{\text{TON}}$ = Natural gas savings per ton (= see tables in Reference Tables section)

For example, the natural gas savings from a chilled water reset on a 10-ton variable air volume, water-cooled chiller in an Indianapolis large office:

$$\Delta\text{MMBtu} = 10 * 0.12 = 1.2\ \text{MMBtu}$$

Reference Tables

Chilled Water Reset Controls - Hospitals

System	City	kWh*	kW*	MMBtu*
Constant Volume Reheat Economizers	Evansville	332	0.052	0.25
	Indianapolis	308	0.036	0.30
	South Bend	287	0.001	0.29
	Ft. Wayne	309	0.037	0.49
	Terre Haute	316	0.034	0.43
Constant Volume Reheat No Economizers	Evansville	237	0.035	0.17
	Ft. Wayne	245	0.024	0.25
	Indianapolis	223	0.024	0.19
	South Bend	211	0.001	0.18
	Terre Haute	240	0.023	0.22
Variable Air Volume Reheat Economizers	Evansville	120	0.001	0.13
	Indianapolis	123	0.011	0.25
	South Bend	122	0.007	0.29
	Ft. Wayne	152	0.019	0.26
	Terre Haute	154	0.083	0.16

* Unit energy savings, demand reduction, and natural gas savings data is based on a series of prototypical commercial building simulation runs. The prototypes are based on the California DEER study prototypes, modified for local construction practices. Simulations were run using TMY3 weather data for each of the cities listed. Building prototypes used in the energy modeling are described in Appendix A - Prototypical Building Energy Simulation Model Development.

Chilled Water Reset Controls - Hotels

System	City	kWh*	kW*	MMBtu*
Constant Volume Reheat Economizers	Indianapolis	121	0.016	0.01
	South Bend	114	0.016	0.01
	Evansville	147	0.016	-0.02
	Ft. Wayne	155	0.014	-0.01
	Terre Haute	139	0.020	-0.01
Constant Volume Reheat No Economizers	Evansville	155	0.016	-0.01
	Ft. Wayne	160	0.014	0.01
	Indianapolis	56	0.015	0.00
	South Bend	51	0.017	0.00
	Terre Haute	153	0.020	0.00
Variable Air Volume Reheat Economizers	Indianapolis	125	0.016	0.00
	South Bend	121	0.016	0.00
	Evansville	173	0.018	0.02
	Ft. Wayne	177	0.014	0.05
	Terre Haute	168	0.020	0.02

* Unit energy savings, demand reduction, and natural gas savings data is based on a series of prototypical commercial building simulation runs. The prototypes are based on the California DEER study prototypes, modified for local construction practices. Simulations were run using TMY3 weather data for each of the cities listed. Building prototypes used in the energy modeling are described in Appendix A - Prototypical Building Energy Simulation Model Development.

Chilled Water Reset Controls - Large Office

System	City	kWh*	kW*	MMBtu*
Constant Volume Reheat Economizers with Water Cooled Chiller	Evansville	125	0.011	0.24
	Ft. Wayne	130	0.016	0.26
	Indianapolis	122	0.011	0.19
	South Bend	125	0.010	0.25
	Terre Haute	112	0.007	0.19
Constant Volume Reheat No Economizers with Water Cooled Chiller	Evansville	168	0.024	0.16
	Ft. Wayne	162	0.017	0.15
	Indianapolis	164	0.019	0.13
	South Bend	154	0.014	0.16
	Terre Haute	171	0.009	0.10
Variable Air Volume Reheat Economizers with Water Cooled Chiller	Evansville	104	0.026	0.11
	Ft. Wayne	112	0.013	0.14
	Indianapolis	102	0.023	0.12
	South Bend	104	0.008	0.10
	Terre Haute	103	0.023	0.10

* Unit energy savings, demand reduction, and natural gas savings data is based on a series of prototypical commercial building simulation runs. The prototypes are based on the California DEER study prototypes, modified for local construction practices. Simulations were run using TMY3 weather data for each of the cities listed. Building prototypes used in the energy modeling are described in Appendix A - Prototypical Building Energy Simulation Model Development.

Variable Frequency Drives for HVAC Applications (Time of Sale, Retrofit – New Equipment)

	Measure Details
Official Measure Code	CI-HVAC-VFD-1
Measure Unit	Per VFD
Measure Category	HVAC
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by system
Peak Demand Reduction (kW)	Varies by system
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by system
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	15
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing a variable frequency drive (VFD) on an HVAC system pump or fan motor. The VFD will modulate the speed of the motor when it is not needed to run at full load. Since the power of the motor is proportional to the cube of the speed, this will result in significant energy savings.

Definition of Efficient Equipment

The efficient condition is a VFD on an HVAC system pump or fan motor.

Definition of Baseline Equipment

For VFDs on fans, the baseline is a variable volume fan with variable inlet vanes. For VFDs on pumps, the baseline is a constant volume motor.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 15 years.[331]

Deemed Measure Cost

The full installed cost for this measure is dependent on horsepower (see table below).

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[331] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05.* "Effective/Remaining Useful Life Values." December 16, 2008.

Deemed Measure Cost by Horsepower

HP	Total Installed Cost*
5	$1,330
7.5	$1,622
10	$1,898
15	$2,518
20	$3,059

* Equipment costs from Granger 2008 Catalog pp. 286-289, average across available voltages and models. Labor costs from RSMeans Mechanical Cost Data, 2008. Used average cost adjustment for all cities listed in Indiana.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = hp * SF_{kWh}$$

Where:

hp = Nameplate horsepower of motor controlled by VFD

SF_{kWh} = Energy savings factor for installing a VFD (= dependent on horsepower, see table)

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = hp * SF_{kW}$$

Where:

SF_{kW} = Demand reduction factor for installing a VFD (= dependent on horsepower, see table)

Fossil Fuel Impact Descriptions and Calculation

There are no expected fossil fuel impacts associated with this measure.

Reference Tables

Energy and Demand Savings Factors for Hospitals

Measure	City	System	SF_{kWh} (kWh/unit)	SF_{kW} (kW/unit)
VFD Return Fan	Indianapolis	VAV reheat econ	1,836	0.250
	South Bend		1,758	0.221
	Evansville		1,907	0.257
	Fort Wayne		1,774	0.238
	Terre Haute		1,857	0.244
VFD Supply Fan	Indianapolis		2,069	0.306
	South Bend		1,994	0.269
	Evansville		2,205	0.309
	Fort Wayne		1,982	0.572
	Terre Haute		2,184	0.297
VFD Tower Fan	Indianapolis	CV reheat no econ	933	0.00
		CV reheat econ	784	0.00
		VAV reheat econ	477	0.00
	South Bend	CV reheat no econ	861	0.00
		CV reheat econ	711	0.00
		VAV reheat econ	452	0.00
	Evansville	CV reheat no econ	1,091	0.00
		CV reheat econ	937	0.00
		VAV reheat econ	538	0.00
	Fort Wayne	CV reheat no econ	846	0.00
		CV reheat econ	713	0.00
		VAV reheat econ	421	0.00
	Terre Haute	CV reheat no econ	1,003	0.00
		CV reheat econ	848	0.00
		VAV reheat econ	545	0.00
VFD CHW Pump	Indianapolis	CV reheat no econ	6,655	0.735
		CV reheat econ	6,814	0.735
		VAV reheat econ	6,685	0.709
	South Bend	CV reheat no econ	6,722	0.511
		CV reheat econ	6,814	0.511
		VAV reheat econ	6,718	0.689
	Evansville	CV reheat no econ	6,639	0.763
		CV reheat econ	6,833	0.763
		VAV reheat econ	6,669	0.723
	Fort Wayne	CV reheat no econ	6,671	0.719
		CV reheat econ	6,789	0.719
		VAV reheat econ	6,689	1.314
	Terre Haute	CV reheat no econ	6,586	0.696
		CV reheat econ	6,747	0.697

Measure	City	System	SF_{kWh} (kWh/unit)	SF_{kW} (kW/unit)
		VAV reheat econ	6,645	0.697
VFD HW Pump	Indianapolis	CV reheat no econ	6,146	0.766
		CV reheat econ	5,665	0.766
		VAV reheat econ	5,142	0.829
	South Bend	CV reheat no econ	6,242	0.622
		CV reheat econ	5,738	0.622
		VAV reheat econ	5,375	0.826
	Evansville	CV reheat no econ	6,057	0.761
		CV reheat econ	5,622	0.761
		VAV reheat econ	5,409	0.852
	Fort Wayne	CV reheat no econ	6,226	0.764
		CV reheat econ	5,720	0.764
		VAV reheat econ	5,369	0.820
	Terre Haute	CV reheat no econ	6,091	0.779
		CV reheat econ	5,647	0.779
		VAV reheat econ	5,211	0.851
VFD CW Pump	Indianapolis	CV reheat no econ	1,989	0.097
		CV reheat econ	1,995	0.097
		VAV reheat econ	2,083	0.097
	South Bend	CV reheat no econ	1,979	0.095
		CV reheat econ	1,985	0.095
		VAV reheat econ	2,069	0.097
	Evansville	CV reheat no econ	2,005	0.097
		CV reheat econ	2,011	0.097
		VAV reheat econ	2,085	0.234
	Fort Wayne	CV reheat no econ	2,007	0.095
		CV reheat econ	2,010	0.095
		VAV reheat econ	2,082	0.234
	Terre Haute	CV reheat no econ	1,953	0.096
		CV reheat econ	1,956	0.096
		VAV reheat econ	2,078	0.096

Energy and Demand Savings Factors for Hotels

Measure	City	System	SF_{kWh} (kWh/unit)	SF_{kW} (kW/unit)
VFD Return Fan	Indianapolis	VAV reheat econ	276	0.133
	South Bend		276	0.117
	Evansville		150	0.00
	Fort Wayne		243	0.126
	Terre Haute		200	0.065
VFD Supply Fan	Indianapolis		163	0.126
	South Bend		164	0.121

Measure	City	System	SF$_{kWh}$ (kWh/unit)	SF$_{kW}$ (kW/unit)
	Evansville		59	0.004
	Fort Wayne		127	0.124
	Terre Haute		95	0.052
VFD Tower Fan	Indianapolis	CV reheat no econ	1,416	0.00
		CV reheat econ	1,124	0.00
		VAV reheat econ	832	0.00
	South Bend	CV reheat no econ	1,536	0.00
		CV reheat econ	1,193	0.00
		VAV reheat econ	850	0.00
	Evansville	CV reheat no econ	1,428	0.00
		CV reheat econ	1,176	0.00
		VAV reheat econ	924	0.00
	Fort Wayne	CV reheat no econ	1,378	0.00
		CV reheat econ	1,103	0.00
		VAV reheat econ	828	0.00
	Terre Haute	CV reheat no econ	1,349	0.00
		CV reheat econ	1,076	0.00
		VAV reheat econ	804	0.00
VFD CHW Pump	Indianapolis	CV reheat no econ	6,657	0.639
		CV reheat econ	6,938	0.639
		VAV reheat econ	6,977	0.609
	South Bend	CV reheat no econ	6,709	0.646
		CV reheat econ	7,021	0.646
		VAV reheat econ	7,109	0.612
	Evansville	CV reheat no econ	6,596	0.597
		CV reheat econ	6,857	0.597
		VAV reheat econ	6,874	0.597
	Fort Wayne	CV reheat no econ	6,760	0.606
		CV reheat econ	7,014	0.606
		VAV reheat econ	7,085	0.606
	Terre Haute	CV reheat no econ	6,643	0.594
		CV reheat econ	6,898	0.594
		VAV reheat econ	6,945	0.621
VFD HW Pump	Indianapolis	CV reheat no econ	7,903	0.704
		CV reheat econ	6,557	0.704
		VAV reheat econ	6,574	0.704
	South Bend	CV reheat no econ	7,978	0.704
		CV reheat econ	6,521	0.704
		VAV reheat econ	6,540	0.704
	Evansville	CV reheat no econ	8,086	0.704
		CV reheat econ	6,681	0.704
		VAV reheat econ	6,720	0.704

Measure	City	System	SF_{kWh} (kWh/unit)	SF_{kW} (kW/unit)
	Fort Wayne	CV reheat no econ	8,117	0.704
		CV reheat econ	6,592	0.704
		VAV reheat econ	6,621	0.704
	Terre Haute	CV reheat no econ	8,037	0.704
		CV reheat econ	6,607	0.704
		VAV reheat econ	6,610	0.704
VFD CW Pump	Indianapolis	CV reheat no econ	77	0.00
		CV reheat econ	72	0.00
		VAV reheat econ	67	0.00
	South Bend	CV reheat no econ	82	0.00
		CV reheat econ	75	0.00
		VAV reheat econ	67	0.00
	Evansville	CV reheat no econ	79	0.00
		CV reheat econ	73	0.00
		VAV reheat econ	67	0.00
	Fort Wayne	CV reheat no econ	79	0.00
		CV reheat econ	72	0.00
		VAV reheat econ	64	0.00
	Terre Haute	CV reheat no econ	78	0.00
		CV reheat econ	72	0.00
		VAV reheat econ	67	0.00

Energy and Demand Savings Factors for Large Offices

Measure	City	System	SF_{kWh} (kWh/unit)	SF_{kW} (kW/unit)
VFD Return Fan	Indianapolis	VAV reheat econ	1,406	0.287
	South Bend		1,339	0.189
	Evansville		1,387	0.239
	Fort Wayne		1,384	0.225
	Terre Haute		1,415	0.287
VFD Supply Fan	Indianapolis		1,771	0.356
	South Bend		1,689	0.234
	Evansville		1,782	0.297
	Fort Wayne		1,771	0.350
	Terre Haute		1,790	0.356
VFD Tower Fan	Indianapolis	CV reheat no econ	49	0.00
		CV reheat econ	71	0.00
		VAV reheat econ	10	0.00
	South Bend	CV reheat no econ	39	0.00
		CV reheat econ	59	0.00
		VAV reheat econ	28	0.00
	Evansville	CV reheat no econ	63	0.00

Measure	City	System	SF$_{kWh}$ (kWh/unit)	SF$_{kW}$ (kW/unit)
		CV reheat econ	77	0.00
		VAV reheat econ	45	0.00
	Fort Wayne	CV reheat no econ	23	0.00
		CV reheat econ	38	0.00
		VAV reheat econ	11	0.00
	Terre Haute	CV reheat no econ	84	0.00
		CV reheat econ	107	0.00
		VAV reheat econ	35	0.00
VFD CHW Pump	Indianapolis	CV reheat no econ	3,865	0.474
		CV reheat econ	4,099	0.476
		VAV reheat econ	4,016	0.432
	South Bend	CV reheat no econ	3,947	0.417
		CV reheat econ	4,249	0.417
		VAV reheat econ	4,101	0.159
	Evansville	CV reheat no econ	3,913	0.595
		CV reheat econ	4,064	0.587
		VAV reheat econ	3,701	0.390
	Fort Wayne	CV reheat no econ	4,114	0.441
		CV reheat econ	4,354	0.441
		VAV reheat econ	4,242	0.140
	Terre Haute	CV reheat no econ	3,603	0.423
		CV reheat econ	3,778	0.423
		VAV reheat econ	3,783	0.483
VFD HW Pump	Indianapolis	CV reheat no econ	3,933	1.001
		CV reheat econ	3,470	1.001
		VAV reheat econ	4,010	0.903
	South Bend	CV reheat no econ	3,557	0.887
		CV reheat econ	3,122	0.882
		VAV reheat econ	4,139	0.877
	Evansville	CV reheat no econ	3,637	0.833
		CV reheat econ	3,349	0.852
		VAV reheat econ	4,431	0.979
	Fort Wayne	CV reheat no econ	3,699	0.962
		CV reheat econ	3,183	0.971
		VAV reheat econ	4,038	2.035
	Terre Haute	CV reheat no econ	4,391	1.039
		CV reheat econ	3,840	1.035
		VAV reheat econ	4,206	0.961
VFD CW Pump	Indianapolis	CV reheat no econ	951	0.100
		CV reheat econ	1,123	0.100
		VAV reheat econ	1,328	0.100
	South Bend	CV reheat no econ	1,047	0.102

Measure	City	System	SF_{kWh} (kWh/unit)	SF_{kW} (kW/unit)
		CV reheat econ	1,165	0.100
		VAV reheat econ	1,298	0.100
	Evansville	CV reheat no econ	908	0.102
		CV reheat econ	1,028	0.100
		VAV reheat econ	1,206	0.102
	Fort Wayne	CV reheat no econ	1,079	0.101
		CV reheat econ	1,200	0.101
		VAV reheat econ	1,367	0.100
	Terre Haute	CV reheat no econ	826	0.101
		CV reheat econ	1,038	0.100
		VAV reheat econ	1,258	0.101

Energy Efficient Furnace (Time of Sale, Retrofit – Early Replacement)

	Measure Details
Official Measure Code	CI-HVAC-Furnace-1
Measure Unit	Per furnace
Measure Category	HVAC
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by location
Peak Demand Reduction (kW)	Varies by location
Annual Fossil Fuel Savings (MMBtu)	Varies by location
Lifetime Energy Savings (kWh)	Varies by location
Lifetime Fossil Fuel Savings (MMBtu)	Varies by location
Water Savings (gal/yr)	0
Effective Useful Life (years)	20
Incremental Cost	$900.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the installation of a high-efficiency natural gas furnace in lieu of a standard efficiency natural gas furnace. High-efficiency natural gas furnaces achieve savings through the use of a sealed, super insulated combustion chamber, more efficient burners, and multiple heat exchangers that remove a significant portion of the waste heat from the flue gasses. Because multiple heat exchangers are used to remove waste heat from the escaping flue gasses, most of the flue gasses condense and must be drained. Furnaces equipped with ECM fan motors can save additional electric energy.

Definition of Efficient Equipment

The efficient equipment is a natural gas-fired furnace with a minimum AFUE of 93%.

Definition of Baseline Equipment

The baseline equipment is a natural gas-fired furnace with an AFUE of 80%.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 20 years.[332]

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[332] Based on engineering modeling by Michael Blasnik (M. Blasnik & Associates) and KEMA in support of “Application of Columbia Gas of Ohio, Inc. to Establish Demand Side Management Programs for Residential and Commercial Consumers,” Filed with the Ohio Public Utilities Commission, Case No. 08-0833-GA-UNC, July 1, 2008.

Deemed Measure Cost

Incremental costs for this measure are estimated at $900.00.[333]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.[334]

Savings Algorithm

Energy Savings

If the furnace is equipped with ECM fan motors, the following algorithm can be used to calculate energy savings; otherwise, electric energy savings are zero:

$$\Delta kWh = CAP * EFLH_H * \left(10 * \frac{\eta_{EE}}{\eta_{BASE}} - 5\right)$$

Where:

CAP = Heating input capacity of installed equipment in MMBtu/hr

$EFLH_H$ = Equivalent full load heating hours (= dependent on building type and location, see table below)

Equivalent Full Load Heating Hours by Building Type and Location

Building	Indianapolis	South Bend	Evansville	Ft Wayne	Terre Haute
Assembly	874	954	611	1,009	659
Auto Repair	3,319	3,930	2,582	3,299	2,918
Big Box Retail	519	538	325	607	367
Fast Food Restaurant	1,253	1,383	824	1,463	907
Full Service Restaurant	1,164	1,396	768	1,441	893
Grocery	519	538	325	607	367
Light Industrial	1,113	1,205	718	1,289	775
Primary School	1,192	1,266	785	1,359	845
Religious Worship	923	1,070	677	1,085	779
Small Office	670	710	487	826	526
Small Retail	939	977	591	1,125	661
Warehouse	1,113	1,205	718	1,289	775
Other	1,133	1,264	784	1,283	873

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[333] Ibid.

[334] Ibid.

10 = Non-ECM kWh per MMBtu of heating fuel consumption[335]

5 = ECM kWh per MMBtu of heating fuel consumption[336]

η_{EE} = Installed equipment efficiency (= actual)

η_{BASE} = Baseline equipment efficiency (= actual, otherwise, 80%)[337]

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.

Fossil Fuel Impact Descriptions and Calculation

$$\Delta\text{MMBtu} = CAP * EFLH_H * \left(\frac{\eta_{BASE}}{\eta_{EE}} - 1\right) - MMBtu_{ECM}$$

Where:

$\text{MMBtu}_{\text{ECM}}$ = Increased heating fuel consumption due to decreased fan motor waste heat (for furnaces with ECM fan ONLY)

$$\Delta MMBtu_{ECM} = 0.019 * CAP * EFLH_H * \frac{\eta_{BASE}}{\eta_{EE}}$$

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[335] Adapted from "Electricity Use by New Furnaces: A Wisconsin Field Study," Energy Center of Wisconsin, October 2003. Assumes ECM fan motor savings scale linearly with annual fuel consumption.

[336] Adapted from "Electricity Use by New Furnaces: A Wisconsin Field Study," Energy Center of Wisconsin, October 2003. Assumes ECM fan motor savings scale linearly with annual fuel consumption.

[337] *ASHRAE 90.1-2007 Warm Air Furnaces and Combination Warm Air Furnaces/Air-Conditioning Units, Warm Air Duct Furnaces and Unit Heaters, Minimum Efficiency Requirements*. Dependent on equipment type and capacity. Minimum efficiency levels range from 78% to 81% and are either expressed as AFUE, combustion efficiency, or thermal efficiency. For analysis purposes, assume 80%.

Stack Damper (Retrofit – New Equipment)

	Measure Details
Official Measure Code	CI-HVAC-StackDamp-1
Measure Unit	Per damper
Measure Category	HVAC
Sector(s)	Commercial
Annual Energy Savings (kWh)	0
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	100
Lifetime Energy Savings (kWh)	0
Lifetime Fossil Fuel Savings (MMBtu)	1,200
Water Savings (gal/yr)	0
Effective Useful Life (years)	12
Incremental Cost	$150.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the installation of a servo-controlled, exhaust vent stack damper on a boiler. The vent damper should be installed in the flue pipe, between the heating equipment and the chimney. A stack damper works like a flue damper on a fireplace by reducing draft, improving comfort, and minimizing heat loss. The vent damper can either be controlled by a heat sensor installed directly in the vent stack or by a mechanical switch connected to the thermostat, which is wired to work in unison with the ignition control switch on the boiler.

In combustion appliances that are directly vented to the atmosphere, there is a decrease in operating efficiency during standby, start-up, and shut-down. During these times, warm room air is drawn through the stack via the draft hood or dilution air inlet at a rate proportional to the stack height, diameter, and outdoor temperature. The most air is drawn through the vent immediately after the appliance shuts off and the flue is still hot. A vent damper can prevent residual heat from being drawn up the warm vent stack by closing itself. Vent dampers can also reduce the amount of air that passes through the furnace or boiler heat exchanger by regulating the start-up exhaust pressure, which can increase operating efficiency by reducing the time needed to achieve steady-state operating conditions. Lastly, by reducing air infiltration in the building, vent dampers can help to retain humidity, which can improve comfort during periods of high heating degree days.

Definition of Efficient Equipment

The efficient equipment is a vent stack with a damper installed.

Definition of Baseline Equipment

The baseline condition is a vent stack with no stack damper installed.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 12 years.[338]

Deemed Measure Cost

Incremental costs for this measure are estimated at $150.00.[339]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

There are not expected electrical energy savings associated with this measure.

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.

Fossil Fuel Impact Descriptions and Calculation

$$\Delta \text{MMBtu} = 100 \text{ MMBtu}^{340}$$

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[338] CenterPoint Energy. *Triennial CIP/DSM Plan 2010-2012 Report*.

[339] Manufacturer research suggests a range of $80.00 to $200.00 in materials cost, depending on size, safety controls, and motor quality, as well as one to two hour average installation time.

[340] CenterPoint Energy – Triennial CIP/DSM Plan 2010-2012 Report. Based on information published by Natural Resources Canada and the Minneapolis Energy Office, savings estimates for stack dampers range from to 0 to 9.5% of total boiler gas consumption. This implies that the boiler capacity assumed to determine the deemed savings value is quite large and may overstate savings for smaller boilers. If significant participation for this measure is realized, it is suggested that the deemed savings estimate be abandoned in favor of a deemed calculated approach.

Natural Gas-Fired Infrared Heater (Time of Sale)

	Measure Details
Official Measure Code	CI-HVAC-IRHeater-1
Measure Unit	Per heater
Measure Category	HVAC
Sector(s)	Commercial
Annual Energy Savings (kWh)	0
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	11.4
Lifetime Energy Savings (kWh)	0
Lifetime Fossil Fuel Savings (MMBtu)	171
Water Savings (gal/yr)	0
Effective Useful Life (years)	15
Incremental Cost	$920.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the installation of a natural gas-fired infrared heater.

Definition of Efficient Equipment

An infrared heater heats primarily through radiation and conduction, as opposed to traditional forced-air space heaters that heat through convection. Infrared heaters are able to heat more efficiently because they directly heat the objects in the space, including the floor slab, which then radiate heat into the air space. With a forced hot air system, the heated air rises to the ceiling and stratifies, gradually working its way down to the floor level. The floor slab and equipment act as heat sinks, causing the ceiling level to be much warmer than the floor area, which will cause the forced air system to work much harder to heat the same space. What is more, forced-air systems can experience drastic losses of heated air-to-ventilation air changes. There is also a negligible amount of electricity use (burner ignition and natural gas valve) compared to a forced-air system that requires large fans to move air around the conditioned space.

Definition of Baseline Equipment

The baseline equipment is a standard natural gas-fired convection space heater.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 15 years.[341]

Deemed Measure Cost

Incremental costs for this measure are estimated at $920.00.[342]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

There are not expected electrical energy savings associated with this measure.

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.

Fossil Fuel Impact Descriptions and Calculation

$$\Delta MMBtu = 11.4\ MMBtu^{343}$$

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[341] Based on engineering modeling by GSE in support of "Application of Columbia Gas of Ohio, Inc., to Establish Demand Side Management Programs for Residential and Commercial Consumers," Filed with the Ohio Public Utilities Commission, Case No. 08-0833-GA-UNC, July 1, 2008. A review of savings assumptions used in Massachusetts indicates that this estimate is very conservative. The proposed value is only 85% of what is assumed for Massachusetts and should be considered for future study if this measure receives significant participation.

[342] Ibid.

[343] Ibid.

Energy Efficient Boiler (Time of Sale)

	Measure Details
Official Measure Code	CI-HVAC-Boiler-1
Measure Unit	Per boiler
Measure Category	HVAC
Sector(s)	Commercial
Annual Energy Savings (kWh)	0
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	Varies by system and location
Lifetime Energy Savings (kWh)	0
Lifetime Fossil Fuel Savings (MMBtu)	Varies by system and location
Water Savings (gal/yr)	0
Effective Useful Life (years)	20
Incremental Cost	$5,000.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the replacement of an irreparable existing boiler with a high-efficiency, natural gas-fired steam or hot water boiler. High-efficiency boilers achieve natural gas savings through a sealed combustion chamber and multiple heat exchangers that remove a significant portion of the waste heat from flue gasses. Because multiple heat exchangers are used to remove waste heat from the escaping flue gasses, some of the flue gasses condense and must be drained.

Definition of Efficient Equipment

The efficient equipment is a natural gas-fired hot water or steam boiler exceeding the efficiency requirements as mandated by ASHRAE 90.1-2007.

Definition of Baseline Equipment

The baseline equipment is a natural gas-fired boiler meeting the efficiency requirements as mandated by ASHRAE 90.1-2007.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 20 years.[344]

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[344] Based on engineering modeling by Michael Blasnik (M. Blasnik & Associates) in support of “Application of Columbia Gas of Ohio, Inc., to Establish Demand Side Management Programs for Residential and Commercial Consumers,” Filed with the Ohio Public Utilities Commission, Case No. 08-0833-GA-UNC, July 1, 2008.

Deemed Measure Cost

The incremental cost is estimated at $5,000.00.[345]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.[346]

Savings Algorithm

Energy Savings

There are no expected energy savings associated with this measure.

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.

Fossil Fuel Impact Descriptions and Calculation

$$\text{Annual MMBtu Savings} = CAP * EFLH_H * \frac{\eta_{EE}}{\eta_{BASE}} - 1$$

Where:

CAP = Equipment heating input capacity in MMBtu/hr (= actual)

$EFLH_h$ = Equivalent full load heating hours (= determined with site-specific data; otherwise see table below)

Small Commercial Building Heating EFLH

Building	Indianapolis	South Bend	Evansville	Ft Wayne	Terre Haute
Assembly	874	954	611	1,009	659
Auto Repair	3,319	3,930	2,582	3,299	2,918
Big Box Retail	519	538	325	607	367
Fast Food Restaurant	1,253	1,383	824	1,463	907
Full Service Restaurant	1,164	1,396	768	1,441	893
Grocery	519	538	325	607	367
Light Industrial	1,113	1,205	718	1,289	775
Primary School	1,192	1,266	785	1,359	845
Religious Worship	923	1,070	677	1,085	779
Small Office	670	710	487	826	526
Small Retail	939	977	591	1,125	661
Warehouse	1,113	1,205	718	1,289	775
Other	1,133	1,264	784	1,283	873

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[345] Ibid.

[346] Ibid.

Large Commercial Building Heating EFLH

Building Type	System	Indianapolis	South Bend	Evansville	Ft Wayne	Terre Haute
Hotel	CAV no econ	703	697	585	703	782
	CAV econ	877	898	784	877	958
	VAV econ	401	367	229	401	437
Large Office	CAV no econ	2,627	2,066	1,785	2,543	2,389
	CAV econ	2,566	2,087	1,761	2,526	2,328
	VAV econ	531	333	294	538	386
Hospital	CAV no econ	3,503	3,073	3,476	3,227	3,005
	CAV econ	3,713	3,359	3,625	3,504	3,367
	VAV econ	604	604	363	613	302

η_{EE} = Installed equipment efficiency; expressed as AFUE, combustion efficiency, or thermal efficiency (= actual)

η_{BASE} = Baseline equipment efficiency; expressed as AFUE, combustion efficiency, or thermal efficiency (= see table below)

Equipment Type	Size Category (Input)	Subcategory Or Rating Condition	Minimum Efficiency*
Boilers, natural gas fired	< 300,000 Btu/hr	Hot water	80% AFUE
		Steam	75% AFUE
	≥ 300,000 Btu/hr and ≤ 2,500,000 Btu/hr	Minimum capacity	75% Thermal Efficiency
	>2,500,000 Btu/hr	Hot water	80% Combustion Efficiency
		Steam	80% Combustion Efficiency

* ASHRAE 90.1-2007 Boilers, Gas- and Oil-Fired, Minimum Efficiency Requirements.

