TESTIMONY OF MICHAEL GOLDENBERG
MANAGER, CUSTOMER PLANNING AND REGULATORY STRATEGY
DUKE ENERGY BUSINESS SERVICES LLC
ON BEHALF OF
DUKE ENERGY INDIANA, INC.
CAUSE NO. 43955 DSM-2 BEFORE THE
INDIANA UTILITY REGULATORY COMMISSION

I. INTRODUCTION

Q1. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A1. My name is Michael Goldenberg, and my business address is 1000 E. Main Street, Plainfield, Indiana 46168.

Q2. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A2. I am employed by Duke Energy Business Services LLC. Duke Energy Business Services LLC is an affiliate of Duke Energy Indiana, Inc. ("Duke Energy Indiana" or "Company"). My title is Senior Strategy and Collaboration Manager.

Q3. WHAT DUTIES AND RESPONSIBILITIES DO YOU HAVE IN YOUR CURRENT POSITION?

A3. As Manager, Customer Planning and Regulatory Strategy, I have responsibilities for Duke Energy Indiana Energy Efficiency initiatives including compliance, filings, Oversight Board and representation on both the Third-Party Administrator ("TPA") and Evaluation and Measurement ("EM&V") Statewide Committees.

Q4. PLEASE OUTLINE YOUR EDUCATIONAL BACKGROUND.

A4. I have a B.S. Degree from American University and a Master's Degree in Business Management and Finance from Cornell University.

Q5. PLEASE SUMMARIZE YOUR PROFESSIONAL EXPERIENCE.

A5. I have held various positions within the Company's Marketing and Sales areas since my employment in 1990. After starting with the Public Service Indiana as a National Accounts Executive, I moved to Manager, Commercial Sales for PSI Energy. Following that position, I took on responsibility for the Company's first foray into DSM as Manager, DSM Operations which oversaw the procuring of vendors, administration of all program management, implementation, and vendor management. After the Cinergy merger, I became Director, Products and Services with responsibility for all regulated and non-regulated products and services. I continued in this position following the Duke Energy merger and managed the energy efficiency and non-regulated portfolio across the Company's five jurisdictions. As Senior Manager, Customer Planning and Regulatory Strategy, I work with our Program Management, Rates, EM&V, Analytics and Legal staffs on the Company's Indiana products and services along with managing the Oversight Board and as a member of the Statewide TPA and EM&V Subcommittees.

Q6. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A6. I will briefly describe Senate Enrolled Act 340 ("SEA 340") and the effect it has on this year's energy efficiency proposal. I will then provide an overview of the Company's current EE portfolio and how those programs performed relative to the Phase II Order targets. I will also describe Duke Energy Indiana's 2015 proposal for its EE portfolio in response to SEA 340. I will describe the portfolio of programs and the cost recovery mechanism that Duke Energy Indiana is proposing in this proceeding. Finally, I will introduce the other witnesses in this proceeding.

Q7. WHAT IS DUKE ENERGY INDIANA SEEKING IN THIS PROCEEDING?

A7. The Company is seeking approval of its reconciliation of 2013 program costs, as well as approval of its 2015 portfolio of programs, recovery of associated program costs, and a shared savings incentive mechanism.

II. <u>SEA 340</u>

Q8. WHAT IS SEA 340 AND WHAT IS ITS RELEVANCE TO THIS PROCEEDING?

A8. SEA 340 is legislation enacted this year that provides for industrial customers with over 1 MW the ability to opt out of energy efficiency programs. Once industrial customers opt out, they remain responsible for the costs incurred as of the effective date of the customer's opt out. The precise guidelines of the opt out are being addressed in Cause No. 44441.

SEA 340 also eliminated the targets established in Cause No. 42963 (Phase II) ("Phase II Order") as well stated the Commission may not require a third-party administrator to oversee a statewide program established in the Phase II Order.

Q9. HOW DOES SEA 340 AFFECT THIS FILING?