Commercial Boiler Tune-Up

	Measure Details
Official Measure Code	CI-HVAC-BoilerTune-1
Measure Unit	Per tune-up
Measure Category	HVAC
Sector(s)	Commercial
Annual Energy Savings (kWh)	0
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	Varies by system and location
Lifetime Energy Savings (kWh)	0
Lifetime Fossil Fuel Savings (MMBtu)	Varies by system and location
Water Savings (gal/yr)	0
Effective Useful Life (years)	5
Incremental Cost	$850.00
Important Comments	
Effective Date	January 2012
End Date	TBD

Description

This measure is the tune-up of an existing commercial boiler to improve the seasonal heating efficiency.

Definition of Efficient Equipment

The efficient condition is the boiler after a tune-up is performed.

Definition of Baseline Equipment

The baseline condition is the existing boiler before a tune-up is performed.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 5 years.

Deemed Measure Cost

The incremental cost for this measure is $850.00[347] per boiler tune-up.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

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[347] This reflects tune-up costs for commercial boilers as listed in the Michigan Efficiency Measures Database.

Savings Algorithm

Energy Savings

There are no expected energy savings associated with this measure.

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.

Fossil Fuel Impact Descriptions and Calculation

$$\Delta MMBtu = CAP * EFLH_H * ESF$$

Where:

CAP = Equipment heating input capacity in MMBtu/hr (= actual)

$EFLH_H$ = Equivalent full load heating hours (= actual; otherwise see table below)

ESF = Energy savings factor (= 0.02)[348]

Small Commercial Building Heating EFLH

Building	Indianapolis	South Bend	Evansville	Ft Wayne	Terre Haute
Assembly	874	954	611	1,009	659
Auto Repair	3,319	3,930	2,582	3,299	2,918
Big Box Retail	519	538	325	607	367
Fast Food Restaurant	1,253	1,383	824	1,463	907
Full Service Restaurant	1,164	1,396	768	1,441	893
Grocery	519	538	325	607	367
Light Industrial	1,113	1,205	718	1,289	775
Primary School	1,192	1,266	785	1,359	845
Religious Worship	923	1,070	677	1,085	779
Small Office	670	710	487	826	526
Small Retail	939	977	591	1,125	661
Warehouse	1,113	1,205	718	1,289	775
Other	1,133	1,264	784	1,283	873

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[348] The Michigan Efficiency Measures Database uses energy savings of approximately 2% for commercial boiler tune ups.

Large Commercial Building Heating EFLH

Building Type	System	Indianapolis	South Bend	Evansville	Ft Wayne	Terre Haute
Hotel	CAV no econ	703	697	585	703	782
	CAV econ	877	898	784	877	958
	VAV econ	401	367	229	401	437
Large Office	CAV no econ	2,627	2,066	1,785	2,543	2,389
	CAV econ	2,566	2,087	1,761	2,526	2,328
	VAV econ	531	333	294	538	386
Hospital	CAV no econ	3,503	3,073	3,476	3,227	3,005
	CAV econ	3,713	3,359	3,625	3,504	3,367
	VAV econ	604	604	363	613	302

For example, the fossil fuel impacts from conducting a tune-up of a 3,000,000 Btu/hr boiler serving a large office with a VAV system in Indianapolis would be:

$$\Delta MMBtu = 3{,}000{,}000 \, * \, 531 * \, 0.02 \, * \, 10^{-6} = 31.9 \, MMBtu$$

Boiler Combustion Controls

	Measure Details
Official Measure Code	CI-HVAC-BlrCombCtrl-1
Measure Unit	Per Control
Measure Category	HVAC
Sector(s)	Commercial
Annual Energy Savings (kWh)	0
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	Varies by system
Lifetime Energy Savings (kWh)	0
Lifetime Fossil Fuel Savings (MMBtu)	Varies by system
Water Savings (gal/yr)	0
Effective Useful Life (years)	10
Incremental Cost	$0.85 per kBtuh of boiler output
Important Comments	
Effective Date	January 2012
End Date	TBD

Description

This measure is an oxygen trim control for a commercial boiler, which provides a 1.1% improvement in boiler efficiency.[349]

Definition of Efficient Equipment

The efficient condition is an existing boiler with an oxygen trim controller installed.

Definition of Baseline Equipment

The baseline condition is an existing boiler without oxygen trim controls.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 10 years.

Deemed Measure Cost

The incremental cost for this measure is $0.85 per kBtuh of boiler output.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

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[349] Oxygen trim control savings taken from Michigan Boiler Oxygen Trim Control Work paper, prepared by Franklin Energy Services for the Michigan Efficiency Measures Database.

Savings Algorithm

Energy Savings

There are no expected energy savings associated with this measure.

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.

Fossil Fuel Impact Descriptions and Calculation

$$\Delta MMBtu = CAP * EFLH_H * ESF * 10^{-6}$$

Where:

CAP = Equipment heating input capacity in Btuh (= actual)

ESF = Energy savings factor (= 0.011)

$EFLH_H$ = Equivalent full load heating hours (= actual; otherwise see table below)

Small Commercial Building Heating EFLH

Building	Indianapolis	South Bend	Evansville	Ft Wayne	Terre Haute
Assembly	874	954	611	1,009	659
Auto Repair	3,319	3,930	2,582	3,299	2,918
Big Box Retail	519	538	325	607	367
Fast Food Restaurant	1,253	1,383	824	1,463	907
Full Service Restaurant	1,164	1,396	768	1,441	893
Grocery	519	538	325	607	367
Light Industrial	1,113	1,205	718	1,289	775
Primary School	1,192	1,266	785	1,359	845
Religious Worship	923	1,070	677	1,085	779
Small Office	670	710	487	826	526
Small Retail	939	977	591	1,125	661
Warehouse	1,113	1,205	718	1,289	775
Other	1,133	1,264	784	1,283	873

Large Commercial Building Heating EFLH

Building Type	System	Indianapolis	South Bend	Evansville	Ft Wayne	Terre Haute
Hotel	CAV no econ	703	697	585	703	782
	CAV econ	877	898	784	877	958
	VAV econ	401	367	229	401	437
Large Office	CAV no econ	2,627	2,066	1,785	2,543	2,389
	CAV econ	2,566	2,087	1,761	2,526	2,328
	VAV econ	531	333	294	538	386
Hospital	CAV no econ	3,503	3,073	3,476	3,227	3,005
	CAV econ	3,713	3,359	3,625	3,504	3,367
	VAV econ	604	604	363	613	302

For example, the fossil fuel impact from installing combustion controls on a 3,000,000 Btuh boiler serving a large office with a VAV system in Indianapolis would be:

$$\text{Annual MMBtu Savings} = CAP * EFLH_H * ESF * 10^{-6}$$

$$= 3{,}000{,}000 * \ 531 * 0.011 * \ 10^{-6} = 17.5 \text{ MMBtu}$$

Lighting

C&I Lighting Controls (Time of Sale, Retrofit)

	Measure Details
Official Measure Code	CI-Ltg-Control-1
Measure Unit	Per control
Measure Category	Lighting
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	Varies by project
Lifetime Energy Savings (kWh)	Varies by project
Lifetime Fossil Fuel Savings (MMBtu)	Varies by project
Water Savings (gal/yr)	0
Effective Useful Life (years)	8
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the installation of a new lighting control on a new or existing lighting system. Lighting control types include wall- or ceiling-mounted occupancy sensors, fixture-mounted occupancy sensors, remote-mounted daylight dimming sensors, fixture-mounted daylight dimming sensors, central lighting controls (time clocks), and switching controls for multi-level lighting. This measure relates to installing a new system in an existing building or a new construction application (i.e., time of sale). Lighting controls required by state energy codes are not eligible.

Definition of Efficient Equipment

The efficient equipment is a lighting system controlled by one of the lighting controls systems listed above.

Definition of Baseline Equipment

The baseline equipment is an uncontrolled lighting system operated by a manual switch.

Deemed Lifetime of Efficient Equipment

The expected measure lifetime for all lighting controls is 8 years.[350]

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[350] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. “Effective/Remaining Useful Life Values.” December 16, 2008.

Deemed Measure Cost

The incremental capital cost for this measure is provided below.

Deemed Incremental Measure Cost by Type of Lighting Control

Lighting Control Type	Incremental Cost
Wall-Mounted Occupancy Sensors	$42*
Ceiling-Mounted Occupancy Sensors	$66*
Fixture-Mounted Occupancy Sensors	$125**
Remote-Mounted Daylight Dimming Sensors	$65**
Fixture-Mounted Daylight Dimming Sensors	$50**
Switching Controls for Multi-Level Lighting	$274*
Central Lighting Controls (Time Clocks)	$103***

* Source: Goldberg et al., KEMA. *State of Wisconsin Public Service Commission of Wisconsin, Focus on Energy Evaluation, Business Programs: Incremental Cost Study*. October 28, 2009.

** Source: Efficiency Vermont. *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions.* February, 19, 2010.

*** Source: California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. “Cost Values and Summary Documentation.” December 16, 2008.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = kW_{CONTROLLED} * Hours * (1 + WHF_E) * ESF$$

Where:

$\text{kW}_{\text{CONTROLLED}}$ = Total lighting load connected to the control in kW (= actual)

HOURS = Total lighting operating hours before lighting controls are installed (= actual from audit report; otherwise see table below)

Lighting Hours of Operation by Building Type

Building Type	HOURS	Source
Food Sales	5,544	OH TRM*
Food Service	3,357	Duke OH** + NC***
Health Care	6,802	Duke OH + NC
Hotel/Motel	3,754	Duke OH + NC
Office	3,253	Duke OH
Public Assembly	2,867	Duke OH + NC
Public Services (non-food)	3,299	Duke OH
Retail	4,984	Duke OH, I&M

Warehouse	3,824	Duke OH, I&M
School	2,379	Duke OH, I&M
College	3,749	Duke OH + NC
Industrial – 1 Shift	2,857	OH TRM
Industrial – 2 Shift	4,730	OH TRM
Industrial – 3 Shift	6,631	OH TRM
Exterior	4,300	OH TRM
Other	4,408	Duke OH

* Source: Kuiken et al., KEMA. *Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0.* March 22, 2010.

** Source: Hall, et al., TecMarket Works. *Evaluation of the Non-Residential Smart Saver Prescriptive Program in Ohio.* Prepared for Duke Energy Inc. 2010.

*** Source: Hall, et al., TecMarket Works. *Evaluation of the Non-Residential Smart Saver Prescriptive Program in North and South Carolina*. Prepared for Duke Energy Inc. 2011.

WHF_E = Lighting-HVAC interaction factor for energy representing the reduced electric space cooling requirements due to the reduction of waste heat rejected by the efficient lighting (= 0 if exterior lighting; otherwise see Appendix B)

ESF = Energy savings factor; the percentage of operating hours reduced due to installing occupancy lighting controls or time clocks, or the percentage of wattage reduction multiplied by the hours of dimming for dimming lighting controls and multilevel switching (= dependent on control type, see table below)

Energy Saving Factor Percentage by Lighting Control Type

Lighting Control Type	ESF*
Wall- or Ceiling-Mounted Occupancy Sensors	30%
Fixture-Mounted Occupancy Sensors	30%
Remote-Mounted Daylight Dimming Sensors	30%
Fixture-Mounted Daylight Dimming Sensors	30%
Switching Controls for Multi-Level Lighting	30%
Central Lighting Controls (Time Clocks)	10%

* Sources: (1) Efficiency Vermont. *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions*. February, 19, 2010. (2) TecMarket Works. *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Measures in Commercial and Industrial Programs.* September 1, 2009. (3) Kuiken et al., KEMA. *Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0.* March 22, 2010.

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = kW_{CONTROLLED} * (1 + WHF_D) * CF$$

Where:

WHF_D = Lighting-HVAC interaction factor for demand representing the reduced electric space cooling requirements due to the reduction of waste heat rejected by the efficient lighting (= 0 if exterior lighting, otherwise see Appendix B)

CF = Summer peak coincidence factor (= dependent on control type, see table below)

Summer Peak Coincidence Factor by Lighting Control Type

Lighting Control Type	CF
Wall- or Ceiling-Mounted Occupancy Sensors	0.15*
Fixture-Mounted Occupancy Sensors	0.15*
Remote-Mounted Daylight Dimming Sensors	0.90**
Fixture-Mounted Daylight Dimming Sensors	0.90**
Switching Controls for Multi-Level Lighting	0.77**
Central Lighting Controls (Time Clocks)	0.00***

* Source: RLW Analytics. *Coincidence Factor Study Residential and Commercial Industrial Lighting Measures.* Spring 2007.

** Source: Kuiken et al., KEMA. *Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0.* March 22, 2010.

*** This is a conservative assumption based on professional judgment considering that time clocks are unlikely to produce significant savings during the summer peak period.

Fossil Fuel Impact Descriptions and Calculation

$$\Delta \text{MMBtu} = \Delta kWh * WHF_G$$

Where:

WHF_G = Lighting-HVAC interaction factor for natural gas heating impacts representing the increased natural gas space heating requirements due to the reduction of waste heat rejected by the efficient lighting (= 0 if exterior lighting, otherwise see Appendix B)

Lighting Systems (Non-Controls) (Time of Sale, New Construction)

	Measure Details
Official Measure Code	CI-Ltg-FixtRep-NC-1
Measure Unit	Per unit
Measure Category	Lighting
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	Varies by project
Lifetime Energy Savings (kWh)	Varies by project
Lifetime Fossil Fuel Savings (MMBtu)	Varies by project
Water Savings (gal/yr)	0
Effective Useful Life (years)	Varies by project
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the installation of new lighting equipment with an efficiency that exceeds that of the equipment that would have been installed following standard market practices. This characterization includes CFLs and fixtures, linear fluorescent lamps and fixtures, linear fluorescent fixtures replacing HID fixtures in high-bay applications, and HID fixtures. This measure could relate to replacing an existing unit at the end of its useful life or installing a new unit in a new or existing facility.

Definition of Efficient Equipment

The efficient equipment must have a higher efficiency than the existing equipment and meet program-specific equipment criteria.

Definition of Baseline Equipment

The assumed baseline equipment varies by technology type.

The assumed baseline for installation of a high bay fluorescent fixture is a metal halide system. The Energy Independence and Security Act of 2007 (EISA) requires that as of January 1, 2009, metal halide fixtures designed for use with lamps ≥150 W and ≤500W must use “probe start” ballasts with ballast efficiency ≥94% or “pulse start” ballasts with ballast efficiency ≥88. It is therefore likely that new metal halide fixtures will utilize “pulse start” technology. Therefore, the assumed baseline system is a magnetic ballast “pulse start” metal halide system.

The assumed baseline for installation of a fluorescent fixture varies by the efficient system installed. High Performance and Reduced Wattage T8s must comply with the requirements as published by the Consortium for Energy Efficiency[351].

Deemed Lifetime of Efficient Equipment

The expected measure lifetime is dependent on technology type; see table below.

Measure Lifetime by Technology Type

Technology Type	Lifetime
Screw-in CFL	3.2 years*
CFL Fixture	12 years**
High Bay Fluorescent Fixture	15 years***
High-Efficiency Linear Fluorescent Fixtures (4 foot lamps)	15 years+
High-Efficiency Linear Fluorescent Fixtures (all other lamp sizes)	15 years***
Metal Halide Track Lighting	15 years***
Ceramic Metal Halide	15 years***

* Kuiken et al., KEMA. *Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0.* March 22, 2010. Assumes a 12,000 hours lamp lifetime with extended burn times per start typical in commercial applications. Assumes 3,730 annual lighting operating hours for the commercial sector. Lamp lifetime is calculated as: 12,000 / 3,730 = 3.2 years.

** California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. "Effective/Remaining Useful Life Values." December 16, 2008.

*** GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007.

+ See discussion in Energy Savings section and Summer Peak Coincident Demand Reduction section.

Deemed Measure Cost

The incremental capital costs for this measure vary by the assumed baseline and efficient equipment scenarios (see table below).

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[351] The Consortium for Energy Efficiency publishes the High Performance T8 Specifications and the Reduced Wattage T8 Specifications periodically including a list of qualifying equipment at the following address: http://www.cee1.org

Incremental Costs by Measure Type

Measure Type	Incremental Cost
Screw-in CFL	$3.00*
CFL Fixture (1-lamp)	$35.00**
CFL Fixture (2-lamp)	$40.00**
High Bay Fluorescent Fixture	$150.00***
High-Efficiency Linear Fluorescent Fixture	$25.00+
20 Watt Ceramic Metal Halide	$130.00***
39 Watt Ceramic Metal Halide	$130.00***
50 Watt Ceramic Metal Halide	$95.00***
70 Watt Ceramic Metal Halide	$95.00***
100 Watt Ceramic Metal Halide	$90.00***
150 Watt Ceramic Metal Halide	$90.00***
20 Watt Metal Halide Track	$155.00***
39 Watt Metal Halide Track	$155.00***
70 Watt Metal Halide Track	$145.00***

* Based on a review of TRM assumptions from Connecticut, New Jersey, New York, and Vermont.

** Based on review of TRM assumptions from California, New York, Vermont, and Northwestern states.

*** Efficiency Vermont. *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions*. February, 19, 2010.

+ Ibid, p. 110 (incremental costs vary from $20 to $27.50 for 1 to 4 lamps).

Deemed O&M Cost Adjustment

In order to account for the shift in baseline due to federal legislation, the levelized baseline replacement cost over the lifetime of the CFL is calculated using the key assumptions shown in the table below.

Baseline Replacement Cost Assumptions

	Standard Incandescent	Efficient Incandescent
Replacement Cost	$0.50	$2.00
Component Life (years; based on lamp life / assumed annual run hours)	0.27*	0.81**

* Assumes rated life of incandescent bulb of approximately 1,000 hours.

** Best estimate of future technology from Ohio Technical Reference Manual.

The calculated net present value of the baseline replacement costs for CFL is $7.50.

Deemed O&M cost adjustments for high-bay fluorescent fixtures were developed assuming a typical baseline system and two typical efficient equipment scenarios. For T5HO high bay fixtures replacing pulse-start metal halide fixtures, the levelized annual baseline replacement cost assumption is $5.87. For

T8VHO high bay fixtures replacing pulse-start metal halide fixtures, the levelized annual baseline replacement cost assumption is -$1.69. The assumptions used to calculate these adjustments are detailed below.

- Baseline 320 Watt Metal-Halide Lamp Cost: $25.00
- Baseline 320 Watt Lamp Life: 15,000 hrs
- Baseline Lamp Labor Cost: $5.00 (15 min @ $20 per hour labor)
- Baseline 320 Watt Ballast Cost: $60.00
- Baseline Ballast Life: 40,000 hrs
- Baseline Ballast Labor Cost: $22.50 (30 min @ $45 per hour labor)
- T5 High-Bay Lamp Cost: $5.00 per lamp (assumes 4 lamps fixture)
- T5 High-Bay Lamp Life: 20,000 hrs
- T5 High-Bay Lamp Labor Cost: $6.67 (20 min @ $20 per hour labor)
- T5 High-Bay Ballast Cost: $51.00
- T5 High-Bay Ballast Life: 70,000 hrs
- T5 High-Bay Ballast Labor Cost: $22.50 (30 min @ $45 per hour labor)
- T8 High-Bay Lamp Cost: $10.00 per lamp (assumes 6 lamp fixture)
- T8 High-Bay Lamp Life: 18,000 hrs
- T8 High-Bay Lamp Labor Cost: $13.33 (40 min @ $20 per hour labor)
- T8 High-Bay Ballast Cost: $100.00 (2 ballasts)
- T8 High-Bay Ballast Life: 70,000 hrs
- T8 High-Bay Ballast Labor Cost: $45.00 (60 min @ $45 per hour labor)

O&M cost adjustments were developed assuming a typical baseline and efficient equipment scenario. For ceramic metal halide fixtures replacing halogen fixtures, the levelized annual baseline replacement cost assumption is $24.29. The assumptions used to calculate these adjustments are detailed below.

- Baseline 75 Watt Halogen Lamp Cost: $30.00 (3 lamps)
- Baseline 75 Watt Halogen Lamp Life: 2,500 hrs
- Baseline 75 Watt Halogen Lamp Labor Cost: $2.67
- 70 Watt CMH Lamp Cost: $60.00
- 70 Watt CMH Lamp Life: 12,000 hrs
- 70 Watt CMH Lamp Labor Cost: $2.67
- 70 Watt CMH Ballast Cost: $90.00
- 70 Watt CMH Ballast Life: 40,000 hrs
- 70 Watt CMH Ballast Labor Cost: $22.50 (30 min @ $45 per hour labor)

Savings Algorithm

Energy Savings

Non-CFLs

$$\Delta\text{kWh} = (WATTS_{BASE} - WATTS_{EE}) * Hours * \frac{(1+WHF_E)}{1{,}000}$$

Where:

$WATTS_{BASE}$ = Connected wattage of baseline fixtures (= assumed baseline wattage for time of sale application; see Appendix D – Standard Wattage Table) [352]

$WATTS_{EE}$ = Connected wattage of high-efficiency fixtures (= actual; otherwise see Appendix D – Standard Wattage Table)[353]

HOURS = Annual lighting operating hours (= actual from audit report or application; otherwise assume default values dependent on building type as shown in table below)

Annual Lighting Operating Hours by Building Type

Building Type	HOURS	Source
Food Sales	5,544	OH TRM*
Food Service	3,357	Duke OH** + NC***
Health Care	6,802	Duke OH + NC
Hotel/Motel	3,754	Duke OH + NC
Office	3,253	Duke OH
Public Assembly	2,867	Duke OH + NC
Public Services (non-food)	3,299	Duke OH
Retail	4,984	Duke OH, I&M
Warehouse	3,824	Duke OH, I&M
School	2,379	Duke OH, I&M
College	3,749	Duke OH + NC
Industrial – 1 Shift	2,857	OH TRM
Industrial – 2 Shift	4,730	OH TRM
Industrial – 3 Shift	6,631	OH TRM

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[352] In cases where Appendix D – Standard Wattage Table does not provide sufficient results, The Consortium for Energy Efficiency publishes the High Performance T8 Specifications and the Reduced Wattage T8 Specifications periodically including a list of qualifying equipment at the following address: http://www.cee1.org

[353] Ibid

Exterior	4,300	OH TRM
Other	4,408	Duke OH

* Source: Kuiken et al., KEMA. *Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0.* March 22, 2010.
** Source: Hall, et al., TecMarket Works. *Evaluation of the Non-Residential Smart Saver Prescriptive Program in Ohio*. Prepared for Duke Energy Inc. 2010.
*** Source: Hall, et al., TecMarket Works. *Evaluation of the Non-Residential Smart Saver Prescriptive Program in North and South Carolina*. Prepared for Duke Energy Inc. 2011.

WHF_E = Lighting-HVAC interaction factor for energy representing the reduced electric space cooling requirements due to reduced waste heat rejected by the efficient lighting (= see Appendix B)

1,000 = Conversion factor from watts to kilowatts

CFL Bulbs and Fixtures

This measure is installing a new ENERGY STAR-certified CFL (for those equipment types with an ENERGY STAR category). This measure could relate to replacing an existing unit at the end of its useful life, or installing a new unit in a new or existing building (i.e., time of sale). This measure applies to installing a screw-in CFL to replace a standard general service incandescent lamp.

$$\text{Annual kWh Savings} = WATTS_{EE} * \text{DWM} * Hours * \frac{(1+WHF_E)}{1{,}000}$$

Where:

DWM = Delta Watts Multiplier (use table below)[354]

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[354] Kuiken et al., KEMA. *Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0*.March 22, 2010. Source document cited several evaluations indicating that the overall average existing incandescent lamp was 75.7 watts, and that the overall average replacement lamp was 20.0 watts for CFLs smaller or equal to 32 watts. For the purposes of the characterization, it was assumed that the baseline and efficient wattages were directly proportional, and W_{BASE} to W_{EFF} ratio was 3.79 to 1, which means the DWM was 2.79. Since 2014 however, federal legislation stemming from the Energy Independence and Security Act of 2007 has required all general-purpose light bulbs between 40 and 100W to be approximately 30% more energy efficient than incandescent bulbs, in essence beginning the phase out of standard incandescent bulbs. New DWMs were calculated by finding the new baseline after incandescent bulb wattage was reduced (from 100W to 72W, 75W to 53W, 60W to 43W, and 40W to 29W). For example, prior to the phase-out, the average-sized CFL replacing a 60W incandescent was 60/ (3.79) = 16 W. Now that the 60W incandescent is replaced by a 43W halogen, the delta watts becomes 43 – 16 = 27, and the delta watts multiplier becomes 27/16 = 1.69.

Delta Watts Multiplier for Calculating Energy Savings

CFL Wattage	Delta Watts Multiplier
15 or less	1.72
16-20	1.69
21 or more	1.73

Summer Peak Coincident Demand Reduction

Non-CFLs

$$\Delta \text{kW} = (WATTS_{BASE} - WATTS_{EE}) * CF * \frac{(1+WHF_D)}{1{,}000}$$

Where:

WHF_D = Lighting-HVAC waste heat factor for demand that represents the reduced electric space cooling requirements due to the reduction of waste heat rejected by the efficient lighting (= see Appendix B)

CF = Summer peak coincidence factor (= dependent on building type as shown in table below)

Summer Peak Coincidence Factor by Building Type

Building Type	CF*
Food Sales	0.92
Food Service	0.83
Health Care	0.78
Hotel/Motel	0.37
Office	0.76
Public Assembly	0.65
Public Services (non-food)	0.64
Retail	0.84
Warehouse	0.79
School	0.50
College	0.68
Industrial	0.76
Garage	1.00**

Building Type	CF*
Exterior	0.00***
Other	0.65

* Methodology adapted from: Kuiken et al., KEMA. *State of Wisconsin Public Service Commission of Wisconsin Focus on Energy Evaluation Business Programs: Deemed Savings Parameter Development*. November 13, 2009. (defining the summer peak coincident period as June through August on weekdays between 3:00 p.m. and 6:00 p.m., unless otherwise noted).

** Assumption consistent with 8,760 operating hours.

*** Assumes that no exterior lighting is operating during summer peak demand.

CFL Bulbs and Fixtures

$$\Delta \text{kW} = WATTS_{EE} * \text{DWM} * Hours * \frac{(1+WHF_D)}{1{,}000}$$

Fossil Fuel Impact Descriptions and Calculation

$$\Delta \text{MMBtu} = \Delta kWh * WHF_G$$

Where:

WHF_G = Lighting-HVAC interaction factor for natural gas heating impacts that represents the increased natural gas space heating requirements due to the reduction of waste heat rejected by the efficient lighting (= see Appendix B)

Lighting Power Density Reduction (New Construction)

	Measure Details
Official Measure Code	CI-Ltg-LPD-1
Measure Unit	Per unit
Measure Category	Lighting
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	Varies by project
Lifetime Energy Savings (kWh)	Varies by project
Lifetime Fossil Fuel Savings (MMBtu)	Varies by project
Water Savings (gal/yr)	0
Effective Useful Life (years)	15
Incremental Cost	Varies by project
Important Comments	
Effective Date	
End Date	

Description

This measure is implementing various lighting design principles to create a quality and appropriate lighting experience while reducing unnecessary light usage. This is often done by a professional in a new construction situation. Techniques like maximizing daylighting, task lighting, and efficient fixtures are used to create a system of optimal functionality while reducing total lighting power density.

Definition of Efficient Equipment

The efficient condition is high-efficiency equipment consisting of a lighting system that exceeds the lighting power density requirements as mandated by ASHRAE 90.1-2007 Table 9.5.1 or Table 9.6.1.

Definition of Baseline Equipment

The baseline efficiency assumes compliance with lighting power density requirements as mandated by ASHRAE 90.1-2007 Table 9.5.1 or Table 9.6.1.

Deemed Lifetime of Efficient Equipment

The expected measure life is 15 years.[355]

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[355] GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

Deemed Measure Cost

The incremental capital costs for this measure vary by the assumed baseline and efficient equipment scenarios.

Deemed O&M Cost Adjustments

There are no cost adjustments associated with this measure.

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = \frac{LPD_{BASE}-LPD_{EE}}{1{,}000} * AREA * HOURS * (1 + WHF_E)$$

Where:

LPD_{BASE} = Allowed lighting power density (watts per square foot) based on energy code requirements for building or space type (= see ASHRAE 90.1-2007 Table 9.5.1 or Table 9.6.1)

LPD_{EE} = Installed lighting wattage per square foot of the efficient lighting system for building type as determined by site-surveys or design diagrams (= actual)

1,000 = Conversion factor from watts to kilowatts

AREA = Square footage of building (= determined from site-specific information)

HOURS = Annual operating hours of lighting system (= actual from audit report or application; otherwise assume default values dependent on building type as shown in table below)

Annual Lighting Operating Hours by Building Type

Building Type	HOURS	Source
Food Sales	5,544	OH TRM*
Food Service	3,357	Duke OH** + NC***
Health Care	6,802	Duke OH + NC
Hotel/Motel	3,754	Duke OH + NC
Office	3,253	Duke OH
Public Assembly	2,867	Duke OH + NC
Public Services (non-food)	3,299	Duke OH
Retail	4,984	Duke OH, I&M
Warehouse	3,824	Duke OH, I&M
School	2,379	Duke OH, I&M
College	3,749	Duke OH + NC
Industrial – 1 Shift	2,857	OH TRM
Industrial – 2 Shift	4,730	OH TRM
Industrial – 3 Shift	6,631	OH TRM

Building Type	HOURS	Source
Exterior	4,300	OH TRM
Other	4,408	Duke OH

* Kuiken et al., KEMA. *Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0*. March 22, 2010.

** Hall, et al., TecMarket Works. *Evaluation of the Non-Residential Smart Saver Prescriptive Program in Ohio*. Prepared for Duke Energy Inc. 2010.

*** Hall, et al., TecMarket Works. *Evaluation of the Non-Residential Smart Saver Prescriptive Program in North and South Carolina*. Prepared for Duke Energy Inc. 2011.

WHF_E = Lighting-HVAC interaction factor for energy representing the reduced electric space cooling requirements due to the reduction of waste heat rejected by the efficient lighting (= see Appendix B)

Summer Peak Coincident Demand Reduction

$$\Delta kW = \frac{LPD_{BASE} - LPD_{EE}}{1{,}000} * AREA * CF * (1 + WHF_D)$$

Where:

WHF_D = Lighting-HVAC waste heat factor for demand representing the reduced electric space cooling requirements due to the reduction of waste heat rejected by the efficient lighting (= see Appendix B)

CF = Summer peak coincidence factor (= dependent on building type as shown in table below)

Summer Peak Coincidence Factor by Building Type

Building Type	CF*
Food Sales	0.92
Food Service	0.83
Health Care	0.78
Hotel/Motel	0.37
Office	0.76
Public Assembly	0.65
Public Services (non-food)	0.64
Retail	0.84
Warehouse	0.79
School	0.50
College	0.68
Industrial	0.76
Garage	1.00**

Building Type	CF*
Exterior	0.00***
Other	0.65

* Methodology adapted from: Kuiken et al., KEMA. *State of Wisconsin Public Service Commission of Wisconsin Focus on Energy Evaluation Business Programs: Deemed Savings Parameter Development*. November 13, 2009. (defining the summer peak coincident period as June through August on weekdays between 3:00 p.m. and 6:00 p.m., unless otherwise noted).

** Assumption consistent with 8,760 operating hours.

*** Assumes that no exterior lighting is operating during summer peak demand.

Fossil Fuel Impact Descriptions and Calculation

$$\Delta \text{MMBtu} = \Delta kWh \ * \ WHF_G$$

Where:

WHF_G = Lighting-HVAC interaction factor for natural gas heating impacts representing the increased natural gas space heating requirements due to the reduction of waste heat rejected by the efficient lighting (= see Appendix B)

Lighting Systems (Non-Controls) (Early Replacement, Retrofit)

	Measure Details
Official Measure Code	CI-Ltg-FixtRep-ER-1
Measure Unit	Per unit
Measure Category	Lighting
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	Varies by project
Lifetime Energy Savings (kWh)	Varies by project
Lifetime Fossil Fuel Savings (MMBtu)	Varies by project
Water Savings (gal/yr)	0
Effective Useful Life (years)	Varies by project
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing new lighting equipment with efficiency that exceeds that of the existing equipment. This applies to CFLs and fixtures, linear fluorescent lamps and fixtures, linear fluorescent fixtures replacing HID fixtures in high bay applications, HID fixtures, and delamping. This measure could relate to the early replacement of an existing unit before the end of its useful life or the retrofit of a unit in an existing facility.

Note: See the Lighting Systems (Non-Controls) (Time of Sale, New Construction) measure above for calculation procedures for commercial screw-in CFLs and CFL fixtures.

Definition of Efficient Equipment

The efficient equipment must have higher efficiency than the existing equipment.

Definition of Baseline Equipment

The baseline equipment is the existing equipment before efficient equipment is installed. Default assumptions of the baseline equipment are presented in the tables below.

Deemed Lifetime of Efficient Equipment

The expected measure lifetime is dependent on technology type as shown in the table below.

Deemed Lifetime by Measure Type

Measure Type	Lifetime
Screw-in CFL	3.2 years*
Hardwired CFL	12 years**
High Bay Fluorescent Fixture	7 years***
High-Efficiency Linear Fluorescent Fixture	15 years***
Pulse Start Metal Halide	7.5 years+
Metal Halide Track Lighting	5 years***
Ceramic Metal Halide	15 years++
Delamping	10+++

* Kuiken et al., KEMA. *Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0*. March 22, 2010. Assumes a 12,000 hour lamp lifetime with extended burn times per start typical in commercial applications. Assumes 3,730 annual lighting operating hours for the commercial sector. The lamp lifetime is calculated as: 12,000 / 3,730 = 3.2 years.

** California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. "Effective/Remaining Useful Life Values." December 16, 2008.

*** GDS Associates. *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures*. June 2007. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

\+ The Energy Independence and Security Act of 2007 requires that as of January 1, 2009, metal halide fixtures designed for use with lamps ≥ 150 watts and ≤ 500 watts must use probe start ballasts with ballast efficiency ≥ 94% or pulse start ballasts with ballast efficiency ≥ 88%. This essentially means that new metal halide fixtures will use pulse start technology. Assuming that the age of the existing equipment being replaced is half of the total expected lifetime for a metal halide fixture (7.5 years), savings are only achieved for half of the lifetime of the new fixture (at which point the customer would have had to replace the inefficient technology with pulse start technology, negating any savings).

++ Efficiency Vermont. *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions.* February, 19, 2010.

+++ Based on a review of delamping measure life assumptions ranging from 9 to 16 years in California, Iowa, and Oregon as presented in: Energy & Resource Solutions. *Measure Life Study*. November 17, 2005. The high end of this range exceeds the assumed fixture lifetime and has been adjusted down to a more conservative 10 years to reflect expected persistence issues.

Deemed Measure Cost

The actual lighting measure installation cost should be used (including material and labor).

Deemed O&M Cost Adjustments

The deemed O&M cost adjustments should be determined on a case-by-case basis.

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = (WATTS_{BASE} - WATTS_{EE}) * HOURS * \frac{1+WHF_E}{1{,}000}$$

Where:

$WATTS_{BASE}$= Connected wattage of the baseline fixtures (= actual for early replacement application; otherwise see Appendix D – Standard Wattage Table)[356]

$WATTS_{EE}$ = Connected wattage of high-efficiency fixtures (= actual; otherwise see Appendix D – Standard Wattage Table)[357]

HOURS = Annual lighting operating hours (= actual from audit report or application; otherwise assume default values dependent on building type as shown in table below)

Annual Lighting Operating Hours by Building Type

Building Type	HOURS	Source
Food Sales	5,544	OH TRM*
Food Service	3,357	Duke OH** + NC***
Health Care	6,802	Duke OH + NC
Hotel/Motel	3,754	Duke OH + NC
Office	3,253	Duke OH
Public Assembly	2,867	Duke OH + NC
Public Services (non-food)	3,299	Duke OH
Retail	4,984	Duke OH, I&M
Warehouse	3,824	Duke OH, I&M
School	2,379	Duke OH, I&M
College	3,749	Duke OH + NC
Industrial – 1 Shift	2,857	OH TRM
Industrial – 2 Shift	4,730	OH TRM
Industrial – 3 Shift	6,631	OH TRM

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[356] In cases where Appendix D – Standard Wattage Table does not provide sufficient results, The Consortium for Energy Efficiency publishes the High Performance T8 Specifications and the Reduced Wattage T8 Specifications periodically including a list of qualifying equipment at the following address: http://www.cee1.org

[357] Ibid

Exterior	4,300	OH TRM
Other	4,408	Duke OH

* Kuiken et al., KEMA. *Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0*. March 22, 2010.

** Hall, et al., TecMarket Works. *Evaluation of the Non-Residential Smart Saver Prescriptive Program in Ohio*. Prepared for Duke Energy Inc. 2010.

*** Hall, et al., TecMarket Works. *Evaluation of the Non-Residential Smart Saver Prescriptive Program in North and South Carolina*. Prepared for Duke Energy Inc. 2011.

WHF_E = Lighting-HVAC interaction factor for energy representing the reduced electric space cooling requirements due to the reduction of waste heat rejected by the efficient lighting (= see Appendix B)

1 / 1,000 = Conversion factor from watts to kilowatts

Summer Peak Coincident Demand Reduction

$$\Delta kW = (WATTS_{BASE} - WATTS_{EE}) * CF * \frac{1+WHF_D}{1{,}000}$$

Where:

WHF_D = Lighting-HVAC waste heat factor for demand representing the reduced electric space cooling requirements due to the reduction of waste heat rejected by the efficient lighting (= see Appendix B)

CF = Summer peak coincidence factor (= dependent on building type, see table below)

Summer Peak Coincidence Factor by Building Type

Building Type	CF*
Food Sales	0.92
Food Service	0.83
Health Care	0.78
Hotel/Motel	0.37
Office	0.76
Public Assembly	0.65
Public Services (non-food)	0.64
Retail	0.84
Warehouse	0.79
School	0.50
College	0.68
Industrial	0.76
Garage	1.00**

Exterior	0.00***
Other	0.65

* Methodology adapted from: Kuiken et al., KEMA. *State of Wisconsin Public Service Commission of Wisconsin Focus on Energy Evaluation Business Programs: Deemed Savings Parameter Development.* November 13, 2009. (defining summer peak coincident period as June through August on weekdays between 3:00 p.m. and 6:00 p.m., unless otherwise noted).

** Assumption consistent with 8,760 operating hours.

*** Assumes that no exterior lighting is operating during summer peak demand.

Fossil Fuel Impact Descriptions and Calculation

$$\Delta\text{MMBtu} = \Delta kWh \ * \ WHF_G$$

Where:

WHF_G = Lighting-HVAC interaction factor for natural gas heating impacts representing the increased natural gas space heating requirements due to the reduction of waste heat rejected by the efficient lighting (= see Appendix B)

LED Exit Signs (Retrofit)

	Measure Details
Official Measure Code	CI-Ltg-LEDExit-1
Measure Unit	Per sign
Measure Category	Lighting
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	Varies by project
Lifetime Energy Savings (kWh)	Varies by project
Lifetime Fossil Fuel Savings (MMBtu)	Varies by project
Water Savings (gal/yr)	0
Effective Useful Life (years)	16
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

These exit signs have a string of very small (typically red or green) glowing LEDs arranged in a circle or oval. The LEDs may also be arranged in a line on the side, top, or bottom of the exit sign. LED exit signs provide the best balance of safety, low maintenance, and very low energy usage compared to other exit sign technologies.

Definition of Efficient Equipment

The efficient equipment is an exit sign illuminated by light emitting diodes.

Definition of Baseline Equipment

The baseline equipment is a fluorescent exit sign.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 16 years.[358]

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[358] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. “Effective/Remaining Useful Life Values.” December 16, 2008.

Deemed Measure Cost

The deemed measure cost is $30.00.[359]

Deemed O&M Cost Adjustments

The stream of replacement costs over the lifetime of the measure results in a net present value of $59.00. This computes to a levelized annual baseline replacement cost of $6.04.[360]

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = kW_{SAVE} * HOURS * ISR * (1 + WHF_E)$$

Where:

kW_{SAVE} = The difference in connected load between baseline equipment and efficient equipment (= 0.009)[361]

HOURS = Annual operating hours (= 8,760)

ISR = In-service rate; the percentage of rebated units actually in service (= 98%)[362]

WHF_E = Waste heat factor for energy accounting for cooling savings from efficient lighting (= see Appendix B)

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW} = kW_{SAVE} * ISR * (1 + WHF_D)$$

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[359] New York State Energy Research and Development Authority. *Deemed Savings Database*. Labor cost assumes 25 minutes @ $18/hr.

[360] This calculation assumes a replacement baseline CFL cost of $4.00 with an estimated labor cost of $5.00 (assuming $20/hour and a task time of 15 minutes). Lamp life is approximated as 2 years, assuming a 16,000 hour lamp life operating 8,760 hours per year.

[361] Efficiency Vermont. *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions*. February, 19, 2010.

[362] Ibid.

Where:

ISR = In-service rate; the percentage of rebated units actually in service (= 98%)[363]

kW_{SAVE}= The difference in connected load between baseline equipment and efficient equipment (= 0.009)[364]

WHF_D = Waste heat factor for demand to account for cooling savings from efficient lighting (= see Appendix B)

The summer peak coincidence factor for this measure is 100%.[365]

Fossil Fuel Impact Descriptions and Calculation

$$\Delta \text{MMBtu} = \Delta kWh\ *\ WHF_G$$

Where:

WHF_G = Lighting-HVAC interaction factor for natural gas heating impacts representing the increased natural gas space heating requirements due to the reduction of waste heat rejected by the efficient lighting (= see Appendix B)

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[363] Efficiency Vermont. *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions*. February, 19, 2010.

[364] Ibid.

[365] Assuming continuous operation of an LED exit sign, the summer peak coincidence factor is 1.0.

Traffic Signals (Retrofit)

	Measure Details
Official Measure Code	CI-Ltg-LEDTraffic-1
Measure Unit	Per signal
Measure Category	Lighting
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by project
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	10
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is illuminating traffic and pedestrian signals with LEDs instead of incandescent lamps.

Definition of Efficient Equipment

The efficient condition is LED traffic and pedestrian signals.

Definition of Baseline Equipment

The baseline condition is incandescent traffic and pedestrian signals.

Deemed Lifetime of Efficient Equipment

The assumed lifetime of an LED traffic signal is 100,000 hours (manufacturer estimate), capped at 10 years.[366] The life in years is calculated by dividing 100,000 hours by the annual operating hours for the particular signal type.

Deemed Measure Cost

The actual measure installation cost should be used (including material and labor).

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[366] Suozzo, Margaret. "A Market Transformation Opportunity Assessment for LED Traffic Signals." Paper presented at the annual meeting for the American Council for an Energy-Efficient Economy, April 1, 1998. Available online: http://www.cee1.org/gov/led/led- ace3/ace3led.pdf

Deemed O&M Cost Adjustments

Because LEDs last much longer than incandescent bulbs, they offer O&M savings from avoided replacement lamps and the labor to install them. The following assumptions[367] are used to calculate the O&M savings:

Incandescent bulb cost:	$3.00 per bulb
Labor cost to replace incandescent lamp:	$60.00 per signal
Life of incandescent bulb:	8,000 hours

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = \frac{W_{BASE} - W_{EFF}}{1{,}000} * HOURS$$

Where:

W_{BASE} = Connected load of baseline equipment (= see table in Reference Table section)

W_{eff} = The connected load of the efficient equipment (= see table in Reference Table section)

HOURS = Annual operating hours of the lamp (= see table in Reference Table section)

1,000 = Conversion factor from watts to kilowatts

For example, the energy savings from an 8-inch red, round signal would be:

$$\Delta\text{kWh} = \frac{69-7}{1{,}000} * 4{,}818 = 299\text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW} = \frac{W_{BASE} - W_{EFF}}{1{,}000} * CF$$

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[367] Efficiency Vermont. *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions*. February, 19, 2010.

Where:

W_{BASE} = Connected load of baseline equipment (= see table in Reference Table section)

W_{EFF} = Connected load of efficient equipment (= see table in Reference Table section)

CF = Summer peak coincidence factor (= see table below)[368]

Coincidence Factors by Traffic Lamp Type

Lamp Type	CF
Red Balls	0.55
Red Arrows	0.86
Green Balls	0.43
Green Arrow	0.08
Yellow Balls	0.02
Yellow Flashing	0.50
Yellow Arrow	0.08
Pedestrian	1.00

For example, the demand reduction from an 8-inch red, round signal would be:

$$\Delta kW = \frac{69-7}{1{,}000} * 0.55 = 0.0341 \text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

Reference Table

Traffic Signals Technology Equivalencies (Incandescent to LED)*

Traffic Fixture Type	Fixture Size and Color	HOURS	Efficient Fixture Wattage	Baseline Fixture Wattage	Energy Savings (kWh)	Demand Reduction (kW)
Flashing Signal	8” Red	4,380	7	69	272	0.034
	12” Red	4,380	6	150	631	0.079
	8” Yellow	4,380	10	69	258	0.03
	12” Yellow	4380	13	150	600	0.069
Round Signals	8” Red	4,818	7	69	299	0.034

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[368] Pennsylvania Public Utility Commission. Technical Reference Manual for Pennsylvania Act 129 Energy Efficiency and Conservation Program and Act 213 Alternative Energy Portfolio Standards. June 2015

	12” Red	4,818	6	150	694	0.079
	8” Yellow	175	10	69	10	0.001
	12” Yellow	175	13	150	24	0.003
	8” Green	3,767	9	69	226	0.026
	12” Green	3,767	12	150	520	0.059
Turn Arrows	8” Red	7,358	5	116	817	0.095
	12” Red	7,358	6	116	809	0.095
	8” Yellow	701	7	116	76	0.009
	12” Yellow	701	9	116	75	0.009
	8” Green	701	7	116	76	0.009
	12” Green	701	7	116	76	0.009
Pedestrian Sign	12” Hand	8,760	8	116	946	0.108

* Pennsylvania Public Utility Commission. *Technical Reference Manual for Pennsylvania Act 129 Energy Efficiency and Conservation Program and Act 213 Alternative Energy Portfolio Standards*. June 2015.

Reference specifications for above traffic signal wattages are from the following manufacturers:

1. 8” incandescent traffic signal bulbs: General Electric Traffic Signal Model 17325-69A21/TS
2. 12” incandescent traffic signal bulbs: General Electric Signal Model 35327-150PAR46/TS
3. Incandescent arrows and hand/man pedestrian signs: General Electric Traffic Signal Model 19010-116A21/TS
4. 8” and 12” LED traffic signals: Leotek Models TSL-ES08 and TSL-ES12
5. 8” LED yellow arrows: General Electric Model DR4-YTA2-01A
6. 8” LED green arrows: General Electric Model DR4-GCA2-01A
7. 12” LED yellow arrows: Dialight Model 431-3334-001X
8. 12” LED green arrows: Dialight Model 432-2324-001X
9. LED hand/man pedestrian signs: Dialight 430-6450-001X

Light Tube Commercial Skylight (Time of Sale)

	Measure Details
Official Measure Code	CI-Ltg-LiteTube-1
Measure Unit	Per light tube
Measure Category	Lighting
Sector(s)	Commercial
Annual Energy Savings (kWh)	250
Peak Demand Reduction (kW)	0.104
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by project
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	10
Incremental Cost	$500.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is a tubular skylight 10-inches to 21-inches in diameter with a prismatic or translucent lens installed on the roof of a commercial facility. The lens reflects light captured from the roof opening through a highly specular reflective tube down to the mounted fixture height. When in use, a light tube fixture resembles a metal halide fixture. Uses include grocery, school, retail, and other businesses in single-story commercial buildings.

Definition of Efficient Equipment

The efficient equipment is a tubular skylight that concentrates and directs light from the roof to an area inside the facility.

Definition of Baseline Equipment

The baseline equipment is a T8 fluorescent lamp with comparable luminosity. The specifications for the baseline lamp depend on the size of the light tube being installed.

Deemed Lifetime of Efficient Equipment

The estimated useful life for a light tube commercial skylight is 10 years.[369]

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[369] Equal to the manufacturer standard warranty.

Deemed Measure Cost

If available, actual incremental cost should be used. For analysis purposes, assume an incremental cost for a light tube commercial skylight of $500.00.[370]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = kW_F * EFLH$$

Where:

kW_F = Kilowatts saved per fixture (= see table)

EFLH = Equivalent full load hours (= 2,400)[371]

Energy Savings per Fixture

Brand/Size	Lumen Output*	Equivalent Fixture	kW	kWh
Solatube 21”	13,500-20,500	2-3LF32T8 172 Watt	0.172	412.8
14”	6,000-9,100	1-3LF32T8	0.086	206.4
10”	3,000-4,600	3-18 Watt quad	0.054	129.6
Average			**0.104**	**249.6**

* Solatube. *Test Report No.: Solatube40.IES - Preliminary BETA Test Report.* 2005. Available online: http://www.mainegreenbuilding.com/files/file/solatube/stb_lumens_datasheet.pdf

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = kW_F * CF$$

Where:

$\Delta \text{kW}_\text{F}$ = Kilowatts saved per fixture (= see table above, “Energy Savings per Fixture”)

CF = Coincidence factor (= 0.75)[372]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[370] Based on a review of available manufacturer pricing information.

[371] Based on replacing electric lighting with daylight for 8 hour a day, 300 day a year.

[372] Determined by taking the average of several building types for the 4p-5p peak period from the following report: RLW Analytics. Coincidence Factor Study - Residential and Commercial Industrial Lighting Measures. Spring 2007.

Plug Load

Vending Machine Occupancy Sensors (Time of Sale, New Construction, Retrofit – New Equipment)

	Measure Details
Official Measure Code	CI-Plug-Vending-1
Measure Unit	Per control
Measure Category	Plug Load
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by equipment type
Peak Demand Reduction (kW)	Varies by equipment type
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by equipment type
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	5
Incremental Cost	$215.50 (Refrigerated), $108.00 (Non-Refrigerated)
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is the installation of new controls on refrigerated beverage vending machines, non-refrigerated snack vending machines, and glass front refrigerated coolers. Controls can significantly reduce the energy consumption of vending machine and refrigeration systems. Qualifying controls must power these systems down during periods of inactivity but, in the case of refrigerated machines, must always maintain a cool product that meets customer expectations. This measure relates to installing a new control on a new or existing unit. This measure should **not** be applied to ENERGY STAR-qualified vending machines, which already have built-in controls.

Definition of Efficient Equipment

The efficient equipment is a standard efficiency refrigerated beverage vending machine, non-refrigerated snack vending machine, or glass front refrigerated cooler with a control system capable of powering down lighting and refrigeration systems during periods of inactivity.

Definition of Baseline Equipment

The baseline equipment is a standard efficiency refrigerated beverage vending machine, non-refrigerated snack vending machine, or glass front refrigerated cooler without a control system capable of powering down lighting and refrigeration systems during periods of inactivity.

Deemed Lifetime of Efficient Equipment

The expected measure life is 5 years.[373]

Deemed Measure Cost

The actual measure installation cost should be used (including material and labor), but the following can be assumed for analysis purposes:[374]

- Refrigerated Vending Machine: $215.50
- Non-Refrigerated Vending Machine: $108.00

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = \frac{WATTS_{BASE}}{1{,}000} * HOURS * ESF$$

Where:

WATTS$_{BASE}$ = Connected kilowatts of controlled equipment (= actual, see table below)

Equipment Type	WATTS$_{BASE}$*
Refrigerated Beverage Vending Machines	400
Non-Refrigerated Snack Vending Machines	85
Glass Front Refrigerated Coolers	460

* USA Technologies. *Energy Management Product Sheets*. July 2006.

1,000 = Conversion factor from watts to kilowatts

HOURS = Operating hours of connected equipment (= 8,760)

ESF = Energy savings factor; represents the percentage reduction in annual kWh consumption of equipment controlled (= see table below)

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[373] Energy & Resource Solutions. *Measure Life Study*. Prepared for the Massachusetts Joint Utilities. November 2005.

[374] *2005 Database for Energy-Efficiency Resources (DEER), Version 2005.21*. "Cost Data for Supporting Documents."

Equipment Type	Energy Savings Factor*
Refrigerated Beverage Vending Machines	46%
Non-Refrigerated Snack Vending Machines	46%
Glass Front Refrigerated Coolers	30%

* USA Technologies. *Energy Management Product Sheets*. July 2006.

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.[375]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[375] Assumed that the peak period is coincident with periods of high traffic, diminishing the demand reduction potential of occupancy based controls.

Commercial Plug Load – Smart Strip Plug Outlets (Time of Use, Retrofit – New Equipment)

	Measure Details
Official Measure Code	CI-Plug-Strip-1
Measure Unit	Per smart strip
Measure Category	Plug Load
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by measure
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	
Lifetime Fossil Fuel Savings (MMBtu)	
Water Savings (gal/yr)	0
Effective Useful Life (years)	8
Incremental Cost	$15.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

A smart strip plug outlet is a multi-plug power strip with the ability to automatically disconnect specific loads plugged in depending on the power draw of a control load, which is also plugged in. The energy savings are measured by estimating the number of hours that electronic devices at typical workstations are either in sleep mode or shut off and the standby loads consumed by the devices at those times. The smart strip will eliminate these standby loads and result in measureable energy savings. A smart strip plug outlet is purchased through a retail outlet and installed in an office environment where standby loads are uncontrolled.

Definition of Efficient Equipment

The efficient condition assumes that peripheral electronic office equipment is plugged into the controlled smart strip outlets, resulting in a reduction in standby load. No savings are associated with the control load, or loads plugged into the uncontrolled outlets.

Definition of Baseline Equipment

The baseline condition is a mix of typical office equipment (computer and peripherals) with uncontrolled standby load.

Deemed Lifetime of Efficient Equipment

The estimated useful life for a smart strip plug outlet is 8 years.[376]

Deemed Measure Cost

The estimated incremental cost for smart strip plug outlets is $15.00.[377]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = \frac{WORKDAYS * \Delta Wh_{WORKDAY} + (365 - WORKDAYS) * \Delta Wh_{NON\_WORKDAY}}{1{,}000}$$

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[376] British Columbia Hydro. *Smart Strip Electrical Savings and Usability.* October 2008.

[377] Research Into Action, Inc. *Electronics and Energy Efficiency: A Plug Load Characterization Study.* Prepared for Southern California Edison. 2010. (This reflects the incremental costs over a standard power strip with surge protection with average market price of $35 for controlled power strip and $20 for baseline plug strip with surge protection.)

Where:

WORKDAYS = Average number of workdays, or business days, in a year (= 240)[378]

$\Delta Wh_{WORKDAY}$ = Energy savings from devices plugged into the strip on work days (= 62.7 Wh; see table below)

Standby Power Consumption from Devices Using Smart Strip Plug Outlets*

Plug Load	Watts in Standby	Hours in Standby	Watts When Off	Hours Off, Workday	Hours Off, Non-Workday	% of Strips	Weighted ΔWh, Workday	Weighted ΔWh, Non-Workday
LCD Monitor	1.4	4	1.1	12	24	69%	13.2	18.7
CRT Monitor	12.1	4	0.8	12	24	25%	14.5	4.8
Printer (average of laser and ink)	N/A	0	1.4	20	24	43%	12.2	14.7
Multifunction Printer (average of laser and ink)	N/A	0	4.2	20	24	12%	10.1	12.1
Speakers	1.8	4	1.8	12	24	1%	0.3	0.4
Scanner	N/A	0	2.5	20	24	7%	3.5	4.2
Copier	N/A	0	1.5	20	24	5%	1.5	1.8
Modem	3.9	16	3.8	0	24	8%	4.9	7.4
Charger	2.2	0	0.3	20	24	50%	2.6	3.1
Total							**62.7**	**67.1**

* Standby and off load values from Lawrence Berkeley National Laboratory. "Standby Power Summary Table." Last updated 2015. http://standby.lbl.gov/summary-table.html. Hours of operation based on engineering estimates.

$\Delta Wh_{NON\text{-}WORKDAY}$ = Energy savings from devices plugged into the strip on non-work days (= 67.1 Wh)

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.[379]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[378] This value is assuming two weeks of vacation and two weeks of holidays annually.

[379] This is based on the assumption that most office equipment will be operating during the peak coincident hour.

Plug Load Occupancy Sensor (Retrofit)

	Measure Details
Official Measure Code	CI-Plug-OccSens-1
Measure Unit	Per control
Measure Category	Plug Load
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by device
Peak Demand Reduction (kW)	0
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by device
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	8
Incremental Cost	$70.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

Plug load occupancy sensors control low wattage office equipment using an occupancy sensor. They typically use an infrared sensor to monitor movement, and use a smart strip to turn off connected devices, or put them in standby mode, when no one is present.

Definition of Efficient Equipment

The installed equipment must be a ‘smart’ power strip with both control and peripheral outlets, and an occupancy sensor.

Definition of Baseline Equipment

The baseline condition assumes a mix of typical document station office equipment (printers, scanners, fax machines, etc.) with uncontrolled standby load.

Deemed Lifetime of Efficient Equipment

The estimated useful life for a smart strip plug outlet is 8 years.[380]

Deemed Measure Cost

The incremental cost for this measure is $70.00.[381]

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[380] British Columbia Hydro. *Smart Strip Electrical Savings and Usability*. October 2008. Unit can only take one surge, then need to be replaced.

[381] Research Into Action. *Plug Load Characterization Study*. Prepared for Southern California Edison. 2010.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = WORKDAYS * \frac{\Delta Wh_{SLEEP}}{1{,}000}$$

Where:

WORKDAYS = Average number of workdays, or business days, in a year (= 240)[382]

ΔWh_{SLEEP} = Daily energy savings from devices plugged into strip when in sleep mode (= 704 Wh; see table below)

Standby Power Consumption for Devices Using Smart Strip Plug Outlets* (All values in Watts)

Computer Peripherals	Connected Load When On	Connected Load in Sleep	Hours in Sleep Mode	Daily Savings (ΔWh_{SLEEP})
Laser Printer	131	2	4	516
Multi-function device, laser (scanner, fax)	50	3	4	188
Total				**704**

* Standby loads from: Lawrence Berkeley National Laboratory. “Standby Power Summary Table.” Last updated 2015. http://standby.lbl.gov/summary-table.html.
Hours of operation based on engineering estimations.

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.[383]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[382] Assumes two weeks of vacation and two weeks of holidays annually.

[383] Based on the assumption that office equipment will be running during the peak period.

Process

High Efficiency Pumps

	Measure Details
Official Measure Code	CI-Proc-Pump-1
Measure Unit	Per pump motor
Measure Category	Process
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by horsepower
Peak Demand Reduction (kW)	Varies by horsepower
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by horsepower
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	15
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is pump efficiency improvements in commercial and industrial applications.

Definition of Efficient Equipment

The efficient condition is an efficient pump and motor combination, with an EISA-compliant motor.

Definition of Baseline Equipment

The baseline condition is a standard efficiency pump and motor combination.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 15 years.

Deemed Measure Cost

The incremental cost for this measure is shown below.

Incremental Cost by Motor Size

Motor Size (hp)	Incremental Cost (per hp)
1.5	$233.33
2	$175.00
3	$116.67
5	$68.20
7.5	$66.40
10	$33.20
15	$39.00
20	$42.50

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = hp * 0.746 * \left(\frac{1}{\eta Motor_{BASE} * \eta Pump_{BASE}} - \frac{1}{\eta Motor_{Eff} * \eta Pump_{Eff}}\right) * LF * \frac{Hrs}{year}$$

Where:

hp = Horsepower of motor
$\eta Pump_{BASE}$ = Baseline pump efficiency
$\eta Pump_{EFF}$ = Efficient pump efficiency
$\eta Motor_{BASE}$ = Baseline pump motor efficiency
$\eta Motor_{EFF}$ = Efficient pump motor efficiency
LF = Motor load factor (= 0.66)
Hrs/year = Hours of pump operation per year (= actual; otherwise use 3,680)

Pump and motor efficiency are a function of the motor size, shown in table below.

Pump and Motor Efficiency by Motor Size

Motor Size (hp)	$\eta Pump_{BASE}$	$\eta Pump_{EFF}$	$\eta Motor_{BASE}$	$\eta Motor_{EFF}$
1.5	0.60	0.63	0.80	0.86
2	0.60	0.63	0.80	0.87
3	0.60	0.65	0.81	0.90
5	0.60	0.68	0.82	0.90
7.5	0.64	0.73	0.82	0.91
10	0.66	0.75	0.85	0.92
15	0.69	0.77	0.86	0.93
20	0.72	0.77	0.87	0.93

Some pump replacements may not involve a motor replacement. If the existing motor is retained, use the baseline motor efficiency in the calculations.