A9. The passage of SEA 340 impacts the Company's EE proposal in a number of ways. First, the Company anticipates it will have less participation from large customers. To date, Duke Energy Indiana has received requests from twelve large customers to opt out, accounting for approximately 25% of the opt-out eligible load in the Duke Energy Indiana service territory. The Company is expecting to have more customers opt out for 2014 and others who will elect by the November 15, 2014 deadline to opt out for 2015. Duke Energy Indiana has experience in opt out programs from its affiliate in North Carolina and has relied on information learned there as a starting point to formulate the

Indiana plan. For example, the Duke Energy Carolinas has seen 62% of its opt-out eligible load actually opt out in North Carolina and Duke Energy Indiana has used this as a guideline for its Indiana forecast. Accordingly, Duke Energy Indiana has modeled an opt out of 65% of opt-out eligible load in planning program participation and impacts.

Second, the legislation eliminated the IURC's implemented Phase II targets for gross energy savings. However, even without one-size-fits all targets, Duke Energy Indiana continues to be committed to energy efficiency, as it has been since 1991. We are proposing a robust set of energy efficiency programs designed for participation from all customer classes. Consistent with its current cost recovery mechanism and to remove the disincentive to invest in energy efficiency, Duke Energy Indiana views shareholder incentives as its return on investment if results are delivered. With the elimination of the administratively determined targets, the Company's current incentive mechanism that is tied to achievement of targets was not as robust as moving to a shared savings model, wherein shareholders retain a small percentage of the energy savings achieved.

Finally, all energy efficiency programs will now be offered by each individual utility. The delineation of Core and Core Plus goes away and Duke Energy Indiana has the responsibility to deliver a comprehensive portfolio of programs to all participating customers, just as it has for decades prior.

III. 2013 PERFORMANCE

Q10. DURING 2013, WHEN THE PHASE II ORDER TARGETS WERE STILL IN EFFECT, HOW DID THE COMPANY PERFORM OVERALL IN RELATION TO TARGETS?

A10. For the Core Plus programs administered by Duke Energy Indiana, the attainment to target was 103%. However, the Core Programs continued to underperform reaching only 47% of the bifurcated target. Specifically, the Core Commercial and Industrial Program only attained 27% of the goal. Overall, including both Core and Core Plus, Duke Energy Indiana met 58% of the total savings goal.

Q11. IN 2013 WHAT IMPACTS WERE ATTRIBUTABLE TO CORE PROGRAMS?

A11. The Core Programs produced impacts of 169.3K MHW with the majority coming from Residential Lighting and C&I Rebate.

Q12. IN 2013 WHAT IMPACTS WERE ATTRIBUTABLE TO CORE PLUS PROGRAMS?

A12. For the Core Plus programs, impacts were 86.3K MWH with the majority generated by the Personalized Energy Report and C&I Prescriptive Rebate.

Q13. WHAT WERE THE CORE PLUS TARGETS FOR 2013?

A13. As I stated in my direct testimony in Cause No. 32955 DSM1, the Core Plus targets as approved were:

Achievement Thresholds		Cost Plus Incentive Level
Percent of Target	2013 (mWh)	Pre-Tax Rate of Return
Greater than 110%	≥ 96,778	15%
100-110%	≥ 87,980	12%
90-100%	≥ 79,182	10%
80-90%	≥ 70,384	8%
60-80%	≥ 52,788	6%
49-60%	≥ 43,110	0%
Less Than 49%	< 43,110	-4%

IV. 2015 PROPOSAL

Q14 PLEASE SUMMARIZE WHAT PROGRAMS DUKE ENERGY INDIANA PROPOSES IN THIS PROCEEDING.