For example, the energy savings from upgrading a 10 hp pump and motor would be:

$$\Delta kWh = 10 * 0.746 * \left(\frac{1}{0.85 * 0.66} - \frac{1}{0.92 * 0.75}\right) * 0.66 * 3{,}680 = 6{,}038 \text{ kWh}$$

Summer Peak Coincident Demand Reduction

$$\Delta kW = HP * 0.746 * (\frac{1}{\eta Motor_{BASE} * \eta Pump_{BASE}} - \frac{1}{\eta Motor_{Eff} * \eta Pump_{Eff}}) * LF * CF$$

Where:

CF = Summer peak coincidence factor (= 0.78)

For example, the demand reduction from upgrading a 10 hp pump and motor would be:

$$\Delta kW = 10 * 0.746 * \left(\frac{1}{0.85 * 0.66} - \frac{1}{0.92 * 0.75}\right) * 0.66 * 0.78 = 1.28 \text{ kW}$$

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

Deemed Savings for this Measure

Deemed values for Annual kWh and Summer Coincident Peak kW Savings as a function of pump motor size are estimated below.

Motor Size (hp)	kWh savings per year	kW savings
1.5	617	0.13
2	900	0.19
3	1,841	0.39
5	3,528	0.75
7.5	5,438	1.15
10	5,952	1.26
15	7,848	1.66
20	7,246	1.54

Engineered Nozzles (Time of Sale, Retrofit - Early Replacement)

	Measure Details
Official Measure Code	CI-Proc-CANozzle-1
Measure Unit	Per nozzle
Measure Category	Process
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by size
Peak Demand Reduction (kW)	Varies by size
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by size
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	15
Incremental Cost	$14.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

Engineered nozzles use compressed air to entrain and amplify atmospheric air into a stream, thus increasing pressure with minimal compressed air use. They are able to induce a large airflow entrainment while still using a smaller volume of air than open jets. The velocity of the resulting airflow is reduced, but the mass flow of the air is increased, thus increasing the cooling and drying effect. Energy savings result due to the decrease in compressor work required to provide the nozzles with compressed air. Engineered nozzles have the added benefits of noise reduction and improved safety in systems with greater than 30 psig.

Definition of Efficient Equipment

The efficient condition is an engineered nozzle equipped to the end of a pneumatic tool.

Definition of Baseline Equipment

The baseline condition is an open copper tube or an air gun with an open end.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 15 years.[384]

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[384] PA Consulting Group. *Business Programs: Measure Life Study.* Prepared for State of Wisconsin Public Service Commission. 2009.

Deemed Measure Cost

The deemed cost for this measure is $14.00.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = (FLOW_{BASE} - FLOW_{ENG}) * kW_{SCFM} * \%USE * HOURS$$

Where:

kW_{SCFM} = Average electrical demand needed to produce one cubic foot of air at 100 psi (= 0.29)

$FLOW_{BASE}$ = Flow rate of compressed air from an open end in SCFM[385]

$FLOW_{ENG}$ = Flow rate of compressed air from an engineered nozzle in SCFM (= depending on size of nozzle, see table below)

Flow Rate by Nozzle Size

	Open Flow (SCFM)* $FLOW_{BASELINE}$	Engineered Nozzle (SCFM)** $FLOW_{ENG}$	ΔSCFM
1/8" Nozzle	21	6	15
1/4" Nozzle	58	11	47

* Machinery's Handbook 25th Edition.

** Survey of Engineered Nozzle Suppliers.

%USE = Percentage of the compressor total operating hours that nozzle is in use (= 3 seconds of use per minute, or 0.05)[386]

HOURS = Annual operating hours of the compressed air system (= actual; otherwise based on number of facility shifts as shown in table below)

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[385] SCFM is the flowrate (cfm) at standard conditions of temperature, pressure, and humidity.

[386] This value assumes 50% handheld air guns and 50% stationary air nozzles. Manual air guns tend to be used less than stationary air nozzles, and a conservative estimate of 1 second of blow-off per minute of compressor run time is assumed. Stationary air nozzles are commonly more wasteful, as they are often mounted on machine tools and can be manually operated (resulting in the possibility of a long-term open blow situation).

Annual Operating Hours by Number of Shifts

No. of Shifts	HOURS	Description
Single Shift (8:00 a.m. to 5:00 p.m.)	1,976	7:00 a.m. to 3:00 p.m. weekdays, minus holidays and scheduled downtime
Two Shifts	3,952	7:00 a.m. to 11:00 p.m. weekdays, minus holidays and scheduled downtime
Three Shifts	5,928	24 hours per weekday, minus holidays and scheduled downtime
Four Shifts	8,320	24 hours per day, minus holidays and scheduled downtime

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = \frac{\Delta\, kWh}{HOURS} * CF$$

Where:

ΔkWh = Energy savings as calculated above

HOURS = Annual operating hours

CF = Summer peak coincidence factor (= 0.75)[387]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[387] *Pacific Gas and Electric, and San Diego Gas and Electric Time of Use Surveys*. 1996. Values based on 4:00 p.m. to 5:00 p.m. as peak hour of use.

Insulated Pellet Dryers (Retrofit)

	Measure Details
Official Measure Code	CI-Proc-InsulPellet-1
Measure Unit	Per heat duct area
Measure Category	Process
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by load
Peak Demand Reduction (kW)	Varies by load
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by load
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	5
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

Resin pellets used in injection molders and extruders are typically dried using electrically heated and desiccant dried air. Flexible ducts in the 3-inch to 8-inch diameter size range circulate the drying air. Air temperatures usually range from 160°F to 200°F. Un-insulated duct heat loss must be replaced by electric resistance heaters. Most facilities have pellet dryers running constantly to maintain pellet dryness at all times.

Definition of Efficient Equipment

The efficient condition is a pellet dryer with insulation on the heat ducts.

Definition of Baseline Equipment

The baseline condition is a pellet dryer with un-insulated heat ducts.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 5 years.[388]

Deemed Measure Cost

Incremental costs are based on the linear feet and diameter of heating ducts.

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[388] This lifetime is based on engineering judgment.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = L * (kW_{BASE} - kW_{EFF}) * HOURS$$

Where:

L = Length of pipe to be insulated in feet

kW_{BASE} = Maximum hourly demand at technology level without insulation (= see table in Reference Table section)

kW_{EFF} = Maximum hourly demand at technology level with pipe insulation (= see table in Reference Table section)

HOURS = Annual operating hours (= 4,962)[389]

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = L * (kW_{BASE} - kW_{EFF}) * CF$$

Where:

CF = Summer peak coincident factor (= 0.75)[390]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

Reference Table

Electric Demand by Load Temperature and Duct Diameter

Temperature (°F)	Duct Diameter (inches)	kW Baseline	kW Energy Efficient	ΔkW
160	3	0.03/ft	0.01/ft	0.02/ft
	4	0.04/ft	0.01/ft	0.03/ft
	5	0.05/ft	0.01/ft	0.04/ft
	6	0.06/ft	0.01/ft	0.05/ft
	8	0.09/ft	0.01/ft	0.08/ft
170	3	0.03/ft	0.01/ft	0.03/ft
	4	0.05/ft	0.01/ft	0.04/ft

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[389] PA Consulting Group Inc. *State of Wisconsin Public Service Commission of Wisconsin, Focus on Energy Evaluation, Business Programs: Deemed Savings Parameter Development*. August 2009.

[390] *Pacific Gas and Electric, San Diego Gas and Electric, and Time of Use Surveys*. 1996.

Temperature (°F)	Duct Diameter (inches)	kW Baseline	kW Energy Efficient	ΔkW
	5	0.06/ft	0.01/ft	0.05/ft
	6	0.07/ft	0.01/ft	0.06/ft
	8	0.10/ft	0.01/ft	0.09/ft
180	3	0.04/ft	0.01/ft	0.03/ft
	4	0.05/ft	0.01/ft	0.04/ft
	5	0.07/ft	0.01/ft	0.06/ft
	6	0.08/ft	0.01/ft	0.07/ft
	8	0.11/ft	0.01/ft	0.10/ft
190	3	0.04/ft	0.01/ft	0.04/ft
	4	0.06/ft	0.01/ft	0.05/ft
	5	0.07/ft	0.01/ft	0.06/ft
	6	0.09/ft	0.01/ft	0.08/ft
	8	0.13/ft	0.02/ft	0.11/ft
200	3	0.05/ft	0.01/ft	0.04/ft
	4	0.07/ft	0.01/ft	0.06/ft
	5	0.08/ft	0.01/ft	0.07/ft
	6	0.10/ft	0.01/ft	0.09/ft
	8	0.14/ft	0.02/ft	0.12/ft

Injecting Molding Barrel Wrap (Retrofit – New Equipment)

	Measure Details
Official Measure Code	CI-Proc-IMMWrap-1
Measure Unit	Per blanket or vest
Measure Category	Process
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by operating temperature
Peak Demand Reduction (kW)	Varies by operating temperature
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by operating temperature
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	5
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

Removable insulated blankets enclose the cylindrical barrels of an injection molding machine. Surface temperatures of the barrels range from 300°F to 600°F, depending on the resins processed. Barrels are heated either with electric resistance band heaters or by friction from the mechanical screw (which shears plastic material in the barrel, generating frictional heat). Insulated blankets minimize the use of resistance heating without affecting the temperature control of the resin. Barrel wraps are held in place by straps. Blankets are available either standard sizes or can be custom manufactured.

Definition of Efficient Equipment

The efficient condition is an injection molding machine with an insulating blanket or vest wrapped around the barrel.

Definition of Baseline Equipment

The baseline condition is an injection molding machine with no added insulation.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 5 years.

Deemed Measure Cost

The actual measure installation cost should be used (including material and labor).

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = \frac{\Delta\, E_{LOSS} * LEN_{BARREL} * D_{BARREL} * \pi}{1{,}000} * HOURS$$

Where:

ΔE_{LOSS} = Difference in heat loss (measured in watts per square foot needed to replace lost heat) between an injection molding barrel with insulation and an injection molding barrel without insulation (= dependent on operating temperature and thickness of insulation; see table below)

Difference in Heat Loss (W/sqft) by Operating Temperature and Insulation Thickness

Calculating Barrel Heat Loss*	Amount of Insulation		
Operating Temperature (°F)	No Insulation	1-Inch	1.5-Inches
300	180	18.6	12.4
325	210	20.9	14
350	243	23.4	15.6
375	275	26	17.3
400	313	29	19
425	350	31.5	21
450	387	34.3	22.9
475	425	37.2	24.8
500	465	40.1	25.8
525	505	43.2	26.9
550	550	46.5	28.3
575	605	49.9	29.9
600	660	54.1	32.1

* Industrial Modeling Supplies. *Reference/Conversion Chart*. 2009. Available online: http://www.imscompany.com/pdf/Tech%20Tips%20&%20Conversion%20and%20Reference%20Charts.pdf

LEN_{BARREL} = Length of barrel (= actual)

D_{BARREL} = Diameter of barrel (= actual)

π = Pi is used to calculate the surface area of the insulated barrel

1,000 = Conversion factor from watts to kilowatts

HOURS = Annual operating hours (= actual; otherwise assume 3,952)[391]

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[391] The default annual operating hours assume that equipment operates continuously on a typical 2-shift operation (7:00 a.m. to 11:00 p.m. weekdays, minus some holidays and scheduled down time).

Summer Peak Coincident Demand Reduction

$$\Delta kW = \frac{\Delta E_{LOSS} * LEN_{BARREL} * D_{BARREL} * \pi}{1{,}000} * CF$$

Where:

CF = Summer peak coincidence factor (= 0.75)[392]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[392] AUTHOR. *Pacific Gas and Electric, RLW Schools, RLW CF, and San Diego Gas and Electric Time of Use Surveys*. 1996. Pending verification based on information to be provided by the utilities.

Efficient Air Compressors (Time of Sale)

	Measure Details
Official Measure Code	CI-Proc-AirComp-1
Measure Unit	Per compressor
Measure Category	Process
Sector(s)	Industrial
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	15
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing an air compressor with a variable frequency drive, load/no load controls, or variable displacement controls. Baseline compressors choke off the inlet air to modulate the compressor output, which is not efficient. Efficient compressors use less energy at part load conditions. Demand curves are per U.S. Department of Energy data for a variable speed compressor versus a modulating compressor. This measure could relate to replacing an existing unit at the end of its useful life, or installing a new system in a new building (i.e., time of sale).

Definition of Efficient Equipment

The efficient equipment is an air compressor with a variable frequency drive, load/no load controls,[393] or variable displacement controls.

Definition of Baseline Equipment

The baseline equipment is a modulating air compressor with blow down.

Deemed Lifetime of Efficient Equipment

The expected measure life is 15 years.[394]

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[393] For analysis purposes, it is assumed that the compressed air system with load/no load controls uses an air receiver with a storage capacity of 5 gallons per cubic foot per minute of compressor capacity.

[394] Based on a review of TRM assumptions from Vermont, New Hampshire, Massachusetts, and Wisconsin. Estimates range from 10 to 15 years.

Deemed Measure Cost

The incremental capital costs for this measure should be determined on a case-by-case basis. For analysis purposes, assume the incremental costs specified in the table below.

Incremental Measure Cost by Compressor Type

Compressor Type	Incremental Cost*
Load/No Load	$200.00/hp
Variable Displacement	$250.00/hp
Variable Frequency Drive	$300.00/hp

* VEIC. *Technical Reference Manual (TRM) for Ohio Senate Bill 221 Energy Efficiency and Conservation Program and 09-512-GE-UNC*. October 15, 2009. Future study of these estimates is recommended, as published estimates of incremental costs for efficient air compressors are scarce. Costs do not include adding a receiver tank; it is assumed that a receiver tank of adequate size is an existing part of the system.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = Bhp * \frac{0.746}{\eta_{MOTOR}} * HOURS * ESF$$

Where:

Bhp = Compressor motor full load brake horsepower (= actual)

0.746 = Conversion factor from horsepower to kilowatts

η_{MOTOR}= Compressor motor nameplate efficiency (= actual; otherwise assume 90%)[395]

HOURS = Total hours of compressor operation (= actual)

ESF = Energy savings factor (= dependent on compressor control type as shown in table below)

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[395] Improving Compressed Air System Performance: A Sourcebook for Industry, U.S. Department of Energy, November 2003.

Energy Saving Factor by Control Type

Control Type	Energy Savings Factor*
Load/No Load	10%
Variable Displacement	17%
Variable Frequency Drive	26%

* Developed using U.S. Department of Energy part load data for different compressor control types, as well as load profiles from 50 facilities employing air compressors.

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = \frac{\Delta kWh}{HOURS} * CF$$

Where:

CF = Summer peak coincidence factor (= 0.38)[396]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[396] *Technical Reference Manual (TRM) for Ohio Senate Bill 221 Energy Efficiency and Conservation Program and 09-512-GE-UNC*. October 15, 2009. This is likely a conservative estimate, but is recommended for further study.

Commercial Clothes Washer (Time of Sale)

	Measure Details
Official Measure Code	CI-Proc-CloWash-1
Measure Unit	Per washer
Measure Category	Process
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by water heater
Peak Demand Reduction (kW)	Varies by water heater
Annual Fossil Fuel Savings (MMBtu)	Varies by water heater
Lifetime Energy Savings (kWh)	Varies by water heater
Lifetime Fossil Fuel Savings (MMBtu)	Varies by water heater
Water Savings (gal/yr)	15,854 gallons per year
Effective Useful Life (years)	10
Incremental Cost	Varies by CEE Tier
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

High-efficiency commercial washers are intended for purchase and installation in laundromats, multifamily buildings, and institutions. These high-efficiency washers are nearly identical to residential models available in retail outlets, with minor engineering changes, such as the addition of a coin box. High-efficiency commercial washers typically save up to 50% of the energy costs and use 30% less water.

Definition of Efficient Equipment

The efficient equipment is a commercial-grade clothes washer meeting the minimum efficiency standards for ENERGY STAR (MEF ≥ 2.0). Also, the facility where the equipment is installed must have an electric water heater.

Definition of Baseline Equipment

The baseline equipment is a commercial-grade clothes washer that meets federal manufacturing standards (MEF ≥1.26).

Deemed Lifetime of Efficient Equipment

The effective measure life for commercial-grade clothes washers is 10 years.[397]

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[397] *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. “Effective/Remaining Useful Life Values.”

Deemed Measure Cost

The deemed measure cost is \$347.00 per unit ENERGY STAR/CEE Tier1, \$475.00 per unit CEE Tier 2, and \$604.00 per unit CEE Tier 3.[398]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = \Delta kWh_{LOAD} * Loads_{YEAR}$$

Where:

$\Delta\text{kWh}_{\text{LOAD}}$ = Difference in electricity consumption per load of laundry between baseline equipment and efficient equipment (= dependent on energy source for washer, see table below)[399]

Assumptions for Electricity and Natural Gas Consumption for Commercial Clothes Washers

Fuel Source	ΔkWh per Load	MMBtu per Load
Electric Hot Water, Electric Dryer	0.57	0
Natural Gas Hot Water, Electric Dryer	0.25	0.002

$\text{Load}_{\text{YEAR}}$ = Number of loads per year (= 950)[400]

For example, the energy savings from installing a commercial clothes washer in a facility with electric water heating and electric drying would be:

$$\Delta\text{kWh} = 0.57 * 950 = 541.5\text{ kWh}$$

Summer Peak Coincident Demand Reduction

No demand reduction is claimed for this measure since there is insufficient peak coincident data.

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[398] *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. "Cost Values and Summary Documentation."

[399] ENERGY STAR. *Calculator for Commercial Clothes Washers.* July 2009. Values based on the difference between the average of all qualified models and the average of all unqualified models.

[400] Multi-Family Laundry Association. *ENERGY STAR Calculator for Commercial Clothes Washers.* 2002.

Fossil Fuel Impact Descriptions and Calculation

Commercial clothes washers will only have fossil fuel impacts when either the washer, dryer, or both are powered by natural gas.

$$\Delta\text{MMBtu} = \Delta MMBtu_{LOAD} * Loads_{YEAR}$$

Where:

$\Delta\text{MMBtu}_{\text{LOAD}}$ = Difference in natural gas consumption per load of laundry between baseline equipment and efficient equipment (= dependent on energy source for washer and dryer, see table above)

$\text{Loads}_{\text{YEAR}}$ = Number of loads per year (= 950)

Water Impact Descriptions and Calculation

The water savings from a commercial clothes washer is 15,854 gallons per year.[401]

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[401] ENERGY STAR. *Calculator for Commercial Clothes Washers.* July 2009. Average water consumption based on all qualified models.

Refrigeration

LED Case Lighting with/without Motion Sensors (New Construction; Retrofit – Early Replacement

	Measure Details
Official Measure Code	CI-Refrig-LEDCase-1
Measure Unit	Per fixture
Measure Category	Refrigeration
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by lamp type
Peak Demand Reduction (kW)	Varies by lamp type
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by lamp type
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	8
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing LED lamps with or without motion sensors in vertical display refrigerators, coolers, and freezers to replace T8 or T12 linear fluorescent lamp technology. LED lamps should be intended for this application. LED lamps not only provide the same light output with lower connected wattages, but produce less waste heat (which decreases the cooling load on the refrigeration system and the amount of energy needed by the refrigerator compressor). Additional savings can be achieved from installing a motion sensor that automatically dims the lighting system when the space is unoccupied. Retrofit projects must completely remove the existing fluorescent fixture end connectors and ballasts to qualify, though wiring may be reused. Eligible fixtures include new, replacement, and retrofit. Savings and assumptions are based on a per-door basis.

Definition of Efficient Equipment

The efficient equipment is LED case lighting with or without motion sensors on refrigerators, coolers, and freezers (specifically on vertical displays).

Definition of Baseline Equipment

The baseline equipment is T8 or T12 linear fluorescent lamps.

Deemed Lifetime of Efficient Equipment

The expected measure life is 8 years.[402]

Deemed Measure Cost

The incremental capital cost for this measure is $250.00 per door retrofit, or $150.00 for time of sale, new construction.[403]

If a motion sensor is installed, there is an additional cost of $130.00 per every 25 feet of case.[404]

Deemed O&M Cost Adjustments

The stream of baseline lamp replacement costs over the lifetime of the measure results in a net present value of $22.96.[405] This computes to a levelized annual baseline replacement cost assumption of $4.07.

Baseline Lamp Cost:	$4.00
Baseline Lamp Life:	12,000 hours
Baseline Lamp Labor Cost:	$5.00 (15 min @ $20 per hour labor)

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = \frac{WATTS_{BASE} - WATTS_{EE}}{1{,}000} * (\mathrm{N} + 1) * HOURS * (1 + WHF_E) * ESF_{MC}$$

Where:

$WATTS_{BASE}$ = Connected wattage per door of baseline fixtures (= see table below)

$WATTS_{EE}$ = Connected wattage per door of high-efficiency fixtures (= actual; otherwise see table below)

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[402] Theobald, M. A., Pacific Gas and Electric Company. *Emerging Technologies Program: Application Assessment Report #0608, LED Supermarket Case Lighting Grocery Store, Northern California*. January 2006. Available online: http://www.etcc-ca.com/images/stories/pdf/ETCC_Report_204.pdf. Assumes 6,205 annual operating hours, and that the lifetime of the motion sensors is equal to the lifetime of the LED lighting.

[403] Based on a review of TRM incremental cost assumptions from Oregon and Vermont, supplemented with completed project information from New York.

[404] Michele Friedrich, Portland Energy Conservation. "LED Case Lighting With and Without Motion Sensors." Presentation. January 2010.

[405] This value is based on using a discount rate of 5.7% (as is used for Efficiency Vermont), and assumes the baseline ballast life exceeds the life of the LED assembly.

Baseline and Efficient Wattage by Measure Type*

Type of Measure	Efficient Lamp	Efficient Fixture Wattage ($WATTS_{EE}$)	Baseline Fixture Wattage ($WATTS_{BASE}$)	Fixture Savings (Watts)
Refrigerated Case Lighting (per door)	5’ LED Case Lighting System	30	55	25
	6’ LED Case Lighting System	36	66	20

* Based on Wisconsin TRM V4.0 (2015) assumption of 11 W/ft of baseline fluorescent case lighting and 6 W/ft of LED case lighting.

1,000 = Conversion factor from watts to kilowatts

N = Number of doors (= actual; note: N+1 accounts for the additional fixture that is present in a row of case lighting doors)

HOURS = Annual operating hours (= actual; otherwise assume 6,205)[406]

ESF_{MC} = Energy savings factor; additional savings percentage achieved with a motion sensor (= 1.0 if no motion sensor is installed; = 1.43 if motion sensor installed)[407]

WHF_E= Waste heat factor for energy to account for cooling savings from efficient lighting (= 0.41 for refrigerated space; = 0.52 for freezer space)[408]

Summer Peak Coincident Demand Reduction

$$\Delta\text{kW} = \frac{WATTS_{BASE} - WATTS_{EE}}{1{,}000} * (\mathrm{N} + 1) * CF * (1 + WHF_D) * DSF_{MC}$$

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[406] Theobald, M. A., Pacific Gas and Electric Company. *Emerging Technologies Program: Application Assessment Report #0608, LED Supermarket Case Lighting Grocery Store, Northern California*. January 2006. Available online: http://www.etcc-ca.com/images/stories/pdf/ETCC_Report_204.pdf. Assumes refrigerated case lighting typically operates 17 hours per day, 365 days per year.

[407] D. Bisbee, Sacramento Municipal Utility District. *Customer Advanced Technologies Program Technology Evaluation Report: LED Freezer Case Lighting Systems.* July 2008.

[408] Hall, N. et al., TecMarket Works. *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Measures in Commercial and Industrial Programs.* September 1, 2009. This factor is a candidate for future adjustments due to climatic differences between Indiana and New York.

Where:

WHF_D = Waste heat factor for energy to account for cooling savings from efficient lighting (= 0.41 for prescriptive refrigerated lighting measures; = 0.52 for freezer space)[409]

DSF_{MC} = Demand savings factor; additional savings percentage achieved with a motion sensor (= 1.0 if no motion sensor is installed; = 1.43 if motion sensor installed)[410]

CF = Summer peak coincidence factor (= 0.92)[411]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts associated with this measure.

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[409] Ibid.

[410] D. Bisbee, Sacramento Municipal Utility District. *Customer Advanced Technologies Program Technology Evaluation Report: LED Freezer Case Lighting Systems.* July 2008.

[411] Kuiken et al., KEMA. *State of Wisconsin Public Service Commission of Wisconsin Focus on Energy Evaluation Business Programs: Deemed Savings Parameter Development.* November 13, 2009. Summer peak coincident period is defined as June through August on weekdays between 3:00 p.m. and 6:00 p.m., unless otherwise noted.

Refrigerated Case Covers (Time of Sale, New Construction, Retrofit – New Equipment)

	Measure Details
Official Measure Code	CI-Refrig-CaseCover-1
Measure Unit	Per cover
Measure Category	Refrigeration
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by linear foot
Peak Demand Reduction (kW)	Varies by linear foot
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by linear foot
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	5
Incremental Cost	$42.00 per linear foot
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

By covering refrigerated cases, the heat gain from spilling refrigerated air and convective mixing with room air is reduced at the case opening. Continuous curtains can be pulled down overnight while the store is closed, yielding significant energy savings.

Definition of Efficient Equipment

The efficient equipment is a refrigerated case with a continuous cover deployed during overnight periods. The savings are based on covers being deployed for six hours daily.

Definition of Baseline Equipment

The baseline equipment is a refrigerated case without a cover.

Deemed Lifetime of Efficient Equipment

The expected measure life is 5 years.[412]

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[412] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. “Effective/Remaining Useful Life Values.” December 16, 2008.

Deemed Measure Cost

The incremental capital cost is $42.00 per linear foot of cover installed, including material and labor.[413]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = \frac{LOAD}{12{,}000} * FEET * \frac{3.516}{COP} * ESF * 8{,}760$$

Where:

LOAD = Average refrigeration load per linear foot of refrigerated case without night covers deployed (= 1,500 Btu/hr)[414]

12,000 = Conversion factor of Btu per ton of cooling

FEET = Linear (horizontal) feet of covered refrigerated case (= actual)

3.516 = Conversion factor from coefficient of performance to kilowatts per ton

COP = Coefficient of performance for refrigerated case (= actual; otherwise assume 2.2)[415]

ESF = Energy savings factor; reflects the percentage reduction in refrigeration load due to the deployment of night covers (= 9%)[416]

8,760 = Assumed annual operating hours of refrigerated case

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.[417]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[413] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05.* "Cost Values and Summary Documentation." December 16, 2008.

[414] Davis Energy Group. *Analysis of Standard Options for Open Case Refrigerators and Freezers.* May 11, 2004.

[415] Kuiken et al., KEMA. *Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0.* March 22, 2010.

[416] Southern California Edison. *Effects of the Low Emissivity Shields on Performance and Power Use of a Refrigerated Display Case*. August 8, 1997. Available online: http://www.sce.com/NR/rdonlyres/2AAEFF0B-4CE5-49A5-8E2C-3CE23B81F266/0/AluminumShield_Report.pdf

[417] Because continuous covers are deployed at night, no demand reduction occurs during the peak period.

Door Heater Controls for Cooler or Freezer (Time of Sale)

	Measure Details
Official Measure Code	CI-Refrig-ASHCtrl-1
Measure Unit	Per heater
Measure Category	Refrigeration
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by connected load
Peak Demand Reduction (kW)	Varies by connected load
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by connected load
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	12
Incremental Cost	$200.00
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

Significant energy savings can be realized by installing a control device to turn off door heaters when there is little or no risk of condensation. There are two commercially available “on-off” control strategies for door heaters:

1. The first is based on the relative humidity of the air in the store. The system activates door heaters when the relative humidity in the store rises above a specific setpoint, and turns them off when the relative humidity falls below that setpoint.
2. The second is based on the conductivity of the door (which drops when condensation appears). The sensor activates door heaters when the door conductivity falls below a certain setpoint, and turns them off when the conductivity rises above that setpoint.

Definition of Efficient Equipment

The efficient equipment is a door heater control on a commercial glass door cooler or refrigerator with humidity or conductivity control.

Definition of Baseline Equipment

The baseline condition is a commercial glass door cooler or refrigerator with a standard heated door with no controls installed.

Deemed Lifetime of Efficient Equipment

The expected measure life is 12 years.[418]

Deemed Measure Cost

The incremental capital cost for a humidity based control is $300.00 per circuit, regardless of the number of doors controlled. The incremental cost for conductivity based controls is $200.00.[419]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta\text{kWh} = kW_{BASE} * NUM_{DOORS} * ESF * BF * 8{,}760$$

Where:

kW_{BASE} = Connected load kilowatts for typical reach-in refrigerator or freezer door and frame with a heater (= actual; otherwise assume 0.195 kW for freezers and 0.092 kW for coolers)[420]

NUM_{DOORS} = Number of reach-in refrigerator or freezer doors controlled by sensor (= actual)

ESF = Energy savings factor; represents the percentage of hours annually that the door heater is powered off due to the controls (= 55% for humidity based controls, = 70% for conductivity based controls)[421]

BF = Bonus factor; represents the increased savings due to the reduced cooling load inside the cases (=1.36 for low-temperature applications, =

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[418] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05.* "Effective/Remaining Useful Life Values." December 16, 2008.

[419] Efficiency Vermont. *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions.* February, 19, 2010.

[420] A review of TRM methodologies from Connecticut, New York, Vermont, and Wisconsin reveals several different sources for this factor. Connecticut requires site-specific information, whereas New York's characterization does not explicitly identify the kW_{BASE}. Connecticut and Vermont provide very consistent values, and the simple average of these two values was used.

[421] A review of TRM methodologies from Connecticut, New York, Vermont, and Wisconsin reveals several different estimates of the energy savings factor. Vermont has the only TRM that provides savings estimates dependent on the control type, and these estimates are the most conservative of all TRMs reviewed. The Vermont TRM values were adopted.

1.22 for medium-temperature applications, = 1.15 for high-temperature applications)[422]

Summer Peak Coincident Demand Reduction

There is no expected peak demand reduction associated with this measure.[423]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[422] Efficiency Vermont. *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions*. February, 19, 2010.

[423] This is based on the assumption that humidity levels will most likely be relatively high during the peak period, reducing the likelihood of demand reduction from door heater controls.

ENERGY STAR Ice Machine (Time of Sale, New Construction)

	Measure Details
Official Measure Code	CI-Refrig-IceMach-1
Measure Unit	Per machine
Measure Category	Refrigeration
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	9
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing a new ENERGY STAR-qualified, air-cooled, cube-type commercial ice machine, including ice-making head, self-contained, and remote-condensing units. This measure could relate to replacing an existing unit at the end of its useful life, or installing a new system in a new or existing building.

Definition of Efficient Equipment

The efficient equipment is a commercial ice machine meeting the minimum ENERGY STAR efficiency standards.

Definition of Baseline Equipment

The baseline equipment is a commercial ice machine meeting the federal equipment standards established January 1, 2010.

Deemed Lifetime of Efficient Equipment

The expected measure life is 9 years.[424]

Deemed Measure Cost

The incremental capital cost for this measure is provided in the table below.

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[424] The following report estimates the life of a commercial ice-maker at 7-10 years: Arthur D. Little, Inc. *Energy Savings Potential for Commercial Refrigeration Equipment*. 1996.

Incremental Capital Cost by Size of Machine

Harvest Rate (H)	Incremental Cost*
100-200 lb. ice machine	$296.00
201-300 lb. ice machine	$312.00
301-400 lb. ice machine	$559.00
401-500 lb. ice machine	$981.00
501-1,000 lb. ice machine	$1,485.00
1,001-1,500 lb. ice machine	$1,821.00
>1,500 lb. ice machine	$2,194.00

* These values are from electronic work papers prepared in support of the following report: San Diego Gas & Electric. *Application for Approval of Electric and Gas Energy Efficiency Programs and Budgets for Years 2009-2011*. March 2, 2009.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = \frac{kWh_{BASE} - kWh_{EE}}{100} * DC * H * 365$$

Where:

kWh_{BASE} = Maximum kilowatt-hour consumption per 100 pounds of ice for the baseline equipment (= dependent on machine type; see table below using the actual harvest rate (H) of efficient equipment)

kWh_{EE} = Maximum kilowatt-hour consumption per 100 pounds of ice for the efficient equipment (=dependent on machine type; see table below using the actual harvest rate (H) of efficient equipment)

Ice Machine Type	kWh_{BASE}*	kWh_{EE}**
Ice Making Head (H < 450)	10.26 - 0.0086*H	9.23 - 0.0077*H
Ice Making Head (H ≥ 450)	6.89 – 0.0011*H	6.20 - 0.0010*H
Remote Condensing Unit, without remote compressor (H < 1,000)	8.85 – 0.0038*H	8.05 - 0.0035*H
Remote Condensing Unit, without remote compressor (H ≥ 1,000)	5.1	4.64
Remote Condensing Unit, with remote compressor (H < 934)	8.85 – 0.0038*H	8.05 - 0.0035*H
Remote Condensing Unit, with remote compressor (H ≥ 934)	5.3	4.82
Self-Contained Unit (H < 175)	18 - 0.0469*H	16.7 - 0.0436*H
Self-Contained Unit (H ≥ 175)	9.8	9.11

* Baseline reflects federal standards that apply to units manufactured on or after January 1, 2010 (http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&rgn=div6&view=text&node=10:3.0.1.4.17.8&idno=10).
** U.S. Environmental Protection Agency. *ENERGY STAR Program Requirements for Commercial Ice Machines, Partner Commitments*.

100 = Conversion factor from kWh_{BASE} and kWh_{EE} into maximum kilowatt-hour consumption per pound of ice

DC = Duty cycle of ice machine (= 0.57)[425]

H = Harvest rate of pounds of ice made per day (= actual)

365 = Days per year

Summer Peak Coincident Demand Reduction

$$\Delta kW = \frac{\Delta kWh}{HOURS * DC} * CF$$

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[425] The duty cycle varies considerably from one installation to the next. TRM assumptions from New York Vermont, and Wisconsin vary from 40% to 57%, while the ENERGY STAR *Commercial Ice Machine Savings Calculator* assumes a value of 75% (http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_Ice_Machines.xls). A field study of eight ice machines in California revealed an average duty cycle of 57% (Food Service Technology Center. *A Field Study to Characterize Water and Energy Use of Commercial Ice-Cube Machines and Quantify Saving Potential*. December 2007.). Furthermore, another report assumed a value of 40% (Nadel, S., American Council for an Energy-Efficient Economy. *Packaged Commercial Refrigeration Equipment: A Briefing Report for Program Planners and Implementers*. December 2002.). These savings are based on the average value of 57% from the California study.

Where:

HOURS = Annual operating hours (= 8,760)[426]

CF = Summer peak coincidence factor (= 0.772)[427]

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

Water Impact Descriptions and Calculation

While the ENERGY STAR labeling criteria have certain "maximum potable water use per 100 pounds of ice made" requirements for certified commercial ice machines, such requirements are intended to prevent equipment manufacturers from gaining energy efficiency at the cost of water consumptions. The AHRI *Certification Directory*[428] indicates that approximately 81% of air-cooled, cube-type machines meet the ENERGY STAR potable water use requirement. Therefore, there are no assumed water impacts for this measure.

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[426] A unit is assumed to be connected to power 24 hours per day, 365 days per year.

[427] This value is based on the summer peak coincidence factor for commercial ice machines being consistent with that of general commercial refrigeration equipment. The savings use a value of 77.2% from: Efficiency Vermont. *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions*. February 19, 2010.

[428] Available online: http://www.ahridirectory.org/ahridirectory/pages/home.aspx

Commercial Solid Door Refrigerators & Freezers (Time of Sale, New Construction)

	Measure Details
Official Measure Code	CI-Refrig-Ref/Freez-1
Measure Unit	Per door
Measure Category	Refrigeration
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by equipment type
Peak Demand Reduction (kW)	Varies by equipment type
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	Varies by equipment type
Lifetime Fossil Fuel Savings (MMBtu)	0
Water Savings (gal/yr)	0
Effective Useful Life (years)	12
Incremental Cost	Varies by project
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This measure is installing a reach-in commercial refrigerator or freezer meeting ENERGY STAR efficiency standards. ENERGY STAR-labeled commercial refrigerators and freezers are more energy efficient because they are designed with components such as ECM evaporator and condenser fan motors, hot natural gas anti-sweat heaters, or high-efficiency compressors, which significantly reduce energy consumption. This measure could relate to replacing an existing unit at the end of its useful life, or installing a new system in a new or existing building.

Definition of Efficient Equipment

The efficient equipment is a solid or glass door refrigerator or freezer meeting the minimum ENERGY STAR efficiency standards.

Definition of Baseline Equipment

The baseline equipment is a solid or glass door refrigerator or freezer meeting the minimum federal manufacturing standards as specified by the Energy Policy Act of 2005.

Deemed Lifetime of Efficient Equipment

The expected measure life is 12 years.[429]

Deemed Measure Cost

The incremental capital cost for this measure is provided in the table below.

Incremental Cost by Refrigerator or Freezer Volume

Type	Refrigerator Incremental Cost*	Freezer Incremental Cost*
Solid or Glass Door		
Volume ≤ 15	$143.00	$142.00
15 ≤ Volume < 30	$164.00	$166.00
30 ≤ Volume < 50	$164.00	$166.00
Volume ≥ 50	$249.00	$407.00

* Estimates of the incremental cost for commercial refrigerators and freezers varies widely by source. One report indicates that the incremental cost is approximately $0.00 (Nadel, S., American Council for an Energy-Efficient Economy. *Packaged Commercial Refrigeration Equipment: A Briefing Report for Program Planners and Implementers*. December 2002.). Another report assumes incremental cost range from $75.00 to $125.00 depending on equipment volume (Efficiency Vermont. *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions.* February 19, 2010.). The American Council for an Energy-Efficient Economy notes that incremental cost ranges from 0% to 10% of the baseline unit cost (http://www.aceee.org/ogeece/ch5_reach.htm). These values use a 5% incremental cost adder on the full unit costs (as presented in: Goldberg et al., KEMA. *State of Wisconsin Public Service Commission of Wisconsin, Focus on Energy Evaluation, Business Programs: Incremental Cost Study*. October 28, 2009.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta \text{kWh} = (kWh_{BASE} - kWh_{EE}) * 365$$

Where:

kWh_{BASE} = Baseline maximum daily energy consumption in kilowatt hours (= dependent on chilled or frozen compartment volume (V) of efficient unit, see table below)

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[429] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. "Effective/Remaining Useful Life Values." December 16, 2008. Available online: http://www.ctsavesenergy.org/files/Measure%20Life%20Report%202007.pdf

Baseline Daily Energy Consumption by Refrigerator or Freezer Volume

Type	kWh_{BASE}*
Solid Door Refrigerator	0.10 * V + 2.04
Glass Door Refrigerator	0.12 * V + 3.34
Solid Door Freezer	0.40 * V + 1.38
Glass Door Freezer	0.75 * V + 4.10

* U.S. Environmental Protection Agency. Energy Policy Act of 2005.

kWh_{EE} = Efficient maximum daily energy consumption in kilowatt hours (= dependent on chilled or frozen compartment volume of efficient unit, see table below)[430]

Efficient Daily Energy Consumption by Refrigerator or Freezer Volume

Type	Refrigerator kWh_{EE}	Freezer kWh_{EE}
Solid Door		
Volume ≤ 15	≤ 0.089V + 1.411	≤ 0.250V + 1.250
15 ≤ Volume < 30	≤ 0.037V + 2.200	≤ 0.400V – 1.000
30 ≤ Volume < 50	≤ 0.056V + 1.635	≤ 0.163V + 6.125
Volume ≥ 50	≤ 0.060V + 1.416	≤ 0.158V + 6.333
Glass Door		
Volume ≤ 15	≤ 0.118V + 1.382	≤ 0.607V + 0.893
15 ≤ Volume < 30	≤ 0.140V + 1.050	≤ 0.733V – 1.000
30 ≤ Volume < 50	≤ 0.088V + 2.625	≤ 0.250V + 13.500
Volume ≥ 50	≤ 0.110V + 1.500	≤ 0.450V + 3.500

V = Chilled or frozen compartment volume in square feet as defined in the Association of Home Appliance Manufacturers Standard HRF1–1979 (= actual)

365 = Days per year

Summer Peak Coincident Demand Reduction

$$\Delta kW = \frac{\Delta kWh}{HOURS} * CF$$

Where:

HOURS = Number of hours equipment is operating (= 8,760)

CF = Summer peak coincidence factor (= 1.0)

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[430] U.S. Environmental Protection Agency. *ENERGY STAR Program Requirements for Commercial Refrigerators and Freezers Partner Commitments Version 2.0*.

Strip Curtain for Walk-in Coolers and Freezers (New Construction, Retrofit – New Equipment, Retrofit –Early Replacement)

	Measure Details
Official Measure Code	CI-Refrig-StripCurt-1
Measure Unit	Per curtain
Measure Category	Refrigeration
Sector(s)	Commercial
Annual Energy Savings (kWh)	2,974 (freezer), 422 (refrigerator)
Peak Demand Reduction (kW)	0.34 (freezer), 0.05 (refrigerator)
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	
Lifetime Fossil Fuel Savings (MMBtu)	
Water Savings (gal/yr)	0
Effective Useful Life (years)	6
Incremental Cost	$10.22 per square foot
Important Comments	
Effective Date	January 10, 2013
End Date	TBD

Description

This commercial measure is installing infiltration barriers (strip curtains) on walk-in coolers or freezers. Strip curtains impede heat transfer from adjacent warm and humid spaces into walk-ins when the main door is opened, thereby reducing the cooling load. As a result, the compressor run time and energy consumption are reduced. The savings values are based on the walk-in door being open 2.5 hours per day every day, and the strip curtain covering the entire door frame. Eligible applications include new construction and retrofit.

Definition of Efficient Equipment

The efficient equipment is a polyethylene strip curtain added to a walk-in cooler or freezer.

Definition of Baseline Equipment

The baseline assumption is a walk-in cooler or freezer with either no strip curtain installed or an old, ineffective strip curtain installed.

Deemed Lifetime of Efficient Equipment

The expected measure life is 6 years.[431]

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[431] M. Goldberg, J.R. Barry, B. Dunn, M. Ackley, J. Robinson, and D. Deangelo-Woolsey, KEMA. *Focus on Energy: Business Programs – Measure Life Study*. August 2009.

Deemed Measure Cost

The incremental capital cost for this measure is $10.22 per square foot of door opening (includes material and labor).[432]

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

ΔkWh[433] = 2,974 for freezers

= 422 for coolers

Summer Peak Coincident Demand Reduction

$$\Delta \text{kW} = \frac{\Delta\, kWh}{8{,}760} * CF$$

Where:

8,760 = Hours per year

CF = Summer peak coincidence factor (= 1.0)

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[432] California Public Utilities Commission. *2008 Database for Energy-Efficiency Resources (DEER), Version 2008.2.05*. “Cost Values and Summary Documentation.” December 16, 2008.

[433] Values based on analysis prepared by ADM for FirstEnergy utilities in Pennsylvania, provided via personal communication with Diane Rapp of FirstEnergy on June 4, 2010. Based on a review of deemed savings assumptions and methodologies from Oregon and California, the values from Pennsylvania appear reasonable and are the most applicable to the Indiana climate.

Door Gaskets for Refrigerated Cases

	Measure Details
Official Measure Code	CI-Refrig-Gasket-1
Measure Unit	Per installation
Measure Category	Refrigeration
Sector(s)	Commercial
Annual Energy Savings (kWh)	Varies by project
Peak Demand Reduction (kW)	Varies by project
Annual Fossil Fuel Savings (MMBtu)	0
Lifetime Energy Savings (kWh)	
Lifetime Fossil Fuel Savings (MMBtu)	
Water Savings (gal/yr)	0
Effective Useful Life (years)	4
Incremental Cost	$2.25 per linear foot
Important Comments	
Effective Date	January 2013
End Date	TBD

Description

This measure is replacing worn-out gaskets with new, better fitting gaskets on glass or solid door reach-in coolers and freezers. Tight-fitting gaskets inhibit the infiltration of warm and moist air from the surrounding environment into the cold refrigerated space, thereby reducing the cooling load. They also prevent moisture from entering the refrigerated space and becoming frost on the cooling coils, reducing heat transfer effectiveness. As a result of these two factors, the compressor run time and energy consumption are reduced.

Definition of Efficient Equipment

The efficient condition is replacement door gaskets being applied to a reach-in cooler or freezer.

Definition of Baseline Equipment

The baseline condition is a reach-in cooler or freezer with worn gaskets.

Deemed Lifetime of Efficient Equipment

The expected lifetime of the measure is 4 years.

Deemed Measure Cost

The incremental cost for this measure is $2.25 per linear foot.

Deemed O&M Cost Adjustments

There are no expected O&M cost adjustments for this measure.

Savings Algorithm

Energy Savings

$$\Delta kWh = \frac{\Delta kWh}{LF} * LF$$

Where:

ΔkWh/LF = Kilowatt-hour savings per linear foot of gasket installed (= 3.3 for reach-in freezers; = 0.5 for reach-in coolers)[434]

LF = Linear feet of installed gasket (= actual)

Summer Peak Coincident Demand Reduction

$$\Delta kW = \frac{\Delta kWh}{8{,}760} * CF$$

Where:

ΔkWh = Annual kilowatt-hour savings from gasket replacement

CF = Summer peak coincidence factor (= 0.9)

Fossil Fuel Impact Descriptions and Calculation

There are no fossil fuel impacts from this measure.

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[434] ADM Associates. *Commercial Facilities Contract Group 2006-2008 Direct Impact Evaluation*. Study ID PUC0016.01. Prepared for California Public Utilities Commission. 2010.

Appendices

Appendix A – Prototypical Building Energy Simulation Model Development

Many of the savings values from the TRM are derived from DOE-2.2 simulations of typical commercial buildings. They are based on building prototypes originally developed to calculate savings for the California DEER, with certain parameters adjusted to Indiana building practice based on a review of the U.S. Energy Information Administration's *Commercial Buildings Energy Consumption Survey*. The following sections describe prototypical buildings and summarize key modeling assumptions.

Residential Building Prototypes

The analysis used to develop parameters for the energy savings and demand savings calculations are based on DOE-2.2 simulations of a set of prototypical residential buildings. The prototypical simulation models were derived from the residential building prototypes used in the California DEER[435] study, with adjustments made for local building practices and climate. The single family model contains four residential buildings: two are one-story and two are two-story. Both versions of the one-story and 2-story buildings are identical except for the orientation, which is shifted by 90 degrees. The selection of four buildings provides a reasonable average of the impacts from energy efficiency measures for buildings of different design and orientation.

A sketch of the single-family residential prototype buildings is shown below.

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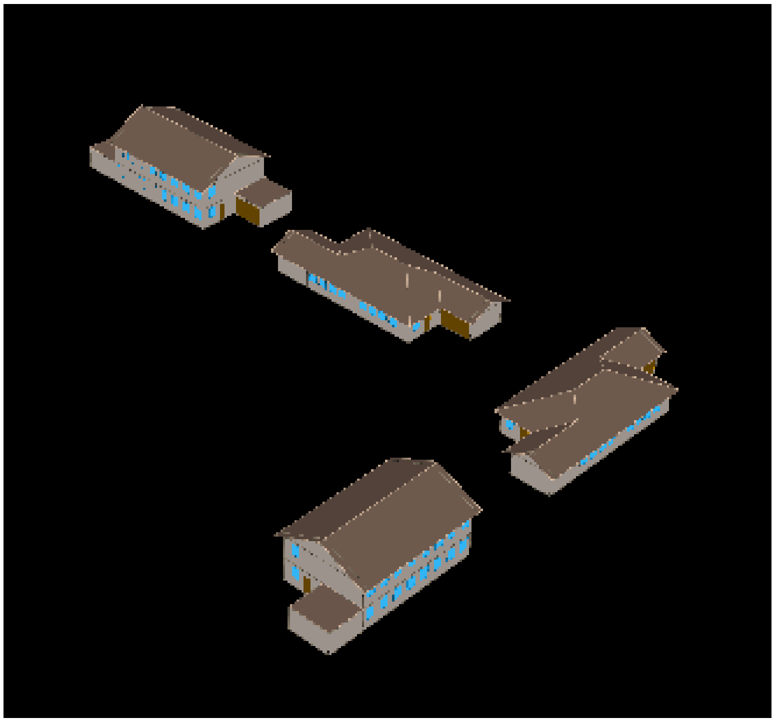
[435] Itron, Inc. *2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report.* December 2005. Available online: http://www.calmac.org/publications/2004-05_DEER_Update_Final_Report-Wo.pdf

Computer Rendering of Single-Family Residential Building Prototypical DOE-2 Model



The general characteristics of the single-family residential building prototype model are summarized below.

Single Family Residential Building Prototype Description

Characteristic	Value
Conditioned floor area	1-story house: 1,465 square feet (not including basement) 2-story house: 2,930 square feet (not including basement)
Wall construction	Wood frame with siding
Roof construction	Wood frame with asphalt shingles
Glazing type	Double pane clear
Lighting and appliance power density	0.51 watts per square foot average
HVAC system type	Packaged single zone air conditioner or heat pump
HVAC system size	Based on peak load with 20% over-sizing
HVAC system efficiency	Baseline SEER = 13
Thermostat setpoints	Heating: 70°F with setback to 67°F Cooling: 75°F with setup to 78°F
Duct location	Buildings without basement: attic Buildings with basement: basement
Duct surface area	Single-story house: 390 square foot supply, 72 square foot return Two-story house: 505 square foot supply, 290 square foot return

Characteristic	Value
Duct insulation	Uninsulated
Duct leakage	20% of fan flow total leakage, evenly split between supply and return
Natural ventilation	Allowed during cooling season when cooling setpoint exceeded and outdoor temperature < 65°F, with three air changes per hour

Commercial Building Prototype Model Development

Commercial sector prototype building models were developed for a series of small commercial buildings with packaged rooftop HVAC systems, including assembly, big-box retail, fast food restaurant, full service restaurant, grocery, light industrial, primary school, small office, and small retail buildings. Large office, hotel, and hospital prototypes were also included to analyze measures associated with built-up HVAC systems. The following sections describe the prototypical simulation models used in this analysis.

Assembly

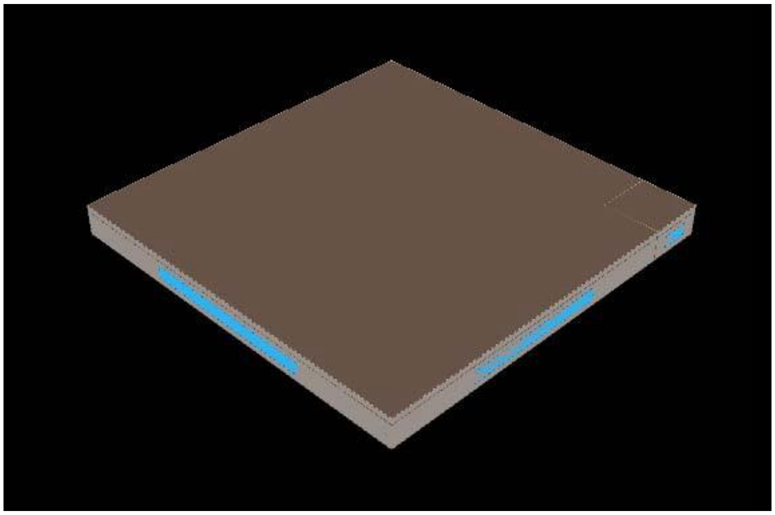
A prototypical building energy simulation model for an assembly building was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in the table below.

Assembly Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	34,000 square feet Auditorium: 33,240 square feet Office: 760 square feet
Number of floors	1
Wall construction and R-value	Concrete block, R-5
Roof construction and R-value	Wood frame with built-up roof, R-12
Glazing type	Multipane shading coefficient = 0.84 U-value = 0.72
Lighting power density	Auditorium: 1.9 watts per square foot Office: 1.55 watts per square foot
Plug load density	Auditorium: 1.2 watts per square foot Office: 1.7 watts per square foot
Operating hours	Monday through Sunday, 8:00 a.m. to 9:00 p.m.
HVAC system type	Packaged single zone, no economizer
HVAC system size	Based on ASHRAE design day conditions, 10% over-sizing assumed
Thermostat setpoints	Occupied hours: 75°F cooling, 70°F heating Unoccupied hours: 80°F cooling, 65°F heating

A computer-generated sketch of the prototype is shown below.

Assembly Building Rendering



Big-Box Retail

A prototypical building energy simulation model for a big-box retail building was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in the table below.

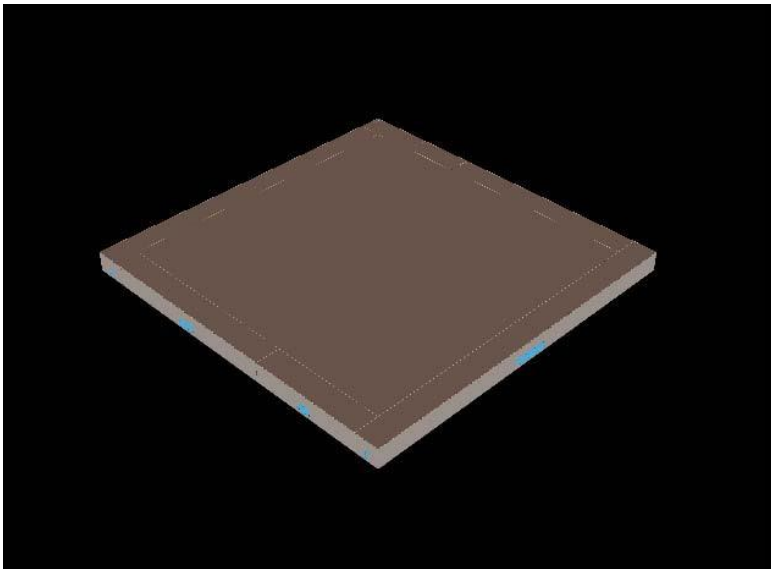
Big-Box Retail Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	130,500 square feet Sales: 107,339 square feet Storage: 11,870 square feet Office: 4,683 square feet Auto repair: 5,151 square feet Kitchen: 1,459 square feet
Number of floors	1
Wall construction and R-value	Concrete block with insulation, R-7.5
Roof construction and R-value	Metal frame with built-up roof, R-13.5
Glazing type	Multipane shading coefficient = 0.84 U-value = 0.72
Lighting power density	Sales: 2.15 watts per square foot Storage: 0.85 watts per square foot (active), 0.45 watts per square foot (inactive) Office: 1.55 watts per square foot Auto repair: 1.7 watts per square foot Kitchen: 2.2 watts per square foot
Plug load density	Sales: 1.15 watts per square foot Storage: 0.23 watts per square foot

Characteristic	Value
	Office: 1.73 watts per square foot Auto repair: 1.15 watts per square foot Kitchen: 3.23 watts per square foot
Operating hours	Monday through Sunday, 10:00 a.m. to 9:00 p.m.
HVAC system type	Packaged single zone, no economizer
HVAC system size	Based on ASHRAE design day conditions, 10% over-sizing assumed
Thermostat setpoints	Occupied hours: 75°F cooling, 70°F heating Unoccupied hours: 80°F cooling, 65°F heating

A computer-generated sketch of the prototype is shown below.

Big-Box Retail Building Rendering



Fast Food Restaurant

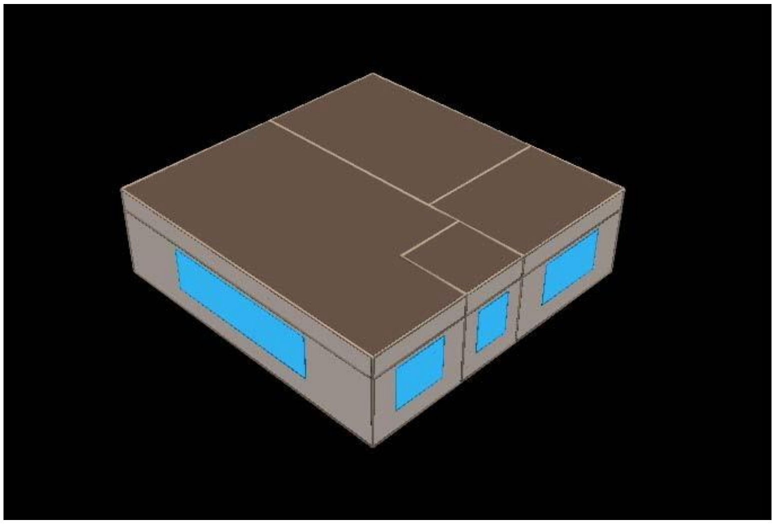
A prototypical building energy simulation model for a fast food restaurant was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in the table below.

Fast Food Restaurant Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	2,000 square feet Dining: 1,000 square feet Entry/lobby: 600 square feet Kitchen: 300 square feet Restroom: 100 square feet
Number of floors	1
Wall construction and R-value	Concrete block with brick veneer, R-7.5
Roof construction and R-value	Concrete deck with built-up roof, R-13.5
Glazing type	Multipane shading coefficient = 0.84 U-value = 0.72
Lighting power density	Dining: 1.7 watts per square foot Entry area: 1.7 watts per square foot Kitchen: 2.2 watts per square foot Restroom: 0.9 watts per square foot
Plug load density	Dining: 0.6 watts per square foot Entry/lobby: 0.6 watts per square foot Kitchen: 4.3 watts per square foot Restroom: 0.2 watts per square foot
Operating hours	Monday through Sunday, 6:00 a.m. to 11:00 p.m.
HVAC system type	Packaged single zone, no economizer
HVAC system size	Based on ASHRAE design day conditions, 10% over-sizing assumed
Thermostat setpoints	Occupied hours: 75°F cooling, 70°F heating Unoccupied hours: 80°F cooling, 65°F heating

A computer-generated sketch of the prototype is shown below.

Fast Food Restaurant Building Rendering



Full-Service Restaurant

A prototypical building energy simulation model for a full-service restaurant was developed using the DOE-2.2 building energy simulation program. The characteristics of the full service restaurant prototype are summarized in the table below.

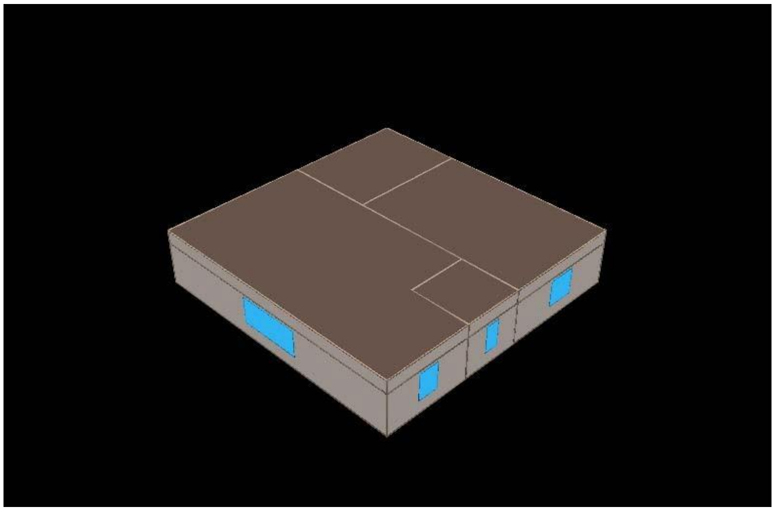
Full Service Restaurant Prototype Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	Dining: 2,000 square feet Entry/reception: 600 square feet Kitchen: 1,200 square feet Restrooms: 200 square feet
Number of floors	1
Wall construction and R-value	Concrete block with brick veneer, R-7.5
Roof construction and R-value	Wood frame with built-up roof, R-13.5
Glazing type	Multipane shading coefficient = 0.84 U-value = 0.72
Lighting power density	Dining: 1.7 watts per square foot Entry: 1.7 watts per square foot Kitchen: 2.2 watts per square foot Restrooms: 1.5 watts per square foot
Plug load density	Dining: 0.6 watts per square foot Entry: 0.6 watts per square foot Kitchen: 3.1 watts per square foot Restrooms: 0.2 watts per square foot
Operating hours	9:00 a.m. to 12:00 a.m.

Characteristic	Value
HVAC system type	Packaged single zone, no economizer
HVAC system size	Based on ASHRAE design day conditions, 10% over-sizing assumed
Thermostat setpoints	Occupied hours: 75°F cooling, 70°F heating Unoccupied hours: 80°F cooling, 65°F heating

A computer-generated sketch of the full-service restaurant prototype is shown in **Error! Reference source not found.**.

Full Service Restaurant Prototype Rendering



Grocery

A prototypical building energy simulation model for a grocery building was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in the table below.