A14. The 2105 EE Plan contains many of the same programs approved by the Commission in Cause Nos. 43955 and 43955 DSM1, with some minor modifications. With elimination of the TPA offering Core programs, Duke Energy Indiana has integrated most of those programs as part of its portfolio. Duke Energy Indiana seeks Commission approval to offer and recover costs for the following programs:

Residential	**Non-Residential**
Residential Smart Saver	Smart Saver Prescriptive
Agency Assistance Portal	Smart Saver Custom
Appliance Recycling	
Energy Education for Schools	
Residential Neighborhood	
Multi-Family EE Products & Services	
My Home Energy Report	
Home Energy House Call	
Power Manager	

Program descriptions can be found in Petitioner's Exhibit A-1.

Q15. WHY IS DUKE ENERGY INDIANA PROPOSING THESE PROGRAMS?

A15. The Company has used three sources to determine the portfolio: 1) its most recent market potential study ("MPS"); 2) the current portfolio of both Core and Core Plus programs; and 3) experience in other Duke Energy jurisdictions. By using these sources, the Company has the benefit to determine what cost effective programs have been most successful, to insure the most comprehensive coverage of our divergent customer mix, and utilize the most up to date go-to-market strategies.

Q16. DID THE COMPANY HAVE A MARKET POTENTIAL STUDY PERFORMED?

A16. Yes, Duke Energy Indiana and its Oversight Board selected Forefront Economics to perform an MPS in 2013. The study primarily focused on the landscape for EE and DR while factoring in the requirements of the Phase II Order. With the enactment of SEA340, the study, although still helpful to some extent, is also skewed towards the mandated targets and the bifurcated delivery of programs that no longer exist. As a result, it is important when using the study to be mindful of the changes that are now taking place around energy efficiency including opt out, no third party administrator or administratively determined targets. The MPS is attached as Petitioner's Exhibit A-2.

Q17. IS THE PORTFOLIO COST EFFECTIVE?

A17. Yes. This is discussed in more detail in Ms. Roshena Ham's testimony.

Q18. WHAT COST RECOVERY IS DUKE ENERGY INDIANA SEEKING?

A18. The Company is seeking to recover program cost, lost revenue and shared savings as a performance incentive.

Q19. PLEASE EXPLAIN DUKE ENERGY INDIANA'S PROPOSAL FOR LOST REVENUE RECOVERY

A19. Consistent with the settlement agreement approved in DSM1, Duke Energy Indiana is seeking recovery of lost revenues for the life of the measure. The lost revenues will be verified and the verification process for lost revenues is explained in the testimony of Ms. Roshena Ham.

Q20. WHY IS THE COMPANY SEEKING LOST REVENUES?

A20. Customers receive the benefits of energy efficiency by experiencing lower electric rates. The promotion of energy efficiency also helps delay the need for future generation resources. At the same time, the promotion of energy efficiency causes utilities to experience a reduction in the recovery of their fixed costs absent the recovery of lost revenues. Lost revenues are a mechanism to make a utility whole between rate cases. Otherwise, there is a strong disincentive for a utility to aggressively offer energy efficiency programs.

Q21. PLEASE EXPLAIN WHY A PERFORMANCE INCENTIVE IS APPROPRIATE.

A21. As provided in the Commission's rules (170IAC 4-8-3), "the regulatory framework attempts to eliminate or offset the regulatory or financial bias against DSM, or in favor of a supply-side resource . . ." Shareholder incentives help to put demand side resources on an equal footing as supply side resources. Additionally, shareholder incentives provide an incentive to pursue cost-effective energy efficiency.

ACEEE (American Council for an Energy Efficient Economy) supports the need for shareholder incentive:

> utilities face key financial disincentives and barriers to investments in energy efficiency. Consequently, leading states have enacted regulations and policies to create new business models for their investor-owned utilities – models that eliminate the financial disincentives that prevent utilities from saving energy and provide incentives for developing successful and effective energy efficiency programs.[1]

Q22. WHAT INCENTIVE STRUCTURE IS DUKE ENERGY INDIANA REQUESTING IN THIS PROCEEDING?

A22. The Company is seeking a shared savings mechanism. Under the proposed shared savings mechanism, Duke Energy Indiana proposes that customers will realize 85% of the net benefit and the Company will retain the remaining 15%.

Q23. PLEASE EXPLAIN HOW SHARED SAVINGS WORKS.

[1] http://www.aceee.org/topics/utility-regulation-and-policy

A23. A Shared Savings mechanism places the utilities investment in energy efficiency programs comparable to supply-side alternatives from a financial perspective. Under a Shared Savings plan, the net benefits from the energy efficiency program are shared between customers and the Company. The net benefit is the difference between the costs avoided through implementation of verified energy efficiency programs and the costs otherwise incurred. The avoided costs include electric capacity, energy and transmission and distribution costs. By incorporating the Shared Savings mechanism, the incentive is tied to the net system benefits delivered through the energy efficiency programs and the magnitude of the incentive paid to both customers and the Company is tied to the cost effectiveness of the programs. Thus, the Shared Savings mechanism aligns the incentive with the delivered benefits to the customer.

Q24. WHY IS THE COMPANY PROPOSING SHARED SAVINGS AS OPPOSED TO TIERED INCENTIVES AS IT HAS DONE IN THE PAST?

A24. Using a cost-plus approach with a tiered incentive mechanism that is tied to MWH attainment, is not as workable without administratively determined targets. Furthermore, the Company believes a shared savings incentive approach aligns the goals of customers and the Company to achieve EE savings as cost-effectively as possible – something all stakeholders should want. Duke Energy Indiana is proposing a shared savings mechanism that shares the net benefit of measureable EE programs between customers and the Company. The net benefit will be calculated on an avoided costs basis (avoided capacity and energy) and the utility incurred costs of the EE programs. Duke Energy

Indiana is proposing that customers receive 85% of the benefit and the Company receive 15%.

Q25. WHY IS THE COMPANY PROPOSING THESE PERCENTAGES FOR SHARING?

A25. There are a number of reasons that have determined the percentage split. First, the Company is now 100% responsible for the performance of the portfolio with the elimination of the TPA. This responsibility includes not only the program management aspect but additionally all of the back office work, marketing, analysis and EM&V. Another consideration is related to our long history of offering energy efficiency and demand response programs since the early 1990's. As a result of this twenty plus years of helping our customers with energy efficiency, we now have the additional challenge of needing to go deeper into the customer segments and maximizing cost effectiveness through innovative programs and delivery channels to be successful. We have also modeled the 15% after two other data points here in Indiana. In its current tiered incentive structure the Commission has allowed Duke Energy Indiana to include a 15% level and Indiana Michigan Power Company also has 15% in their current shared savings mechanism. And lastly, in the proposed mechanism, our customers are the primary beneficiary with 85% of the earned incentives.

Q26. HOW WILL THE AVOIDED COSTS BE CALCULATED?

A26. This topic is covered by Ms. Roshena Ham in her testimony.

Q27. IS THE COMPANY PROPOSING THAT ALL PROGRAMS BE INCLUDED IN THE SHARED SAVINGS PROPOSAL?

A27. No. The plan is to exclude the Low Income Neighborhood Program, the EMIS pilot program and any other pilots proposed through the end of 2015.

Q28. WHY IS THE COMPANY ONLY SEEKING RECOVERY OF A ONE YEAR PLAN?

A28. SEA 340 contains a provision that requires the Commission to prepare a status report on programs implemented under the Phase II Order and other additional information about energy efficiency to the Regulatory Flexibility Committee and the Legislative Counsel no later than August 15, 2014. Additionally, Governor Pence has requested that the Commission make recommendations to assist his administration in formulating its DSM/ EE policy for the state. The Commission is soliciting input through its General Administrative Order 2014-1.

Because there are so many variables over the next year, Duke Energy Indiana management decided that it was best to file for one year to see what guidance emerges and then make a more long-term filing. Duke Energy Indiana is providing a three year look to establish preliminary budgets and results to maintain our commitment to energy efficiency.

Q29. IS DUKE ENERGY INDIANA MAINTAINING THE OVERSIGHT BOARD (OSB) THAT WAS APPROVED IN 43955?