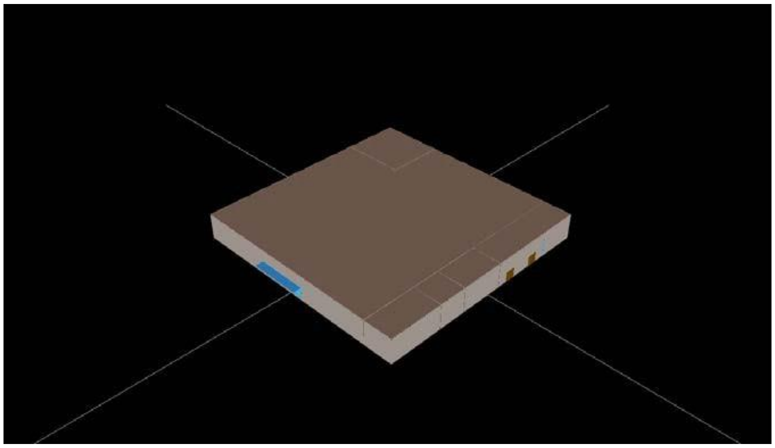
Grocery Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	50,000 square feet Sales: 40,000 square feet Office and employee lounge: 3,500 square feet Dry storage: 2,860 square feet 50°F prep area: 1,268 square feet 35°F walk-in cooler: 1,560 square feet - 5°F walk-in freezer: 812 square feet
Number of floors	1
Wall construction and R-value	Concrete block with insulation, R-5
Roof construction and R-value	Metal frame with built-up roof, R-12

Characteristic	Value
Glazing type	Single pane clear
Lighting power density	Sales: 3.36 watts per square foot Office: 2.2 watts per square foot Storage: 1.82 watts per square foot 50°F prep area: 4.3 watts per square foot 35°F walk-in cooler: 0.9 watts per square foot - 5°F walk-in freezer: 0.9 watts per square foot
Equipment power density	Sales: 1.15 watts per square foot Office: 1.73 watts per square foot Storage: 0.23 watts per square foot 50°F prep area: 0.23 watts per square foot+ 36 kBtu/hr process load 35°F walk-in cooler: 0.23 watts per square foot+ 17 kBtu/hr process load - 5°F walk-in freezer: 0.23 watts per square foot+ 29 kBtu/hr process load
Operating hours	Monday through Sunday, 6:00 a.m. to 10:00 p.m.
HVAC system type	Packaged single zone, no economizer
Refrigeration system type	Air cooled multiplex
Refrigeration system size	-20°F suction temperature: 23 compressor ton 18°F suction temperature: 45 compressor ton
Refrigeration condenser size	-20°F suction temperature: 535 kBtu/hr THR 18°F suction temperature: 756 kBtu/hr THR
Thermostat setpoints	Occupied hours: 74°F cooling, 70°F heating Unoccupied hours: 79°F cooling, 65°F heating

A computer-generated sketch of the prototype is shown in the figure below.

Grocery Building Rendering



Hospital

A prototypical building energy simulation model for a large hospital building was developed using the DOE-2.2 building energy simulation program and TMY3 long-term average weather data. The characteristics of the prototype are summarized in the table below.

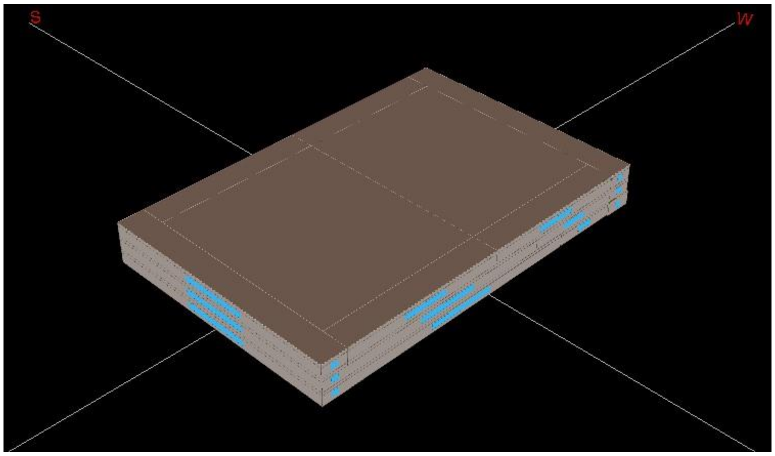
Large Hospital Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	250,000 square feet
Number of floors	3
Wall construction and R-value	Brick and CMU, R=7.5
Roof construction and R-value	Built-up roof, R=13.5
Glazing type	Multipane shading coefficient = 0.84 U-value = 0.72
Lighting power density	Patient rooms: 2.3 watts per square foot Office: 2.2 watts per square foot Lab: 4.4 watts per square foot Dining: 1.7 watts per square foot Kitchen and food prep: 4.3 watts per square foot
Plug load density	Patient rooms: 1.7 watts per square foot Office: 1.7 watts per square foot Lab: 1.7 watts per square foot Dining: 0.6 watts per square foot Kitchen and food prep: 4.6 watts per square foot
Operating hours	24/7, 365
HVAC system types	Patient Rooms: 4 pipe fan coil Kitchen: Rooftop DX Remaining space: 1. Central constant volume system with hydronic reheat, without economizer 2. Central constant volume system with hydronic reheat, with economizer 3. Central VAV system with hydronic reheat, with economizer
HVAC system size	Based on ASHRAE design day conditions, 10% over-sizing assumed
Chiller type	Water cooled and air cooled
Chilled water system type	Constant volume with 3-way control valves
Chilled water system control	Constant CHW temperature, 45°F setpoint
Boiler type	Hot water, 80% efficiency
Hot water system type	Constant volume with 3-way control valves
Hot water system control	Constant hot water temperature, 180°F setpoint
Thermostat setpoints	Occupied hours: 76°F cooling, 72°F heating Unoccupied hours: 79°F cooling, 69°F heating

Each set of measures was run with three different HVAC system configurations: (1) a constant volume reheat system without economizer, (2) a constant volume reheat system with economizer, and (3) a VAV system with economizer. The constant volume reheat system without economizer represents a system with the most heating and cooling operating hours, while the VAV system with economizer represents a system with the least heating and cooling hours. This presents a range of system loads and energy savings for each measure analyzed.

A computer-generated sketch of the prototype is shown below.

Hospital Building Rendering



Hotel

A prototypical building energy simulation model for a hotel building was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in the table below.

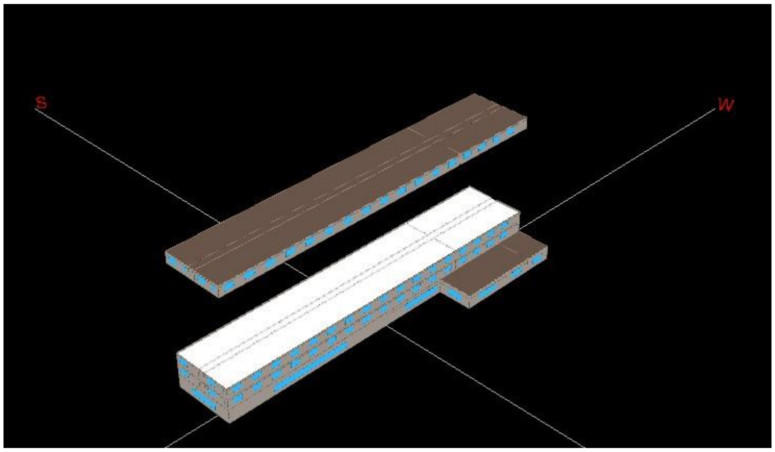
Hotel Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	200,000 square feet total Bar/cocktail lounge: 800 square feet Corridor: 20,100 square feet Dining: 1,250 square feet Guest rooms: 160,680 square feet Kitchen: 750 square feet Laundry: 4,100 square feet Lobby: 8,220 square feet Office: 4,100 square feet
Number of floors	11
Wall construction and R-value	Block construction, R-7.5
Roof construction and R-value	Wood deck with built-up roof, R-13.5

Characteristic	Value
Glazing type	Multipane shading coefficient = 0.84 U-value = 0.72
Lighting power density	Bar/cocktail lounge: 1.7 watts per square foot Corridor: 1.0 watts per square foot Dining: 1.7 watts per square foot Guest: 0.6 watts per square foot Kitchen: 4.3 watts per square foot Laundry: 1.8 watts per square foot Lobby: 3.1 watts per square foot Office: 2.2 watts per square foot
Plug load density	Bar/cocktail lounge: 1.2 watts per square foot Corridor: 0.2 watts per square foot Dining: 0.6 watts per square foot Guest rooms: 0.6 watts per square foot Kitchen: 3.0 watts per square foot Laundry: 3.5 watts per square foot Lobby: 0.6 watts per square foot Office: 1.7 watts per square foot
Operating hours	Rooms: 60% occupied 40% unoccupied All others: 24 hr/day
HVAC system type	Guest rooms: PTAC Corridors: PSZ Everywhere else: central built-up system: 1. Central constant volume system with perimeter hydronic reheat, without economizer 2. Central constant volume system with perimeter hydronic reheat, with economizer 3. Central VAV system with perimeter hydronic reheat, with economizer
HVAC system size	Based on ASHRAE design day conditions, 10% over-sizing assumed
Chiller type	Water cooled and air cooled
Chilled water system type	Constant volume with 3-way control valves
Chilled water system control	Constant CHW temperature, 45°F setpoint
Boiler type	Hot water, 80% efficiency
Hot water system type	Constant volume with 3-way control valves
Hot water system control	Constant hot water temperature, 180°F setpoint
Thermostat setpoints	Occupied hours: 76°F cooling, 72°F heating Unoccupied hours: 81°F cooling, 67°F heating

A computer-generated sketch of the prototype is shown below.

Hotel Building Rendering



Large Office

A prototypical building energy simulation model for a large office building was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in the table below.

Large Office Prototype Building Description

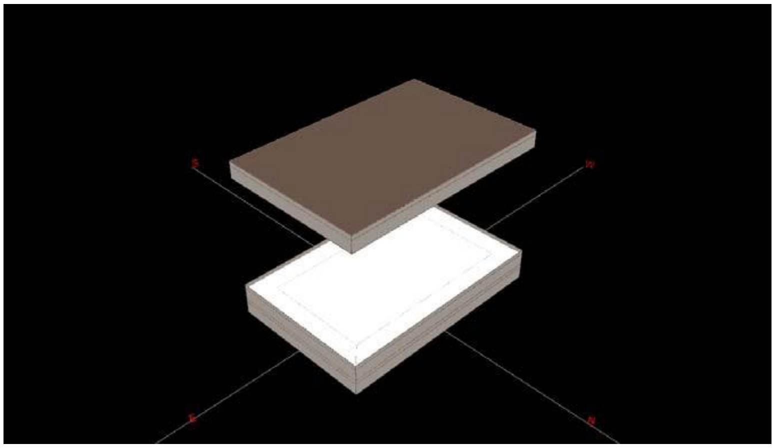
Characteristic	Value
Vintage	Existing (1970s) vintage
Size	350,000 square feet
Number of floors	10
Wall construction and R-value	Glass curtain wall, R-7.5
Roof construction and R-value	Built-up roof, R-13.5
Glazing type	Multipane shading coefficient = 0.84 U-value = 0.72
Lighting power density	Perimeter offices: 1.55 watts per square foot Core offices: 1.45 watts per square foot
Plug load density	Perimeter offices: 1.6 watts per square foot Core offices: 0.7 watts per square foot
Operating hours	Monday through Saturday, 9:00 a.m. to 6:00 p.m. Sunday unoccupied
HVAC system types	1. Central constant volume system with perimeter hydronic reheat, without economizer 2. Central constant volume system with perimeter hydronic reheat, with economizer 3. Central VAV system with perimeter hydronic reheat, with economizer
HVAC system size	Based on ASHRAE design day conditions, 10% over-sizing assumed
Chiller type	Water cooled and air cooled
Chilled water system type	Constant volume with 3-way control valves

Chilled water system control	Constant CHW temperature, 45°F setpoint
Boiler type	Hot water, 80% efficiency
Hot water system type	Constant volume with 3-way control valves
Hot water system control	Constant hot water temperature, 180°F setpoint
Thermostat setpoints	Occupied hours: 75°F cooling, 70°F heating Unoccupied hours: 80°F cooling, 65°F heating

Each set of measures was run using three different HVAC system configurations: (1) a constant volume reheat system without economizer, (2) a constant volume reheat system with economizer, and (3) a VAV system with economizer. The constant volume reheat system without economizer represents the system with the most heating and cooling operating hours, while the VAV system with economizer represents a system with the least heating and cooling hours. This presents a range of system loads and energy savings for each measure analyzed.

A computer-generated sketch of the prototype is shown below. Note that middle floors are thermally equivalent, therefore were simulated as a single floor with the results multiplied by the number of floors.

Large Office Building Rendering



Light Industrial

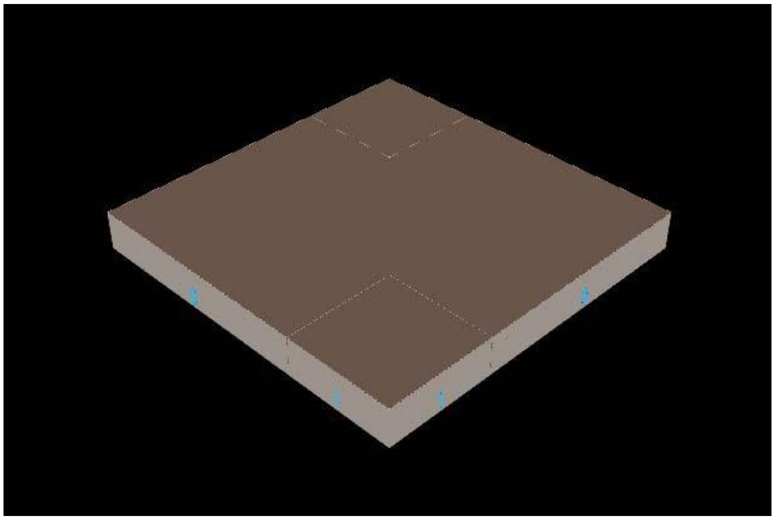
A prototypical building energy simulation model for a light industrial building was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in the table below.

Light Industrial Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	100,000 square feet total Factory: 80,000 square feet Warehouse: 20,000 square feet
Number of floors	1
Wall construction and R-value	Concrete block with brick, no insulation, R-5
Roof construction and R-value	Concrete deck with built-up roof, R-12
Glazing type	Multipane shading coefficient = 0.84 U-value = 0.72
Lighting power density	Factory: 2.25 watts per square foot Warehouse: 0.7 watts per square foot
Plug load density	Factory: 1.2 watts per square foot Warehouse: 0.2 watts per square foot
Operating hours	Monday through Friday, 6:00 a.m. to 6:00 p.m. Saturday and Sunday, u noccupied
HVAC system type	Packaged single zone, no economizer
HVAC system size	Based on ASHRAE design day conditions, 10% over-sizing assumed
Thermostat setpoints	Occupied hours: 75°F cooling, 70°F heating Unoccupied hours: 80°F cooling, 65°F heating

A computer-generated sketch of the prototype is shown below.

Light Industrial Building Rendering



Primary School

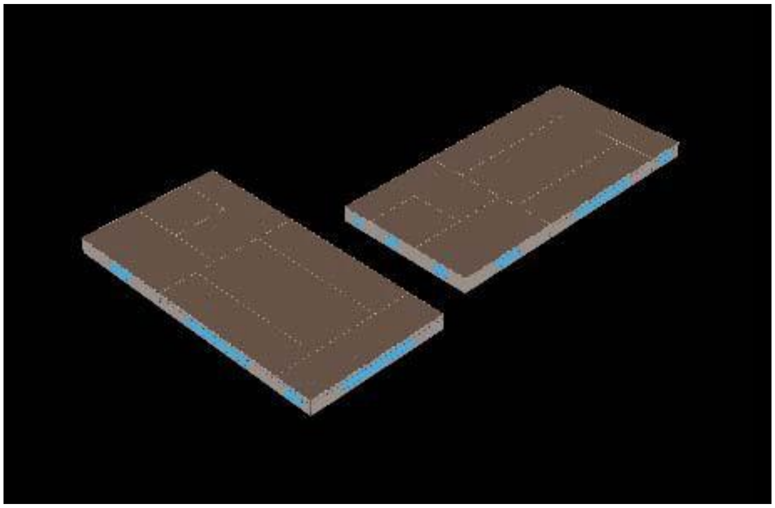
A prototypical building energy simulation model for an elementary school was developed using the DOE-2.2 building energy simulation program. The model is of two identical buildings oriented in different directions. The characteristics of the prototype are summarized in the table below.

Elementary School Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	2 buildings, 25,000 square feet each, oriented 90 degrees from each other Classroom: 15,750 square feet Cafeteria: 3,750 square feet Gymnasium: 3,750 square feet Kitchen: 1,750 square feet
Number of floors	1
Wall construction and R-value	Concrete with brick veneer, R-7.5
Roof construction and R-value	Wood frame with built-up roof, R-13.5
Glazing type	Multipane shading coefficient = 0.84 U-value = 0.72
Lighting power density	Classroom: 1.8 watts per square foot Cafeteria: 1.3 watts per square foot Gymnasium: 1.7 watts per square foot Kitchen: 2.2 watts per square foot
Plug load density	Classroom: 1.2 watts per square foot Cafeteria: 0.6 watts per square foot Gymnasium: 0.6 watts per square foot Kitchen: 4.2 watts per square foot
Operating hours	Monday through Friday, 8:00 a.m. to 6:00 p.m. Sunday, 8:00 a.m. to 4:00 p.m. Saturday, unoccupied
HVAC system type	Packaged single zone, no economizer
HVAC system size	Based on ASHRAE design day conditions, 10% over-sizing assumed
Thermostat setpoints	Occupied hours: 75°F cooling, 70°F heating Unoccupied hours: 80°F cooling, 65°F heating

A computer-generated sketch of the prototype is shown below.

School Building Rendering



Small Office

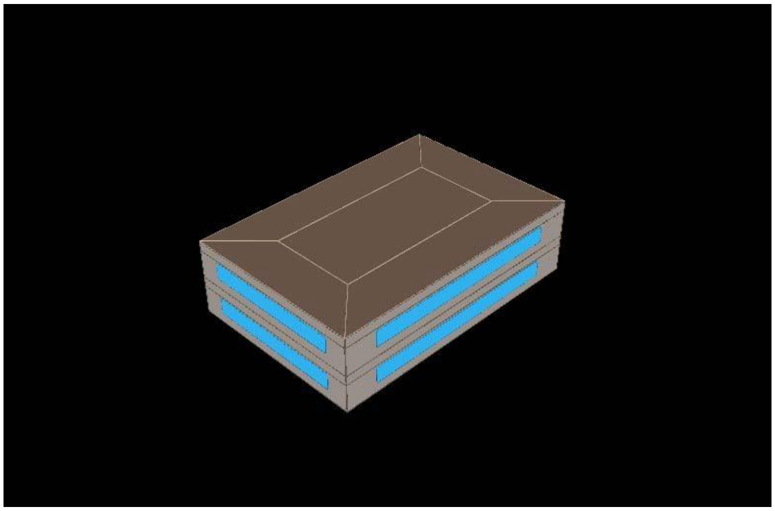
A prototypical building energy simulation model for a small office was developed using the DOE-2.2 building energy simulation program. The characteristics of the small office prototype are summarized in the table below.

Small Office Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	10,000 square feet
Number of floors	2
Wall construction and R-value	Wood frame with brick veneer, R-7.5
Roof construction and R-value	Wood frame with built-up roof, R-13.5
Glazing type	Multipane shading coefficient = 0.84 U-value = 0.72
Lighting power density	Perimeter offices: 1.55 watts per square foot Core offices: 1.45 watts per square foot
Plug load density	Perimeter offices: 1.6 watts per square foot Core offices: 0.7 watts per square foot
Operating hours	Monday through Saturday, 9:00 a.m. to 6:00 p.m. Sunday, unoccupied
HVAC system type	Packaged single zone, no economizer
HVAC system size	Based on ASHRAE design day conditions, 10% over-sizing assumed
Thermostat setpoints	Occupied hours: 75°F cooling, 70°F heating Unoccupied hours: 80°F cooling, 65°F heating

A computer-generated sketch of the small office prototype is shown below.

Small Office Prototype Building Rendering



Small Retail

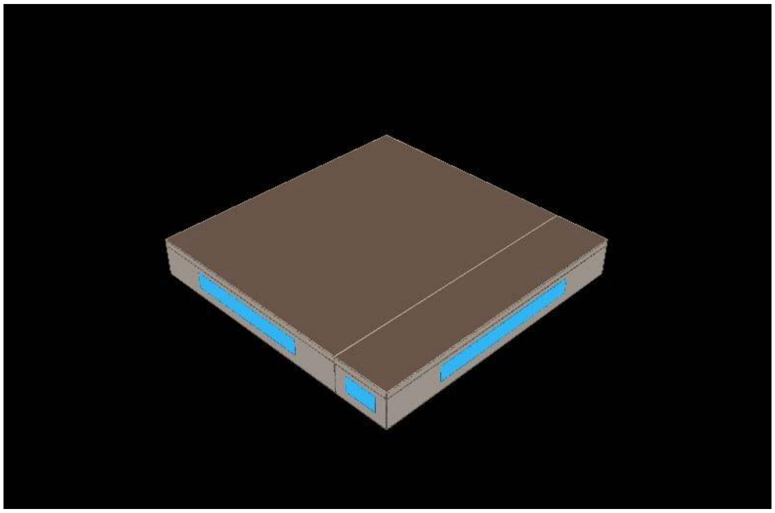
A prototypical building energy simulation model for a small retail building was developed using the DOE-2.2 building energy simulation program. The characteristics of the small retail building prototype are summarized in the table below.

Table 1. Small Retail Prototype Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	8,000 square feet total Sales area: 6,400 square feet Storage: 1,600 square feet
Number of floors	1
Wall construction and R-value	Concrete block with brick veneer, R-7.5
Roof construction and R-value	Wood frame with built-up roof, R-13.5
Glazing type	Multipane shading coefficient = 0.84 U-value = 0.72
Lighting power density	Sales area: 2.15 watts per square foot Storage: 0.85 watts per square foot (active); 0.45 watts per square foot (inactive)
Plug load density	Sales area: 1.2 watts per square foot Storage: 0.2 watts per square foot
Operating hours	Monday through Saturday, 10:00 a.m. to 10:00 p.m. Sunday, 10:00 a.m. to 8:00 p.m.
HVAC system type	Packaged single zone, no economizer
HVAC system size	Based on ASHRAE design day conditions, 10% over-sizing assumed
Thermostat setpoints	Occupied hours: 75°F cooling, 70°F heating Unoccupied hours: 80°F cooling, 65°F heating

A computer-generated sketch of the small retail building prototype is shown below.

Small Retail Prototype Building Rendering



Appendix B – HVAC Interactive Effects Multipliers

Residential Buildings

HVAC Interactive Effects Multipliers for Residential Buildings

City	AC with Natural Gas Heat			Heat Pump			AC with Electric Heat			Electric Heat Only			Natural Gas Heat Only		
	WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G
Indianapolis	0.06	0.07	-0.0024	-0.17	0.03	0.00	-0.45	0.07	0.00	-0.52	0.00	0.00	0.00	0.00	-0.0024
South Bend	0.05	0.05	-0.0025	-0.18	0.00	0.00	-0.47	0.05	0.00	-0.54	0.00	0.00	0.00	0.00	-0.0025
Evansville	0.07	0.11	-0.0022	-0.11	0.10	0.00	-0.37	0.11	0.00	-0.45	0.00	0.00	0.00	0.00	-0.0022
Ft Wayne	0.05	0.05	-0.0026	-0.22	0.00	1.00	-0.50	0.05	1.00	-0.56	0.00	0.00	0.00	0.00	-0.0026
Terre Haute	0.07	0.08	-0.0024	-0.15	0.00	2.00	-0.42	0.08	2.00	-0.50	0.00	0.00	0.00	0.00	-0.0024

Data to calculated weights for each HVAC system type in residential buildings were obtained from the *Residential Energy Consumption Survey* for the East North Central census region (including Indiana and Ohio). These data are summarized in the table below.

Waste Heat Factor Weights by HVAC System Type

HVAC System Type	Number of Homes (millions)	Weight
AC Natural Gas Heat	4.22	0.63
Heat Pump	0.30	0.04
AC Electric Heat	1.18	0.18
Electric Heat Only	0.15	0.02
Natural Gas Heat Only	0.85	0.13

Applying these weights to the waste heat factor from the table above gives the following weighted averages by city, along with a statewide value assuming equal weights across cities.

Weighted Average Waste Heat Factors by City

City	Weighted		
	WHF_E	WHF_D	WHF_G
Indianapolis	-0.061	0.055	-0.0018
South Bend	-0.070	0.038	-0.0019
Evansville	-0.034	0.092	-0.0017
Ft Wayne	-0.082	0.038	-0.0019
Terre Haute	-0.048	0.061	-0.0018
Statewide	**-0.059**	**0.057**	**-0.0018**

Commercial Buildings

HVAC Interactive Effects Multipliers for Commercial Buildings

Building	City	AC with Natural Gas Heat			Heat Pump			AC with Electric Heat			Electric Heat Only			Natural Gas Heat Only		
		WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G
Assembly	Indianapolis	0.155	0.2	-0.0029	-0.174	0.2	0	-0.434	0.2	0	-0.591	0	0	0	0	-0.0029
	South Bend	0.133	0.2	-0.0023	-0.221	0.2	0	-0.349	0.2	0	-0.483	0	0	0	0	-0.0024
	Evansville	0.2	0.2	-0.0017	-0.042	0.2	0	-0.143	0.2	0	-0.318	0	0	0	0	-0.0017
	Ft Wayne	0.123	0.2	-0.003	-0.571	0.2	0	-0.485	0.2	0	-0.607	0	0	0	0	-0.0029
	Terre Haute	0.165	0.2	-0.0031	-0.184	0.2	0	-0.459	0.2	0	-0.604	0	0	0	0	-0.003
Big Box	Indianapolis	0.146	0.2	-0.0017	-0.086	0.2	0	-0.193	0.2	0	-0.318	0	0	0	0	-0.0017
	South Bend	0.133	0.2	-0.0019	-0.099	0.2	0	-0.242	0.2	0	-0.365	0	0	0	0	-0.0019
	Evansville	0.177	0.2	-0.0012	0.049	0.2	0	-0.043	0.2	0	-0.186	0	0	0	0	-0.0011
	Ft Wayne	0.126	0.2	-0.002	-0.16	0.2	0	-0.266	0.2	0	-0.371	0	0	0	0	-0.002
	Terre Haute	0.17	0.2	-0.0015	-0.028	0.2	0	-0.116	0.2	0	-0.28	0	0	0	0	-0.0015
Elementary School	Indianapolis	0.096	0.2	-0.0033	-0.278	0.2	0	-0.605	0.2	0	-0.743	0	0	0	0	-0.0033
	South Bend	0.073	0.2	-0.0036	-0.318	0.2	0	-0.701	0.2	0	-0.839	0	0	0	0	-0.0036
	Evansville	0.126	0.2	-0.0029	-0.148	0.2	0	-0.465	0.2	0	-0.606	0	0	0	0	-0.0029
	Ft Wayne	0.069	0.2	-0.0037	-0.356	0.2	0	-0.736	0.2	0	-0.869	0	0	0	0	-0.0037
	Terre Haute	0.101	0.2	-0.0034	-0.274	0.2	0	-0.605	0.2	0	-0.784	0	0	0	0	-0.0034

Building	City	AC with Natural Gas Heat			Heat Pump			AC with Electric Heat			Electric Heat Only			Natural Gas Heat Only		
		WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G
Fast Food	Indianapolis	0.109	0.2	-0.0029	-0.023	0.2	0	-0.53	0.2	0	-0.661	0	0	0	0	-0.0032
	South Bend	0.09	0.2	-0.0032	-0.024	0.2	0	-0.586	0.2	0	-0.664	0	0	0	0	-0.0032
	Evansville	0.131	0.2	-0.0025	-0.016	0.2	0	-0.404	0.2	0	-0.677	0	0	0	0	-0.0033
	Ft Wayne	0.088	0.2	-0.0032	-0.026	0.2	0	-0.618	0.2	0	-0.66	0	0	0	0	-0.0032
	Terre Haute	0.112	0.2	-0.0029	-0.02	0.2	0	-0.505	0.2	0	-0.689	0	0	0	0	-0.0034
Full Service Restaurant	Indianapolis	0.108	0.2	-0.0033	-0.023	0.2	0	-0.556	0	0	-0.872	0	0	0	0	-0.0042
	South Bend	0.091	0.2	-0.0034	-0.024	0.2	0	-0.602	0	0	-0.746	0	0	0	0	-0.0036
	Evansville	0.135	0.2	-0.0026	-0.016	0.2	0	-0.372	0	0	-0.546	0	0	0	0	-0.0028
	Ft Wayne	0.088	0.2	-0.0036	-0.026	0.2	0	-0.638	0	0	-0.758	0	0	0	0	-0.0036
	Terre Haute	0.124	0.2	-0.0029	-0.02	0.2	0	-0.458	0	0	-0.628	0	0	0	0	-0.0031
Grocery	Indianapolis	0.146	0.2	-0.0017	-0.086	0.2	0	-0.193	0.2	0	-0.318	0	0	0	0	-0.0017
	South Bend	0.133	0.2	-0.0019	-0.099	0.2	0	-0.242	0.2	0	-0.365	0	0	0	0	-0.0019
	Evansville	0.177	0.2	-0.0012	0.049	0.2	0	-0.043	0.2	0	-0.186	0	0	0	0	-0.0011
	Ft Wayne	0.126	0.2	-0.002	-0.16	0.2	0	-0.266	0.2	0	-0.371	0	0	0	0	-0.002
	Terre Haute	0.17	0.2	-0.0015	-0.028	0.2	0	-0.116	0.2	0	-0.28	0	0	0	0	-0.0015
Light Industrial	Indianapolis	0.096	0.2	-0.0022	-0.145	0.2	0	-0.332	0.2	0	-0.433	0	0	0	0	-0.0021
	South Bend	0.08	0.2	-0.0024	-0.173	0.2	0	-0.397	0.2	0	-0.496	0	0	0	0	-0.0024
	Evansville	0.123	0.2	-0.0018	-0.048	0.2	0	-0.217	0.2	0	-0.308	0	0	0	0	-0.0017
	Ft Wayne	0.074	0.2	-0.0025	-0.188	0.2	0	-0.407	0.2	0	-0.499	0	0	0	0	-0.0024
	Terre Haute	0.103	0.2	-0.0021	-0.099	0.2	0	-0.306	0.2	0	-0.394	0	0	0	0	-0.0021
Small Office	Indianapolis	0.119	0.2	-0.0016	-0.027	0.2	0	-0.182	0.2	0	-0.182	0	0	0	0	-0.0015
	South Bend	0.122	0.2	-0.0015	-0.015	0.2	0	-0.169	0.2	0	-0.169	0	0	0	0	-0.0014
	Evansville	0.144	0.2	-0.0012	0.051	0.2	0	-0.072	0.2	0	-0.072	0	0	0	0	-0.009
	Ft Wayne	0.102	0.2	-0.0019	-0.112	0.2	0	-0.271	0.2	0	-0.271	0	0	0	0	-0.0018
	Terre Haute	0.124	0.2	-0.0016	-0.036	0.2	0	-0.184	0.2	0	-0.184	0	0	0	0	-0.0014
Small Retail	Indianapolis	0.124	0.2	-0.0023	-0.083	0.2	0	-0.315	0.2	0	-0.437	0	0	0	0	-0.0022
	South Bend	0.121	0.2	-0.0024	-0.088	0.2	0	-0.324	0.2	0	-0.445	0	0	0	0	-0.0022
	Evansville	0.157	0.2	-0.0016	0.023	0.2	0	-0.128	0.2	0	-0.264	0	0	0	0	-0.0015
	Ft Wayne	0.101	0.2	-0.0026	-0.168	0.2	0	-0.41	0.2	0	-0.51	0	0	0	0	-0.0025