A29. Yes. The Company has maintained monthly phone calls to review a scorecard of performance and also quarterly in-person meetings. The quarterly meetings have been a great venue to have in-depth discussions on topics as far ranging as EM&V vendor selection, EM&V report review to program marketing and budgetary issues. With all the energy efficiency programs coming under the management of Duke Energy Indiana, the OSB will be able to assist across the entire portfolio rather than only the Core Plus programs.

Q30. WHAT IS THE COMPANY'S PLAN WITH REGARDS TO EVALUATION, MEASUREMENT &VERIFICATION (EM&V) FOR THE 2015 PORTFOLIO OF PROGRAMS?

A30. Duke Energy Indiana is committed to using an independent EM&V vendor as it has for its current Core Plus programs. Ms. Roshena Hamm will discuss this in her testimony.

V. OTHER WITNESSES

Q31. WHO ARE THE OTHER WITNESS IN THIS PROCEEDING AND WHAT WILL THEY BE DISCUSSING?

A31. Ms. Roshena Ham will provide an overview of EM&V, how it factors into true up and estimates of portfolio costs. She will also provide an update on EM&V costs, cost-effectiveness results and how those results factor into the shared savings mechanism. (Petitioner's Exhibit B).

Ms. Karen Holbrook will be discussing the process for developing the actual costs for the 2013 reconciliation, as well as the proposed costs for the 2015 portfolio and the calculation of Lost Revenues(Petitioner's Exhibit C).

Ms. Diana Douglas will cover the Company's 2013 reconciliation, development of the rates proposed to be billed in 2015, and the development of the prices used for lost revenues included in this filing (Petitioner's Exhibit D).

VI. CONCLUSION

Q32. DOES DUKE ENERGY INDIANA SEE THIS FILING AS A NEXT BEST STEP FOLLOWING THE PASSAGE OF SEA 340?

A32. Yes. As stated previously, the Company has a long history of commitment to energy efficiency and demand response. With some of the issues surrounding the Phase II Order, it is important that we provide our customers with a portfolio of programs that will meet their needs while moderating the expenditures to generate reasonable reduction of usage. It is important that Duke Energy customers reconnect with the Company as their go-to provider of all information relating to energy and how to use it wisely. This filing provides that connection and rewards the Company and the customers if it is successfully implemented.

Q33. WERE PETITIONER'S EXHIBITS A-1 AND A-2 PREPARED BY YOU OR AT YOUR DIRECTION?

A33. Yes, they were.

Q34. DOES THIS CONCLUDE YOUR PREPARED TESTIMONY AT THIS TIME?

A34. Yes it does.

VERIFICATION

I hereby verify under the penalties of perjury that the foregoing representations are true to the best of my knowledge, information and belief.

Signed: Michael Goldenberg Dated: 5-29-14

Michael Goldenberg

Residential Programs

Residential Smart Saver

The Residential Smart Saver program (Program) has been expanded where it now contains measures designed to help customers improve efficiency of their HVAC system, building shell and indoor and outdoor lighting.

HVAC and building shell measures and implementation are described first with Lighting measures following.

HVAC Equipment

Cash incentives are provided for installing high efficiency heat pump or air conditioner systems. The Program establishes relationships with home builders and HVAC contractors who interface directly with residential customers at the time of equipment selection. Trade allies adhere to program requirements and submit incentive applications for qualified installations. Incentives for existing HVAC system are split between the Duke Energy customer and the installing contractor. Incentives for new home construction are paid the home builder, but the builder has the option to pass the incentive on to the customer.

HVAC Tune ups

This low cost measure allows customers and trade allies a documented approach to ensuring optimal efficiency is maintained for residential heat pump and air conditioning systems. Qualified technicians utilize approved diagnostic tune up equipment to determine the current efficiency of the system. If the diagnostic equipment determines that the system is currently operating inefficiently and steps are taken to improve the efficiency the customer can qualify for an incentive. The diagnostic equipment must document a pre and post diagnostic test of the customers system that reflects an efficiency improvement. A heat pump or air conditioner system can qualify for an incentive 1 time over the life of the system.

Duct Sealing

Program incentives are provided to customers that have a certified contractor seal the home's duct work system. Trained technicians utilize diagnostic equipment and proven procedures to seal leaks which can reduce energy bills and improve comfort.

Attic Insulation and Sealing

Program incentives are provided to customers that have a certified contractor to seal and insulate the home's attic. Trained technicians utilize diagnostic equipment and proven procedures to identify and seal attic penetrations to improve the homes comfort and to reduce energy bills. After the sealing process is complete, attic insulation is installed to provide protection from higher attic temperatures.

Duke Energy Indiana (DEI) served homeowners currently residing in a single family residence, condominium, duplex or mobile home.

Weather sensitive electrical loads represent the largest impact for high electric bills for most customers. This Program offers a variety of proven measures that help customers reduce energy usage while improving comfort. The measures allow customers to make the most economical energy investment for their home while having confidence in the cost saving benefits.

The primary goal for the Program is to provide eligible customers with a broad selection of energy efficiency measures for their homes. The Program will reach customers who are replacing their current HVAC equipment, seeking to improve the performance of their home envelope or existing HVAC systems. The Program measures provide a life cycle management opportunity that enable customers to maintain optimal operation of the HVAC equipment installed through the Program.

Promotion of the Program is primarily targeted to HVAC contractors, home performance contractors and new home builders. Trade allies are important to the program success because they interface with the customer during the HVAC decision making event which doesn't come along very often for most customers.

The majority of trade ally marketing is conducted through personal outreach activities such as: face-to-face, phone, electronic and direct mail.

Trade ally engagement is supplemented with general customer awareness of the Program through email, direct mail and bill inserts. Duke Energy's website and ad words are also used to improve Program awareness and knowledge.

Residential Lighting

The Residential Lighting measures within the Smart SaverProgram have 2 basic components, a standard CFL offer and a Specialty Lighting offer. Measure descriptions are provided below.

CFL

The Compact Fluorescent Lamps Program (CFLs) is designed to increase the energy efficiency of residential customers by offering customers CFLs to install in high-use fixtures within their homes. The CFLs are offered through an on-demand ordering platform, enabling eligible customers to request CFLs and have them shipped directly to their homes. Eligibility is based on past Program participation and other Duke Energy programs distributing CFLs. Bulbs are available in 3, 6, 8, 12 and 15 pack kits that have a mixture of 13 and 20 watt bulbs. The maximum number of bulbs available for each customer is 15, but customers may choose to order less. Customers have the flexibility to order and track their shipment through three separate channels:

Telephone

Customers may call a toll-free number to access the IVR (Interactive Voice Response) system which provides prompts to facilitate the ordering process. Both English and Spanish-speaking customers may easily validate their account, determine their eligibility and place their CFL order over the phone.

Duke Energy Web Site

Customers can go online to complete the ordering process. Eligibility rules and frequently asked questions are also available.

Online Services (OLS)

Customers who participate in the Online Services program are encouraged to order their CFLs through the Duke Energy web site, if they are eligible.

The benefits of providing these three distinct channels include:

- Improved customer experience
- Advanced inventory management
- Simplified program coordination

- Enhanced reporting
- Increased program participation
- Reduced program costs

Specialty Lighting

The Duke Energy Savings Store is an extension of the on-demand ordering platform enabling eligible customers to purchase specialty bulbs and have them shipped directly to their homes. The Savings Store offers a variety of Compact Fluorescent Lamps (CFLs) and Light Emitting Diodes lamps (LEDs) including; Reflectors, Globes, Candelabra, 3 Way, Dimmable and A-Line type bulbs. Duke Energy incentive levels vary by bulb type and the customer pays the difference, including shipping. The maximum number of incentivized bulbs available for each household varies by category, but customers may choose to order more without the Duke incentive.