Building	City	AC with Natural Gas Heat			Heat Pump			AC with Electric Heat			Electric Heat Only			Natural Gas Heat Only		
		WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G	WHF_E	WHF_D	WHF_G
	Terre Haute	0.145	0.2	-0.002	-0.076	0.2	0	-0.247	0.2	0	-0.381	0	0	0	0	-0.002
Warehouse	Indianapolis	0.096	0.2	-0.0022	-0.145	0.2	0	-0.332	0.2	0	-0.433	0	0	0	0	-0.0021
	South Bend	0.08	0.2	-0.0024	-0.173	0.2	0	-0.397	0.2	0	-0.496	0	0	0	0	-0.0024
	Evansville	0.123	0.2	-0.0018	-0.048	0.2	0	-0.217	0.2	0	-0.308	0	0	0	0	-0.0017
	Ft Wayne	0.074	0.2	-0.0025	-0.188	0.2	0	-0.407	0.2	0	-0.499	0	0	0	0	-0.0024
	Terre Haute	0.103	0.2	-0.0021	-0.099	0.2	0	-0.306	0.2	0	-0.394	0	0	0	0	-0.0021
Other	Indianapolis	0.115	0.2	-0.0023	-0.15	0.2	0	-0.357	0.185	0	-0.487	0	0	0	0	-0.0022
	South Bend	0.103	0.2	-0.0024	-0.159	0.2	0	-0.38	0.185	0	-0.488	0	0	0	0	-0.0021
	Evansville	0.142	0.2	-0.0019	-0.047	0.2	0	-0.24	0.185	0	-0.375	0	0	0	0	-0.0017
	Ft Wayne	0.095	0.2	-0.0026	-0.247	0.2	0	-0.448	0.185	0	-0.544	0	0	0	0	-0.0023
	Terre Haute	0.126	0.2	-0.0023	-0.129	0.2	0	-0.345	0.185	0	-0.476	0	0	0	0	-0.0021

Appendix C – Insulation Measures in Single Family Buildings

Roof Insulation Measure Tables by City and HVAC Type

City: Indianapolis
HVAC: AC with Natural Gas Heat

Measure R-Value	Base														
	0			11			19			30			38		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	416.2	0.154	30.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	467.6	0.205	33.8	51.4	0.051	3.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	496.6	0.222	36.0	80.4	0.068	5.8	29.0	0.017	2.2	N/A	N/A	N/A	N/A	N/A	N/A
38	505.3	0.239	36.8	89.1	0.085	6.6	37.7	0.034	3.0	8.7	0.017	0.8	N/A	N/A	N/A
49	514.3	0.239	37.5	98.1	0.085	7.4	46.8	0.034	3.7	17.7	0.017	1.6	9.0	0.00	0.7
60	522.9	0.239	38.0	106.7	0.085	7.8	55.3	0.034	4.2	26.3	0.017	2.0	17.6	0.00	1.2

City: Indianapolis
HVAC: Heat Pump

Measure R-Value	Base									
	0		11		19		30		38	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	5,043.2	0.410	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	5,588.4	0.495	545.2	0.085	N/A	N/A	N/A	N/A	N/A	N/A
30	5,902.4	0.546	859.2	0.137	314.0	0.051	N/A	N/A	N/A	N/A
38	6,022.0	0.563	978.8	0.154	433.6	0.068	119.6	0.017	N/A	N/A
49	6,128.3	0.580	1,085.2	0.171	539.9	0.085	225.9	0.034	106.3	0.017
60	6,194.0	0.580	1,150.9	0.171	605.6	0.085	291.6	0.034	172.0	0.017

City: Indianapolis
HVAC: AC with Electric Heat

Measure R-Value	Base									
	0		11		19		30		38	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	7,280.0	0.375	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	8,141.3	0.444	861.3	0.068	N/A	N/A	N/A	N/A	N/A	N/A
30	8,644.2	0.495	1,364.2	0.119	502.9	0.051	N/A	N/A	N/A	N/A
38	8,837.4	0.512	1,557.3	0.137	696.1	0.068	193.2	0.017	N/A	N/A
49	9,011.4	0.529	1,731.4	0.154	870.1	0.085	367.2	0.034	174.1	0.017
60	9,118.9	0.529	1,838.9	0.154	977.6	0.085	474.7	0.034	281.6	0.017

City: Indianapolis
HVAC: Electric Heat Only

Measure R-Value	Base									
	0		11		19		30		38	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	6942.2	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	7766.6	0.00	824.4	0.00	N/A	N/A	N/A	N/A	N/A	N/A
30	8247.6	0.00	1305.5	0.00	481.1	0.00	N/A	N/A	N/A	N/A
38	8434.0	0.00	1491.8	0.00	667.4	0.00	186.3	0.00	N/A	N/A
49	8596.1	0.00	1653.9	0.00	829.5	0.00	348.5	0.00	162.1	0.00
60	8701.9	0.00	1759.7	0.00	935.3	0.00	454.3	0.00	267.9	0.00

City: Indianapolis
HVAC: Natural Gas Heat Only

	Base														
Measure	0			11			19			30			38		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	149.1	0.00	30.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	166.7	0.00	34.4	17.6	0.00	3.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	177.0	0.00	36.5	27.8	0.00	5.9	10.2	0.00	2.2	N/A	N/A	N/A	N/A	N/A	N/A
38	180.9	0.00	37.4	31.7	0.00	6.7	14.2	0.00	3.0	3.9	0.00	0.9	N/A	N/A	N/A
49	184.1	0.00	38.1	35.0	0.00	7.5	17.4	0.00	3.8	7.2	0.00	1.6	3.2	0.00	0.7
60	186.3	0.00	38.6	37.2	0.00	8.0	19.6	0.00	4.2	9.4	0.00	2.1	5.5	0.00	1.2

City: South Bend
HVAC: AC with Natural Gas Heat

Measure	Base														
	0			11			19			30			38		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	351.2	0.137	30.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	394.5	0.171	34.1	43.3	0.034	3.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	417.2	0.188	36.2	66.0	0.051	5.9	22.7	0.017	2.2	N/A	N/A	N/A	N/A	N/A	N/A
38	424.4	0.188	37.1	73.2	0.051	6.7	29.9	0.017	3.0	7.2	0.00	0.8	N/A	N/A	N/A
49	433.1	0.188	37.8	81.9	0.051	7.4	38.6	0.017	3.7	15.9	0.00	1.6	8.7	0.00	0.8
60	437.9	0.188	38.3	86.7	0.051	7.9	43.3	0.017	4.2	20.6	0.00	2.1	13.5	0.00	1.2

City: South Bend
HVAC: Heat Pump

Measure R-Value	Base									
	0		11		19		30		38	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	5,171.8	0.119	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	5,730.0	0.154	558.2	0.034	N/A	N/A	N/A	N/A	N/A	N/A
30	6,044.9	0.171	873.0	0.051	314.8	0.017	N/A	N/A	N/A	N/A
38	6,166.4	0.188	994.5	0.068	436.3	0.034	121.5	0.017	N/A	N/A
49	6,271.7	0.188	1,099.8	0.068	541.6	0.034	226.8	0.017	105.3	0.00
60	6,343.0	0.188	1,171.2	0.068	613.0	0.034	298.1	0.017	176.6	0.00

City: South Bend
HVAC: AC with Electric Heat

Measure R-Value	Base									
	0		11		19		30		38	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	7,316.2	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	8,190.4	0.034	874.2	0.034	N/A	N/A	N/A	N/A	N/A	N/A
30	8,694.2	0.068	1,378.0	0.068	503.8	0.034	N/A	N/A	N/A	N/A
38	8,892.2	0.068	1,575.9	0.068	701.7	0.034	198.0	0.00	N/A	N/A
49	9,063.7	0.085	1,747.4	0.085	873.2	0.051	369.5	0.017	171.5	0.017
60	9,177.8	0.085	1,861.6	0.085	987.4	0.051	483.6	0.017	285.7	0.017

City: South Bend
HVAC: Electric Heat Only

Measure	Base									
	0		11		19		30		38	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	7,061.6	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	7,905.5	0.00	843.9	0.00	N/A	N/A	N/A	N/A	N/A	N/A
30	8,393.2	0.00	1,331.6	0.00	487.7	0.00	N/A	N/A	N/A	N/A
38	8,584.3	0.00	1,522.7	0.00	678.8	0.00	191.1	0.00	N/A	N/A
49	8,750.3	0.00	1,688.7	0.00	844.9	0.00	357.2	0.00	166.0	0.00
60	8,859.0	0.00	1,797.4	0.00	953.6	0.00	465.9	0.00	274.7	0.00

City: South Bend
HVAC: Natural Gas Heat Only

Measure	Base														
	0			11			19			30			38		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	151.9	0.00	30.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	170.0	0.00	34.6	18.1	0.00	3.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	180.2	0.00	36.8	28.3	0.00	6.0	10.2	0.00	2.2	N/A	N/A	N/A	N/A	N/A	N/A
38	184.1	0.00	37.6	32.3	0.00	6.8	14.2	0.00	3.1	3.9	0.00	0.9	N/A	N/A	N/A
49	187.7	0.00	38.4	35.8	0.00	7.6	17.7	0.00	3.8	7.5	0.00	1.6	3.6	0.00	0.8
60	189.9	0.00	38.9	38.1	0.00	8.0	20.0	0.00	4.3	9.7	0.00	2.1	5.8	0.00	1.2

City: Evansville
HVAC: AC with Natural Gas Heat

Measure	Base														
	0			11			19			30			38		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	475.3	0.392	24.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	530.7	0.461	27.3	55.5	0.068	3.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	562.1	0.512	29.0	86.9	0.119	4.8	31.4	0.051	1.8	N/A	N/A	N/A	N/A	N/A	N/A
38	573.5	0.529	29.7	98.3	0.137	5.5	42.8	0.068	2.5	11.4	0.017	0.7	N/A	N/A	N/A
49	582.4	0.546	30.3	107.2	0.154	6.1	51.7	0.085	3.1	20.3	0.034	1.3	8.9	0.017	0.6
60	588.6	0.563	30.7	113.3	0.171	6.5	57.8	0.102	3.5	26.5	0.051	1.7	15.0	0.034	1.0

City: Evansville
HVAC: Heat Pump

Measure R-Value	Base									
	0		11		19		30		38	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	3,299.0	0.631	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	3,673.2	0.717	374.2	0.085	N/A	N/A	N/A	N/A	N/A	N/A
30	3,886.9	0.751	587.9	0.119	213.7	0.034	N/A	N/A	N/A	N/A
38	3,968.4	0.768	669.5	0.137	295.2	0.051	81.6	0.017	N/A	N/A
49	4,042.0	0.785	743.0	0.154	368.8	0.068	155.1	0.034	73.5	0.017
60	4,089.2	0.785	790.3	0.154	416.0	0.068	202.4	0.034	120.8	0.017

City: Evansville
HVAC: AC with Electric Heat

Measure R-Value	Base									
	0		11		19		30		38	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	5,831.6	0.580	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	6,547.1	0.648	715.5	0.068	N/A	N/A	N/A	N/A	N/A	N/A
30	6,959.0	0.683	1,127.5	0.102	411.9	0.034	N/A	N/A	N/A	N/A
38	7,118.8	0.700	1,287.2	0.119	571.7	0.051	159.7	0.017	N/A	N/A
49	7,260.1	0.700	1,428.5	0.119	713.0	0.051	301.0	0.017	141.3	0.00
60	7,351.2	0.717	1,519.6	0.137	804.1	0.068	392.2	0.034	232.4	0.017

City: Evansville
HVAC: Electric Heat Only

Measure R-Value	Base									
	0		11		19		30		38	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	5,398.6	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	6,057.8	0.00	659.2	0.00	N/A	N/A	N/A	N/A	N/A	N/A
30	6,441.1	0.00	1,042.5	0.00	383.3	0.00	N/A	N/A	N/A	N/A
38	6,591.1	0.00	1,192.5	0.00	533.3	0.00	150.0	0.00	N/A	N/A
49	6,721.3	0.00	1,322.7	0.00	663.5	0.00	280.2	0.00	130.2	0.00
60	6,806.8	0.00	1,408.2	0.00	749.0	0.00	365.7	0.00	215.7	0.00

City: Evansville
HVAC: Natural Gas Heat Only

Measure	Base														
	0			11			19			30			38		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	115.5	0.00	24.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	129.7	0.00	27.7	14.2	0.00	3.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	137.7	0.00	29.5	22.2	0.00	4.9	8.0	0.00	1.8	N/A	N/A	N/A	N/A	N/A	N/A
38	141.0	0.00	30.2	25.4	0.00	5.6	11.3	0.00	2.5	3.2	0.00	0.7	N/A	N/A	N/A
49	143.7	0.00	30.8	28.2	0.00	6.2	14.0	0.00	3.1	6.0	0.00	1.3	2.7	0.00	0.6
60	145.4	0.00	31.2	29.9	0.00	6.6	15.7	0.00	3.5	7.7	0.00	1.7	4.4	0.00	1.0

City: Ft Wayne
HVAC: AC with Natural Gas Heat

Measure	Base														
	0			11			19			30			38		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	339.2	0.171	32.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	378.7	0.205	35.9	39.4	0.034	3.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	399.7	0.239	38.1	60.4	0.068	6.1	21.0	0.034	2.3	N/A	N/A	N/A	N/A	N/A	N/A
38	409.2	0.239	39.0	70.0	0.068	7.0	30.5	0.034	3.2	9.6	0.00	0.9	N/A	N/A	N/A
49	417.4	0.256	39.8	78.2	0.085	7.8	38.7	0.051	3.9	17.7	0.017	1.7	8.2	0.017	0.8
60	421.7	0.256	40.3	82.4	0.085	8.3	43.0	0.051	4.4	22.0	0.017	2.2	12.5	0.017	1.3

City: Ft Wayne
HVAC: Heat Pump

Measure R-Value	Base									
	0		11		19		30		38	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	5,507.3	0.051	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	6,091.0	0.085	583.6	0.034	N/A	N/A	N/A	N/A	N/A	N/A
30	6,427.1	0.102	919.8	0.051	336.2	0.017	N/A	N/A	N/A	N/A
38	6,555.6	0.102	1,048.3	0.051	464.7	0.017	128.5	0.00	N/A	N/A
49	6,667.2	0.102	1,159.9	0.051	576.3	0.017	240.1	0.00	111.6	0.00
60	6,739.8	0.119	1,232.4	0.068	648.8	0.034	312.6	0.017	184.1	0.017

City: Ft Wayne
HVAC: AC with Electric Heat

Measure R-Value	Base									
	0		11		19		30		38	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	7,528.7	0.171	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	8,421.0	0.205	892.3	0.034	N/A	N/A	N/A	N/A	N/A	N/A
30	8,941.0	0.239	1,412.3	0.068	520.0	0.034	N/A	N/A	N/A	N/A
38	9,146.8	0.239	1,618.1	0.068	725.8	0.034	205.8	0.00	N/A	N/A
49	9,326.1	0.256	1,797.4	0.085	905.1	0.051	385.2	0.017	179.4	0.017
60	9,441.8	0.256	1,913.1	0.085	1,020.8	0.051	500.9	0.017	295.1	0.017

City: Ft Wayne
HVAC: Electric Heat Only

Measure R-Value	Base									
	0		11		19		30		38	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	7,338.6	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	8,208.0	0.00	869.5	0.00	N/A	N/A	N/A	N/A	N/A	N/A
30	8,718.1	0.00	1,379.5	0.00	510.1	0.00	N/A	N/A	N/A	N/A
38	8,917.9	0.00	1,579.4	0.00	709.9	0.00	199.8	0.00	N/A	N/A
49	9,092.5	0.00	1,753.9	0.00	884.5	0.00	374.4	0.00	174.6	0.00
60	9,206.7	0.00	1,868.1	0.00	998.6	0.00	488.6	0.00	288.7	0.00

City: Ft Wayne
HVAC: Natural Gas Heat Only

Measure	Base														
	0			11			19			30			38		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	149.0	0.00	32.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	166.4	0.00	35.8	17.4	0.00	3.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	176.6	0.00	38.1	27.6	0.00	6.1	10.2	0.00	2.3	N/A	N/A	N/A	N/A	N/A	N/A
38	180.5	0.00	39.0	31.6	0.00	7.0	14.2	0.00	3.2	3.9	0.00	0.9	N/A	N/A	N/A
49	184.1	0.00	39.8	35.2	0.00	7.8	17.7	0.00	4.0	7.5	0.00	1.7	3.6	0.00	0.8
60	186.3	0.00	40.3	37.4	0.00	8.3	20.0	0.00	4.5	9.7	0.00	2.2	5.8	0.00	1.3

City: Terre Haute
HVAC: AC with Natural Gas Heat

Measure	Base														
	0			11			19			30			38		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	344.0	0.188	31.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	384.3	0.205	35.8	40.3	0.017	3.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	406.0	0.222	38.1	61.9	0.034	6.2	21.7	0.017	2.3	N/A	N/A	N/A	N/A	N/A	N/A
38	416.4	0.239	39.0	72.4	0.051	7.1	32.1	0.034	3.2	10.4	0.017	0.9	N/A	N/A	N/A
49	420.6	0.239	39.8	76.6	0.051	7.9	36.3	0.034	4.0	14.7	0.017	1.7	4.3	0.00	0.8
60	426.3	0.239	40.3	82.3	0.051	8.4	42.0	0.034	4.5	20.3	0.017	2.2	9.9	0.00	1.3

City: Terre Haute
HVAC: Heat Pump

Measure	Base									
	0		11		19		30		38	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	5,539.8	0.188	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	6,144.0	0.205	604.3	0.017	N/A	N/A	N/A	N/A	N/A	N/A
30	6,488.6	0.222	948.8	0.034	344.5	0.017	N/A	N/A	N/A	N/A
38	6,621.2	0.239	1,081.4	0.051	477.1	0.034	132.6	0.017	N/A	N/A
49	6,737.4	0.239	1,197.6	0.051	593.3	0.034	248.8	0.017	116.2	0.00
60	6,813.0	0.256	1,273.2	0.068	668.9	0.051	324.4	0.034	191.8	0.017

City: Terre Haute
HVAC: AC with Electric Heat

Measure R-Value	Base									
	0		11		19		30		38	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	7,544.0	0.188	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	8,444.2	0.205	900.2	0.017	N/A	N/A	N/A	N/A	N/A	N/A
30	8,970.3	0.222	1,426.3	0.034	526.1	0.017	N/A	N/A	N/A	N/A
38	9,178.5	0.239	1,634.5	0.051	734.3	0.034	208.2	0.017	N/A	N/A
49	9,355.3	0.239	1,811.3	0.051	911.1	0.034	385.0	0.017	176.8	0.00
60	9,473.7	0.239	1,929.7	0.051	1,029.5	0.034	503.4	0.017	295.2	0.00

City: Terre Haute
HVAC: Electric Heat Only

Measure R-Value	Base									
	0		11		19		30		38	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	7,354.6	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	8,232.6	0.00	878.0	0.00	N/A	N/A	N/A	N/A	N/A	N/A
30	8,747.6	0.00	1,393.0	0.00	515.0	0.00	N/A	N/A	N/A	N/A
38	8,949.5	0.00	1,594.9	0.00	716.9	0.00	201.9	0.00	N/A	N/A
49	9,125.8	0.00	1,771.2	0.00	893.2	0.00	378.2	0.00	176.3	0.00
60	9,241.0	0.00	1,886.3	0.00	1,008.4	0.00	493.3	0.00	291.5	0.00

City: Terre Haute
HVAC: Natural Gas Heat Only

Measure	Base														
	0			11			19			30			38		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	154.4	0.00	31.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	172.7	0.00	35.8	18.3	0.00	3.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	183.3	0.00	38.1	28.8	0.00	6.2	10.6	0.00	2.3	N/A	N/A	N/A	N/A	N/A	N/A
38	187.4	0.00	39.0	32.9	0.00	7.1	14.7	0.00	3.2	4.1	0.00	0.9	N/A	N/A	N/A
49	191.1	0.00	39.8	36.7	0.00	7.9	18.4	0.00	4.0	7.8	0.00	1.7	3.8	0.00	0.8
60	193.5	0.00	40.3	39.1	0.00	8.4	20.8	0.00	4.5	10.2	0.00	2.2	6.1	0.00	1.3

Wall Insulation Measure Tables by City and HVAC Type

City: Indianapolis
HVAC: AC with Natural Gas Heat

Measure	Base														
	0			11			13			17			19		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	96.0	0.073	8.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	108.4	0.073	9.3	12.4	0.00	1.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	128.2	0.091	11.1	32.2	0.018	3.0	19.8	0.018	1.8	N/A	N/A	N/A	N/A	N/A	N/A
19	135.6	0.091	11.8	39.6	0.018	3.7	27.3	0.018	2.5	7.5	0.00	0.7	N/A	N/A	N/A
21	140.5	0.109	12.4	44.5	0.036	4.3	32.2	0.036	3.1	12.4	0.018	1.2	4.9	0.018	0.6
25	152.2	0.109	13.2	56.2	0.036	5.1	43.8	0.036	3.9	24.0	0.018	2.1	16.5	0.018	1.4
27	156.0	0.109	13.6	60.0	0.036	5.5	47.6	0.036	4.3	27.8	0.018	2.5	20.4	0.018	1.8

City: Indianapolis
HVAC: Heat Pump

Measure R-Value	Base									
	0		11		13		17		19	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	1,150.4	0.145	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	1,312.9	0.164	162.5	0.018	N/A	N/A	N/A	N/A	N/A	N/A
17	1,567.1	0.200	416.7	0.055	254.2	0.036	N/A	N/A	N/A	N/A
19	1,658.7	0.218	508.4	0.073	345.8	0.055	91.6	0.018	N/A	N/A
21	1,735.8	0.218	585.5	0.073	422.9	0.055	168.7	0.018	77.1	0.00
25	1,855.1	0.236	704.7	0.091	542.2	0.073	288.0	0.036	196.4	0.018
27	1,902.4	0.255	752.0	0.109	589.5	0.091	335.3	0.055	243.6	0.036

City: Indianapolis
HVAC: AC with Electric Heat

Measure R-Value	Base									
	0		11		13		17		19	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	1,866.2	0.127	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	2,135.5	0.145	269.3	0.018	N/A	N/A	N/A	N/A	N/A	N/A
17	2,556.2	0.182	690.0	0.055	420.7	0.036	N/A	N/A	N/A	N/A
19	2,709.3	0.182	843.1	0.055	573.8	0.036	153.1	0.00	N/A	N/A
21	2,837.8	0.200	971.6	0.073	702.4	0.055	281.6	0.018	128.5	0.018
25	3,036.7	0.200	1,170.5	0.073	901.3	0.055	480.5	0.018	327.5	0.018
27	3,116.5	0.218	1,250.4	0.091	981.1	0.073	560.4	0.036	407.3	0.036

City: Indianapolis
HVAC: Electric Heat Only

Measure R-Value	Base									
	0		11		13		17		19	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	1,794.2	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	2,054.2	0.00	260.0	0.00	N/A	N/A	N/A	N/A	N/A	N/A
17	2,458.9	0.00	664.7	0.00	404.7	0.00	N/A	N/A	N/A	N/A
19	2,606.0	0.00	811.8	0.00	551.8	0.00	147.1	0.00	N/A	N/A
21	2,730.0	0.00	935.8	0.00	675.8	0.00	271.1	0.00	124.0	0.00
25	2,920.2	0.00	1,126.0	0.00	866.0	0.00	461.3	0.00	314.2	0.00
27	2,998.4	0.00	1,204.2	0.00	944.2	0.00	539.5	0.00	392.4	0.00

City: Indianapolis
HVAC: Natural Gas Heat Only

Measure	Base														
	0			11			13			17			19		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	39.3	0.00	8.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	44.7	0.00	9.3	5.5	0.00	1.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	53.6	0.00	11.2	14.4	0.00	3.0	8.9	0.00	1.8	N/A	N/A	N/A	N/A	N/A	N/A
19	56.9	0.00	11.9	17.6	0.00	3.7	12.2	0.00	2.5	3.3	0.00	0.7	N/A	N/A	N/A
21	59.6	0.00	12.4	20.4	0.00	4.3	14.9	0.00	3.1	6.0	0.00	1.2	2.7	0.00	0.6
25	63.8	0.00	13.3	24.5	0.00	5.2	19.1	0.00	4.0	10.2	0.00	2.1	6.9	0.00	1.5
27	65.5	0.00	13.7	26.2	0.00	5.5	20.7	0.00	4.3	11.8	0.00	2.5	8.5	0.00	1.8

City: South Bend
HVAC: AC with Natural Gas Heat

Measure	Base														
	0			11			13			17			19		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	81.5	0.055	8.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	91.6	0.055	9.5	10.2	0.00	1.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	111.8	0.073	11.3	30.4	0.018	3.1	20.2	0.018	1.8	N/A	N/A	N/A	N/A	N/A	N/A
19	117.6	0.073	12.0	36.2	0.018	3.8	26.0	0.018	2.5	5.8	0.00	0.7	N/A	N/A	N/A
21	121.3	0.073	12.5	39.8	0.018	4.4	29.6	0.018	3.1	9.5	0.00	1.2	3.6	0.00	0.6
25	131.1	0.073	13.4	49.6	0.018	5.3	39.5	0.018	3.9	19.3	0.00	2.1	13.5	0.00	1.4
27	135.3	0.073	13.8	53.8	0.018	5.6	43.6	0.018	4.3	23.5	0.00	2.5	17.6	0.00	1.8

City: South Bend
HVAC: Heat Pump

Measure R-Value	Base									
	0		11		13		17		19	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	1,160.0	0.055	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	1,338.5	0.073	178.5	0.018	N/A	N/A	N/A	N/A	N/A	N/A
17	1,591.3	0.091	431.3	0.036	252.7	0.018	N/A	N/A	N/A	N/A
19	1,682.0	0.091	522.0	0.036	343.5	0.018	90.7	0.00	N/A	N/A
21	1,756.2	0.091	596.2	0.036	417.6	0.018	164.9	0.00	74.2	0.00
25	1,876.4	0.091	716.4	0.036	537.8	0.018	285.1	0.00	194.4	0.00
27	1,924.5	0.109	764.5	0.055	586.0	0.036	333.3	0.018	242.5	0.018

City: South Bend
HVAC: AC with Electric Heat

Measure R-Value	Base									
	0		11		13		17		19	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	1,885.5	0.073	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	2,184.2	0.073	298.7	0.00	N/A	N/A	N/A	N/A	N/A	N/A
17	2,606.5	0.091	721.1	0.018	422.4	0.018	N/A	N/A	N/A	N/A
19	2,758.9	0.091	873.5	0.018	574.7	0.018	152.4	0.00	N/A	N/A
21	2,886.5	0.091	1,001.1	0.018	702.4	0.018	280.0	0.00	127.6	0.00
25	3,090.5	0.109	1,205.1	0.036	906.4	0.036	484.0	0.018	331.6	0.018
27	3,171.3	0.109	1,285.8	0.036	987.1	0.036	564.7	0.018	412.4	0.018

City: South Bend
HVAC: Electric Heat Only

Measure R-Value	Base									
	0		11		13		17		19	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	1,826.5	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	2,117.6	0.00	291.1	0.00	N/A	N/A	N/A	N/A	N/A	N/A
17	2,526.2	0.00	699.6	0.00	408.5	0.00	N/A	N/A	N/A	N/A
19	2,675.3	0.00	848.7	0.00	557.6	0.00	149.1	0.00	N/A	N/A
21	2,799.6	0.00	973.1	0.00	682.0	0.00	273.5	0.00	124.4	0.00
25	2,995.8	0.00	1,169.3	0.00	878.2	0.00	469.6	0.00	320.5	0.00
27	3,074.2	0.00	1,247.6	0.00	956.5	0.00	548.0	0.00	398.9	0.00

City: South Bend
HVAC: Natural Gas Heat Only

Measure	Base														
	0			11			13			17			19		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	40.0	0.00	8.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	46.4	0.00	9.5	6.4	0.00	1.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	55.5	0.00	11.4	15.5	0.00	3.2	9.1	0.00	1.9	N/A	N/A	N/A	N/A	N/A	N/A
19	58.7	0.00	12.1	18.7	0.00	3.8	12.4	0.00	2.5	3.3	0.00	0.7	N/A	N/A	N/A
21	61.5	0.00	12.6	21.5	0.00	4.4	15.1	0.00	3.1	6.0	0.00	1.2	2.7	0.00	0.6
25	65.6	0.00	13.5	25.6	0.00	5.3	19.3	0.00	4.0	10.2	0.00	2.1	6.9	0.00	1.5
27	67.5	0.00	13.9	27.5	0.00	5.7	21.1	0.00	4.3	12.0	0.00	2.5	8.7	0.00	1.8

City: Evansville
HVAC: AC with Natural Gas Heat

Measure	Base														
	0			11			13			17			19		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	100.5	0.109	6.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	118.4	0.127	7.6	17.8	0.018	1.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	144.2	0.164	9.1	43.6	0.055	2.6	25.8	0.036	1.5	N/A	N/A	N/A	N/A	N/A	N/A
19	151.8	0.164	9.7	51.3	0.055	3.1	33.5	0.036	2.1	7.6	0.00	0.5	N/A	N/A	N/A
21	158.7	0.182	10.1	58.2	0.073	3.6	40.4	0.055	2.5	14.5	0.018	1.0	6.9	0.018	0.5
25	169.6	0.182	10.9	69.1	0.073	4.3	51.3	0.055	3.2	25.5	0.018	1.7	17.8	0.018	1.2
27	175.1	0.200	11.1	74.5	0.091	4.6	56.7	0.073	3.5	30.9	0.036	2.0	23.3	0.036	1.5

City: Evansville
HVAC: Heat Pump

Measure	Base									
	0		11		13		17		19	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	760.9	0.127	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	882.2	0.145	121.3	0.018	N/A	N/A	N/A	N/A	N/A	N/A
17	1,062.9	0.182	302.0	0.055	180.7	0.036	N/A	N/A	N/A	N/A
19	1,124.2	0.200	363.3	0.073	242.0	0.055	61.3	0.018	N/A	N/A
21	1,174.4	0.200	413.5	0.073	292.2	0.055	111.5	0.018	50.2	0.00
25	1,255.3	0.218	494.4	0.091	373.1	0.073	192.4	0.036	131.1	0.018
27	1,287.6	0.218	526.7	0.091	405.5	0.073	224.7	0.036	163.5	0.018

City: Evansville
HVAC: AC with Electric Heat

Measure	Base									
	0		11		13		17		19	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	1,479.6	0.109	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	1,716.7	0.127	237.1	0.018	N/A	N/A	N/A	N/A	N/A	N/A
17	2,062.5	0.145	582.9	0.036	345.8	0.018	N/A	N/A	N/A	N/A
19	2,184.0	0.164	704.4	0.055	467.3	0.036	121.5	0.018	N/A	N/A
21	2,286.4	0.164	806.7	0.055	569.6	0.036	223.8	0.018	102.4	0.00
25	2,444.4	0.182	964.7	0.073	727.6	0.055	381.8	0.036	260.4	0.018
27	2,507.8	0.182	1,028.2	0.073	791.1	0.055	445.3	0.036	323.8	0.018

City: Evansville
HVAC: Electric Heat Only

Measure R-Value	Base									
	0		11		13		17		19	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	1,381.1	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	1,602.4	0.00	221.3	0.00	N/A	N/A	N/A	N/A	N/A	N/A
17	1,925.3	0.00	544.2	0.00	322.9	0.00	N/A	N/A	N/A	N/A
19	2,038.9	0.00	657.8	0.00	436.5	0.00	113.6	0.00	N/A	N/A
21	2,133.8	0.00	752.7	0.00	531.5	0.00	208.5	0.00	94.9	0.00
25	2,282.5	0.00	901.5	0.00	680.2	0.00	357.3	0.00	243.6	0.00
27	2,342.4	0.00	961.3	0.00	740.0	0.00	417.1	0.00	303.5	0.00

City: Evansville
HVAC: Natural Gas Heat Only

Measure	Base														
	0			11			13			17			19		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	30.0	0.00	6.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	34.9	0.00	7.6	4.9	0.00	1.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	42.0	0.00	9.1	12.0	0.00	2.6	7.1	0.00	1.5	N/A	N/A	N/A	N/A	N/A	N/A
19	44.4	0.00	9.7	14.4	0.00	3.1	9.5	0.00	2.1	2.4	0.00	0.5	N/A	N/A	N/A
21	46.5	0.00	10.1	16.5	0.00	3.6	11.6	0.00	2.5	4.5	0.00	1.0	2.2	0.00	0.5
25	49.6	0.00	10.8	19.6	0.00	4.3	14.7	0.00	3.2	7.6	0.00	1.7	5.3	0.00	1.2
27	51.1	0.00	11.1	21.1	0.00	4.6	16.2	0.00	3.5	9.1	0.00	2.0	6.7	0.00	1.5

City: Ft. Wayne
HVAC: AC with Natural Gas Heat

Measure	Base														
	0			11			13			17			19		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	50.8	0.033	5.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	58.5	0.043	6.1	7.7	0.011	0.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	69.4	0.054	7.3	18.5	0.022	2.0	10.8	0.011	1.2	N/A	N/A	N/A	N/A	N/A	N/A
19	73.4	0.054	7.8	22.5	0.022	2.4	14.8	0.011	1.6	4.0	0.00	0.4	N/A	N/A	N/A
21	76.5	0.054	8.1	25.7	0.022	2.8	18.0	0.011	2.0	7.2	0.00	0.8	3.1	0.00	0.4
25	82.9	0.054	8.7	32.1	0.022	3.4	24.4	0.011	2.5	13.5	0.00	1.4	9.5	0.00	0.9
27	84.5	0.054	8.9	33.7	0.022	3.6	26.0	0.011	2.8	15.2	0.00	1.6	11.2	0.00	1.1

City: Ft Wayne
HVAC: Heat Pump

Measure R-Value	Base									
	0		11		13		17		19	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	778.7	0.022	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	897.9	0.022	119.2	0.00	N/A	N/A	N/A	N/A	N/A	N/A
17	1,062.4	0.033	283.8	0.011	164.5	0.011	N/A	N/A	N/A	N/A
19	1,122.6	0.033	343.9	0.011	224.7	0.011	60.2	0.00	N/A	N/A
21	1,172.0	0.033	393.3	0.011	274.1	0.011	109.6	0.00	49.4	0.00
25	1,251.8	0.033	473.1	0.011	353.9	0.011	189.4	0.00	129.2	0.00
27	1,282.0	0.043	503.4	0.022	384.1	0.022	219.6	0.011	159.4	0.011

City: Ft Wayne
HVAC: AC with Electric Heat

Measure R-Value	Base									
	0		11		13		17		19	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	1,218.4	0.033	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	1,409.0	0.043	190.5	0.011	N/A	N/A	N/A	N/A	N/A	N/A
17	1,677.1	0.054	458.7	0.022	268.2	0.011	N/A	N/A	N/A	N/A
19	1,775.1	0.054	556.7	0.022	366.1	0.011	98.0	0.00	N/A	N/A
21	1,856.7	0.054	638.3	0.022	447.8	0.011	179.6	0.00	81.6	0.00
25	1,986.3	0.054	767.9	0.022	577.4	0.011	309.2	0.00	211.3	0.00
27	2,037.4	0.054	819.0	0.022	628.4	0.011	360.3	0.00	262.3	0.00

City: Ft Wayne
HVAC: Electric Heat Only

Measure R-Value	Base									
	0		11		13		17		19	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	1,193.0	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	1,380.2	0.00	187.2	0.00	N/A	N/A	N/A	N/A	N/A	N/A
17	1,643.4	0.00	450.4	0.00	263.2	0.00	N/A	N/A	N/A	N/A
19	1,739.4	0.00	546.4	0.00	359.2	0.00	96.0	0.00	N/A	N/A
21	1,819.4	0.00	626.4	0.00	439.2	0.00	176.0	0.00	80.0	0.00
25	1,945.5	0.00	752.4	0.00	565.3	0.00	302.1	0.00	206.0	0.00
27	1,996.0	0.00	802.9	0.00	615.8	0.00	352.6	0.00	256.6	0.00

City: Ft. Wayne
HVAC: Natural Gas Heat Only

Measure	Base														
	0			11			13			17			19		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	25.9	0.00	5.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	29.9	0.00	6.1	4.0	0.00	0.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	35.7	0.00	7.3	9.8	0.00	2.0	5.7	0.00	1.2	N/A	N/A	N/A	N/A	N/A	N/A
19	37.7	0.00	7.8	11.8	0.00	2.4	7.8	0.00	1.6	2.1	0.00	0.4	N/A	N/A	N/A
21	39.5	0.00	8.1	13.5	0.00	2.8	9.5	0.00	2.0	3.8	0.00	0.8	1.7	0.00	0.4
25	42.2	0.00	8.7	16.3	0.00	3.4	12.2	0.00	2.5	6.5	0.00	1.4	4.4	0.00	0.9
27	43.2	0.00	8.9	17.3	0.00	3.6	13.3	0.00	2.8	7.6	0.00	1.6	5.5	0.00	1.2

City: Terre Haute
HVAC: AC with Natural Gas Heat

Measure	Base														
	0			11			13			17			19		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	49.2	0.033	5.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	57.2	0.033	6.0	8.0	0.00	0.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	72.6	0.043	7.1	23.4	0.011	2.0	15.4	0.011	1.2	N/A	N/A	N/A	N/A	N/A	N/A
19	74.9	0.043	7.5	25.7	0.011	2.4	17.7	0.011	1.6	2.3	0.00	0.4	N/A	N/A	N/A
21	79.4	0.043	7.9	30.2	0.011	2.8	22.2	0.011	1.9	6.8	0.00	0.8	4.6	0.00	0.4
25	84.5	0.054	8.5	35.3	0.022	3.3	27.3	0.022	2.5	11.9	0.011	1.3	9.6	0.011	0.9
27	88.0	0.054	8.7	38.8	0.022	3.5	30.8	0.022	2.7	15.4	0.011	1.6	13.1	0.011	1.1

City: Terre Haute
HVAC: Heat Pump

Measure R-Value	Base									
	0		11		13		17		19	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	760.8	0.033	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	878.8	0.033	118.0	0.00	N/A	N/A	N/A	N/A	N/A	N/A
17	1,046.2	0.043	285.4	0.011	167.4	0.011	N/A	N/A	N/A	N/A
19	1,105.9	0.043	345.1	0.011	227.1	0.011	59.7	0.00	N/A	N/A
21	1,154.8	0.043	394.0	0.011	276.0	0.011	108.6	0.00	48.9	0.00
25	1,233.0	0.054	472.3	0.022	354.2	0.022	186.9	0.011	127.1	0.011
27	1,265.8	0.054	505.0	0.022	386.9	0.022	219.6	0.011	159.9	0.011

City: Terre Haute
HVAC: AC with Electric Heat

Measure R-Value	Base									
	0		11		13		17		19	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	1,175.9	0.033	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	1,363.4	0.033	187.5	0.00	N/A	N/A	N/A	N/A	N/A	N/A
17	1,631.7	0.043	455.8	0.011	268.3	0.011	N/A	N/A	N/A	N/A
19	1,726.3	0.043	550.4	0.011	362.9	0.011	94.6	0.00	N/A	N/A
21	1,807.7	0.043	631.8	0.011	444.3	0.011	176.0	0.00	81.4	0.00
25	1,933.8	0.054	757.9	0.022	570.3	0.022	302.1	0.011	207.5	0.011
27	1,985.6	0.054	809.7	0.022	622.2	0.022	353.9	0.011	259.3	0.011

City: Terre Haute
HVAC: Electric Heat Only

Measure R-Value	Base									
	0		11		13		17		19	
	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF	kWh/kSF	kW/kSF
11	1,151.6	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	1,335.1	0.00	183.5	0.00	N/A	N/A	N/A	N/A	N/A	N/A
17	1,593.5	0.00	441.9	0.00	258.4	0.00	N/A	N/A	N/A	N/A
19	1,688.1	0.00	536.4	0.00	352.9	0.00	94.5	0.00	N/A	N/A
21	1,766.6	0.00	615.0	0.00	431.5	0.00	173.1	0.00	78.6	0.00
25	1,890.3	0.00	738.7	0.00	555.2	0.00	296.8	0.00	202.3	0.00
27	1,939.7	0.00	788.1	0.00	604.6	0.00	346.2	0.00	251.7	0.00

City: Terre Haute
HVAC: Natural Gas Heat Only

Measure	Base														
	0			11			13			17			19		
	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF	kWh/ kSF	kW/ kSF	MMBtu/ kSF
11	25.0	0.00	5.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	29.0	0.00	6.0	4.0	0.00	0.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	34.7	0.00	7.1	9.6	0.00	2.0	5.6	0.00	1.2	N/A	N/A	N/A	N/A	N/A	N/A
19	36.7	0.00	7.6	11.7	0.00	2.4	7.7	0.00	1.6	2.1	0.00	0.4	N/A	N/A	N/A
21	38.4	0.00	7.9	13.3	0.00	2.8	9.3	0.00	2.0	3.7	0.00	0.8	1.6	0.00	0.4
25	41.1	0.00	8.5	16.0	0.00	3.3	12.0	0.00	2.5	6.4	0.00	1.3	4.3	0.00	0.9
27	42.2	0.00	8.7	17.1	0.00	3.5	13.1	0.00	2.7	7.5	0.00	1.5	5.4	0.00	1.1

Appendix D – Standard Wattage Tables

High Bay Fixture Baseline and Efficient Wattages

Efficient Lamp	Efficient Fixture Ballast Type	Baseline Lamp	Baseline Fixture Ballast Type	Efficient Fixture Wattage ($WATTS_{EE}$)	Efficient Fixture Wattage Source	Baseline Fixture Wattage ($WATTS_{BASE}$)	Baseline Fixture Wattage Source	Fixture Savings (Watts)
High Bay Fixtures								
T-5 46" Two Lamp High Output	Electronic - PRS	150 Watt Pulse Start Metal Halide	Magnetic-CWA	117	4	183	4	66
T-5 46" Three Lamp High Output	Electronic - PRS	200 Watt Pulse Start Metal Halide	Magnetic-CWA	181	4	232	3	51
T-5 46" Four Lamp High Output	Electronic – IS	320 Watt Pulse Start Metal Halide	Magnetic-CWA	234	3	365	3	131
T-5 46" Six Lamp High Output	Electronic – IS	350 Watt Pulse Start Metal Halide	Magnetic-CWA	351	3	400	3	49
T-5 46" Eight Lamp High Output	Electronic – IS	1,000 Watt Pulse Start Metal Halide	Magnetic-CWA	468	3	1,080	3	612
T-5 46" Six Lamp High Output (2 Fixtures)	Electronic – IS	1,000 Watt Pulse Start Metal Halide	Magnetic-CWA	702	3	1,080	3	378
T-8 48" Two Lamp Very High Output	Electronic – IS	150 Watt Pulse Start Metal Halide	Magnetic-CWA	77	4	183	4	106
T-8 48" Three Lamp Very High Output	Electronic – IS	150 Watt Pulse Start Metal Halide	Magnetic-CWA	112	3	183	4	71
T-8 48" Four Lamp Very High Output	Electronic – IS	200 Watt Pulse Start Metal Halide	Magnetic-CWA	151	3	232	3	81
T-8 48" Six Lamp Very High Output	Electronic – IS	320 Watt Pulse Start Metal Halide	Magnetic-CWA	226	3	365	3	139
T-8 48" Eight Lamp Very High Output	Electronic - PRS	350 Watt Pulse Start Metal Halide	Magnetic-CWA	288	4	400	3	112

Efficient Lamp	Efficient Fixture Ballast Type	Baseline Lamp	Baseline Fixture Ballast Type	Efficient Fixture Wattage (WATTS_{EE})	Efficient Fixture Wattage Source	Baseline Fixture Wattage (WATTS_{BASE})	Baseline Fixture Wattage Source	Fixture Savings (Watts)
T-8 48” Eight Lamp Very High Output (2 Fixtures)	Electronic – PRS	1,000 Watt Pulse Start Metal Halide	Magnetic-CWA	576	4	1,080	3	504
High Efficiency Fluorescent (HEF) Fixtures								
T-8 24" One Lamp	Electronic	T-12 24" One Lamp	Magnetic-STD	18	3	24	3	6
T-8 24" Two Lamp	Electronic	T-12 24" Two Lamp	Magnetic-STD	32	3	56	3	24
T-8 24" Three Lamp	Electronic	T-12 24" Three Lamp	Magnetic-STD	50	3	62	3	12
T-8 24" Four Lamp	Electronic	T-12 24" Four Lamp	Magnetic-STD	65	3	112	3	47
T-8 36" One Lamp	Electronic	T-12 36" One Lamp	Magnetic-STD	25	3	46	3	21
T-8 36" Two Lamp	Electronic	T-12 36" Two Lamp	Magnetic-STD	46	3	81	3	35
T-8 36" Three Lamp	Electronic	T-12 36" Three Lamp	Magnetic-STD	70	3	127	3	57
T-8 36" Four Lamp	Electronic	T-12 36" Four Lamp	Magnetic-STD	88	3	162	3	74
Reduced Wattage T-8 48" One Lamp-28 Watts	Electronic – IS	T-8 48" One Lamp	Electronic - IS	23	2	31	3	7.7
Reduced Wattage T-8 48" Two Lamp-28 Watts	Electronic – IS	T-8 48" Two Lamp	Electronic - IS	47	2	59	3	12
Reduced Wattage T-8 48" Three Lamp-28 Watts	Electronic – IS	T-8 48" Three Lamp	Electronic - IS	69.9	2	89	3	19.1
Reduced Wattage T-8 48" Four Lamp-28 Watts	Electronic – IS	T-8 48" Four Lamp	Electronic - IS	92.6	2	112	3	19.4
Reduced Wattage T-8 48" One Lamp-25 Watts	Electronic – IS	T-8 48" One Lamp	Electronic - IS	22	2	31	3	9
Reduced Wattage T-8 48" Two Lamp-25 Watts	Electronic – IS	T-8 48" Two Lamp	Electronic - IS	41	2	59	3	18
Reduced Wattage T-8 48" Three Lamp-25 Watts	Electronic – IS	T-8 48" Three Lamp	Electronic - IS	61.3	2	89	3	27.7
Reduced Wattage T-8 48" Four Lamp-25 Watts	Electronic – IS	T-8 48" Four Lamp	Electronic - IS	80.5	2	112	3	31.5

Efficient Lamp	Efficient Fixture Ballast Type	Baseline Lamp	Baseline Fixture Ballast Type	Efficient Fixture Wattage (WATTS$_{EE}$)	Efficient Fixture Wattage Source	Baseline Fixture Wattage (WATTS$_{BASE}$)	Baseline Fixture Wattage Source	Fixture Savings (Watts)
T-8 96" One Lamp	Electronic – IS	T-12 96" One Lamp-ES	Magnetic-STD	58	3	75	3	17
T-8 96" Two Lamp	Electronic – IS	T-12 96" Two Lamp-ES	Magnetic-ES	109	3	123	3	14
T-8 96" Four Lamp	Electronic – IS	T-12 96" Four Lamp-ES	Magnetic-ES	219	3	246	3	27
High Performance T-8 48" One Lamp	Electronic	T-8 48" One Lamp	Electronic - IS	25	6	31	3	6
High Performance T-8 48" Two Lamp	Electronic	T-8 48" Two Lamp	Electronic - IS	48	6	59	3	10
High Performance T-8 48" Three Lamp	Electronic	T-8 48" Three Lamp	Electronic - IS	73	6	89	3	17
High Performance T-8 48" Four Lamp	Electronic	T-8 48" Four Lamp	Electronic - IS	96	6	112	3	18
Metal Halide Track (MHT) Fixtures								
Metal Halide 20 Watts		Two 50 Watt Halogen		23	1	100	1	77
Metal Halide 39 Watts		Two 75 Watt Halogen		43	1	150	1	107
Metal Halide 70 Watts		Three 75 Watt Halogen		77	1	225	1	148
Ceramic Metal Halide (CMH) Fixtures								
Ceramic Metal Halide 20 Watts		Two 50 Watt Halogen		26	1	100	1	74
Ceramic Metal Halide 39 Watts		Two 75 Watt Halogen		45	1	150	1	105
Ceramic Metal Halide 50 Watts		Three 65 Watt Halogen		55	1	195	1	140
Ceramic Metal Halide 70 Watts		Three 75 Watt Halogen		79	1	225	1	146
Ceramic Metal Halide 100 Watts		Three 90 Watt Halogen		110	1	270	1	160
Ceramic Metal Halide 150		Three 120 Watt Halogen		163	1	360	1	197

Efficient Lamp	Efficient Fixture Ballast Type	Baseline Lamp	Baseline Fixture Ballast Type	Efficient Fixture Wattage (WATTS_{EE})	Efficient Fixture Wattage Source	Baseline Fixture Wattage (WATTS_{BASE})	Baseline Fixture Wattage Source	Fixture Savings (Watts)
Watts								
Low and High Bay Fixtures								
Low Bay LED 85 Watts 3		Metal Halide 250 Watts		85		295		210
Low Bay LED 85 Watts 3		T-8 96" Two Lamp High Output	Electronic	85		160		75
High Bay LED 139 Watts		Metal Halide 200 Watts		139		232		93
High Bay LED 175 Watts		Metal Halide 250 Watts		175		295		120

Sources

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2. Kuiken et al., KEMA. *Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0*. March 22, 2010.
3. Southern California Edison. *2010 Standard Performance Contract Procedures Manual.* "Appendix B: 2010 Table of Standard Fixture Wattages. Ver. 1.1." February 25, 2010. Available online: http://www.aesc-inc.com/download/SPC/2010SPCDocs/UnifiedManual/App%20B%20Standard%20Fixture%20Watts.pdf
4. El Paso Electric. "2009 EPE Program Downloads. Wattage Table 2009." Accessed September 26, 2009. http://www.epelectricefficiency.com/downloads.asp?section=ci
5. *New Jersey Clean Energy Program: Protocols to Measure Resource Savings.* December 2007.
6. Thorne and Nadel. *Commercial Lighting Retrofits: A Briefing Report for Program Implementers.* Paper presented at the annual meeting for the American Council for an Energy-Efficient Economy, April 2003.

Appendix E – TRM Updates and Changes

Measure	Edit #	Major Edit Description	Date
Residential Sector			
Residential ENERGY STAR Compact Fluorescent Lamp (CFL) Lighting (CFL and LED)	1	Combined with LED lamps	June 2015
	2	Fully accepted EISA baselines (no more language about future changes)	June 2015
	3	Included annual hours-of-use for school programs	June 2015
	4	Included annual hours-of-use for multifamily and specialty bulbs (from Illinois TRM)	June 2015
	5	Changed algorithm from delta watts multiplier to base watts multiplier	June 2015
	6	Updated incremental cost for CFLs	June 2015
	7	Updated incremental cost for LEDs	June 2015
Residential Direct Install - ENERGY STAR Compact Fluorescent Lamp (CFL) (Early Replacement)	1	Removed from TRM (combined with CFL/LED section)	June 2015
Residential LED Lamps	1	Removed from TRM (combined with CFL/LED section)	June 2015
	2	Created baseline watt multiplier from ENERGY STAR-qualified list	June 2015
LED Night Lights	1	No edits made	June 2015
Refrigerator and/or Freezer Retirement (Early Retirement)	1	Corrected math in example equation	June 2015
Residential HVAC Maintenance/Tune Up (Retrofit)	1	Included typical existing cooling capacity in accordance with 2012 Baseline Study	June 2015
	2	Included typical existing SEER in accordance with 2012 Baseline Study	June 2015
Residential Boiler Tune-Up	1	Included typical existing heating input in accordance with 2012 Baseline Study	June 2015

Measure	Edit #	Major Edit Description	Date
Attic/Roof/Ceiling Insulation (Retrofit)	1	Removed from TRM (combined with Wall Insulation)	June 2015
	2	Corrected math in example equation	June 2015
ENERGY STAR Torchiere (Time of Sale)	1	Updated baseline watts to reflect EISA	June 2015
Dedicated Pin Based Compact Fluorescent Lamp (CFL) Table Lamp	1	Updated baseline watts to reflect EISA	June 2015
Ceiling Fan with ENERGY STAR Light Fixture (Time of Sale)	1	Updated baseline watts to reflect EISA	June 2015
Efficient Refrigerator – ENERGY STAR and CEE TIER 2 (Time of Sale)	1	Updated baseline UEC from ENERGY STAR website	June 2015
Refrigerator Replacement (Low Income, Early Replacement)	1	Updated baseline and efficient UEC from ENERGY STAR website	June 2015
Clothes Washer – ENERGY STAR and CEE TIER 3 (Time of Sale)	1	No edits made (could not follow methodology); future edits should update RECs data	June 2015
	2	Updated incremental cost	June 2015
ENERGY STAR Room Air Conditioner (Time of Sale)	1	Updated average size of rebated unit according to ENERGY STAR list	June 2015
	2	Updated baseline efficiency based on 2015 e-CFR (federal standard)	June 2015
	3	Updated ENERGY STAR efficiency to comply with standards	June 2015
ENERGY STAR Room Air Conditioner Replacement (Low Income, Early Replacement)	1	Updated average size of rebated unit according to ENERGY STAR list	June 2015
	2	Updated the baseline efficiency based on 2015 e-CFR (fed standard)	June 2015
	3	Updated ENERGY STAR efficiency to comply with standards	June 2015
ENERGY STAR Room Air Conditioner Recycling (Early Retirement)	1	Updated average size of rebated unit according to ENERGY STAR list	June 2015
Central Air Conditioning (Early Replacement)	1	Included typical existing cooling capacity in accordance with 2012 Baseline Study	June 2015

Measure	Edit #	Major Edit Description	Date
	2	Included typical existing SEER in accordance with 2012 Baseline Study	June 2015
Central Air Conditioning (Time of Sale	1	Included typical existing cooling capacity in accordance with 2012 Baseline Study	June 2015
Central Air Source Heat Pump (Early Replacement)	1	Corrected algorithm to distinguish between heating and cooling capacities	June 2015
Central Air-Source Heat Pump (Time of Sale)	1	Corrected algorithm to distinguish between heating and cooling capacities	June 2015
Ground-Source Heat Pumps (Time of Sale)	1	Corrected algorithm to distinguish between heating and cooling capacities	June 2015
Low-Flow Faucet Aerator (Time of Sale or Early Replacement)	1	Overhauled measure and algorithm to comply with Cadmus Michigan water study and Interstate Power & Light multifamily direct install study	June 2015
	2	Updated groundwater temperature table to comply with *DHW Event Generator* developed by NREL	June 2015
Low-Flow Showerhead (Time of Sale or Early Replacement)	1	Overhauled measure and algorithm to comply with Cadmus Michigan water study and Interstate Power & Light multifamily direct install study	June 2015
	2	Updated incremental cost	June 2015
	2	Updated groundwater temperature table to comply with *DHW Event Generator* developed by NREL	June 2015
Domestic Hot Water Pipe Insulation (Retrofit)	1	Updated incremental cost	June 2015
Wall Insulation (Retrofit)	1	Removed from TRM (combined with Attic/Roof/Ceiling Insulation)	June 2015
Air Sealing - Reduce Infiltration (Retrofit)	1	Updated N-factors in table to align properly with *Residential Energy Book*	June 2015

Measure	Edit #	Major Edit Description	Date
	2	Updated reference tables to incorporate the adjustment proxy for new modeling	June 2015
Duct Sealing and Insulation (Retrofit)	1	Included typical existing cooling capacity in accordance with 2012 Baseline Study	June 2015
	2	Included typical existing SEER in accordance with 2012 Baseline Study	June 2015
	3	Updated incremental cost	June 2015
ENERGY STAR Windows (Time of Sale)	1	Updated reference tables to incorporate the adjustment proxy for new modeling	June 2015
Natural Gas Water Heaters (Time of Sale)	1	Updated groundwater temperature table to comply with *DHW Event Generator* developed by NREL	June 2015
	2	Updated ENERGY STAR criteria table	June 2015
Programmable Thermostats (Time of Sale, Direct Install)	1	Updated ESFs based on NIPSCO smart Wi-Fi t-stat study	June 2015
	2	Updated heating algorithm (no efficiency term needed since FF equipment rating is already in input)	June 2015
Condensing Furnaces-Residential (Time of Sale)	1	Updated incremental cost	June 2015
Residential New Construction	1	Updated based on IECC 2009 specifications	June 2015
Other Software	1	Removed	June 2015
Commercial Sector			
Chiller Tune-Up	1	Corrected math in example equation	June 2015
C&I Lighting Controls (Time of Sale, Retrofit)	1	Removed redundant ESF from demand reduction algorithm	June 2015
Lighting Systems (Non-Controls) (Time of Sale, New Construction	1	Reformatted to condense	June 2015
Lighting Systems (Non-Controls) (Early Replacement, Retrofit)	1	Reduced Delta Watts multiplier due to EISA	June 2015

Measure	Edit #	Major Edit Description	Date
LED Case Lighting with/without Motion Sensors (New Construction; Retrofit – Early Replacement	1	Updated wattage tables to align with Wisconsin TRM	June 2015
	1	Corrected algorithm to account for additional freezer fixture	June 2015
June 2015Traffic Signals (Retrofit)	1	Updated wattage tables and CFs to align with Pennsylvania TRM	June 2015
ENERGY STAR Room Air Conditioner (Time of Sale)	1	Updated baseline efficiency standards	June 2015
	2	Updated Tier 1 and ENERGY STAR efficiency standards	June 2015
ENERGY STAR Hot Food Holding Cabinet (Time of Sale)	1	Updated baseline and efficient wattage per cubic foot based on ENERGY STAR requirements and fishnick.com	June 2015
ENERGY STAR Griddle (Time of Sale)	1	Updated efficient model parameters based on fishnick.com	June 2015
Spray Nozzles for Food Service (Retrofit)	1	Updated groundwater temperature table to comply with *DHW Event Generator* developed by NREL	June 2015
Heat Pump Water Heaters (New Construction, Retrofit)	1	Updated groundwater temperature table to comply with *DHW Event Generator* developed by NREL	June 2015
	2	Updated EF algorithms based on federal baseline	June 2015
Commercial Clothes Washer (Time of Sale)	1	No edits made	June 2015
Commercial Plug Load – Smart Strip Plug Outlets (Time of Use, Retrofit – New Equipment)	1	Expanded standby power consumption table to include weighted values	June 2015
Energy Efficient Furnace (Time of Sale, Retrofit – Early Replacement)	1	Corrected algorithm to conform with citation	June 2015
High Efficiency Storage Tank Water Heater (Time of Sale, Retrofit – Early Replacement)	1	Updated groundwater temperature table to comply with *DHW Event Generator* developed by NREL	June 2015
	2	Updated EF algorithms based on federal baseline	June 2015

Measure	Edit #	Major Edit Description	Date
Tankless Water Heaters (Time of Sale, Retrofit – Early Replacement)	1	Updated groundwater temperature table to comply with *DHW Event Generator* developed by NREL	June 2015
	2	Updated EF algorithms based on federal baseline	June 2015