Currently, residential customers can check eligibility and shop for specialty bulbs through two separate channels:

Duke Energy Web Site

Customers can go online to visit the Saving Store and purchase specialty bulbs. Frequently asked questions and a savings calculator are available to help customers understand how much they can save and how sustainable they can be by purchasing and using CFL and LED lighting.

Online Services (OLS)

Customer enrolled in the Company's Online Services may visit the Savings Store and purchase specialty bulbs. Upon login, eligible customers are intercepted with the Savings Store offer. Customers can choose to "Shop Now" or "No Thanks". Additional links within OLS are also available for customers to access the Savings Store.

The Savings Store is managed by a third party vendor, Energy Federation Inc. (EFI). EFI is responsible for maintaining the Savings Store website and fulfilling customer purchases. The Savings Store landing page provides information about the store, lighting products, account information and order history. Support features include a toll free number, live chat, package tracking and frequently asked questions.

An educational tool is available to help customers with their purchase decisions. The interactive tool provides information on bulb types, application types, savings calculator, lighting benefits, understanding watts versus lumens (includes a video) and recycling/safety tips. Each wireframe within the educational tool provides insight on the types of bulbs customers can purchase and/or provides answers to questions they have about the products or savings.

As the Program evolves, additional purchasing options may be provided to improve participation through channels that reflect marketplace purchasing behaviors.

Eligible program participants include Duke Energy Indiana (DEI) residential customers.

The Program provides discounted lighting products for residential customers to help them reduce their energy usage while maintaining comfortable lighting atmosphere. Lighting education assists customers in determining the best application for lighting alternatives and emerging technologies.

The primary goal for the Program is to help customers lower their energy bills and to remove inefficient equipment from the electric grid. The Program educates customers about energy consumption related to lighting and how it compares to high efficiency alternatives.

The Program will implement an integrated approach to marketing this program which may include, but not limited to:

- Direct mail
- Bill inserts/messaging
- Community/trade events
- Digital and broadcast media

Residential Multifamily Energy Efficiency

The Residential Multifamily Energy Efficiency program contains several measures designed to improve the apartment's energy efficiency. Duke Energy works with property managers/owners to enroll properties and complete a direct installation of measures. A description of the various measures is provided below.

- Compact Fluorescent Bulbs - Up to 12 compact fluorescent bulbs to replace incandescent bulbs in the apartment's permanent fixtures.
- Electric Water Heater Insulation for Water Pipes.
- Electric Water Heaters Low-Flow Faucet Aerators – for bathrooms and kitchen.
- Electric Water Heater Low-Flow Showerheads – for bathrooms.

Duke Energy Indiana (DEI) individually metered multifamily residences. Apartments with individual electric water heaters benefit the most from Program participation

Often times, neither property managers/owners or tenants are motivated to make energy efficiency improvements because they either don't pay the electric bill or the residence is considered temporary. This Program bridges this gap by educating property managers/owners about benefits and provides a low cost/no cost solution for improving the efficiency of the apartments.

The primary goal for the Program is to provide eligible multifamily properties with a variety of energy efficiency improvements that reduce electric usage. The Program will reach customers that may not be motivated by or educated about energy related improvements. The Program will improve awareness and create a win-win situation for property managers and tenants.

Promotion of the Program is primarily focused on personalized outreach to targeted property managers/owners with individually metered units with electric water heaters. Program collateral will stress the benefits of the Program to property managers that are motivated by higher occupancy rates, lower water bills and lower tenant turnover. In addition, tenants will be informed about the Program benefits and how it will help them reduce their energy costs.

Appliance Recycling

The Appliance Recycling Program ("Program") promotes the removal and responsible disposal of operating refrigerators and freezers from Duke Energy Indiana, LLC (the "Company") residential customers. The program recycles approximately 95% of the material from the harvested appliances. The refrigerator or freezer must have a capacity of at least 10 cubic feet but not more than 30 cubic feet. The Program includes a free pick up at the customer's home and provides a cash incentive for qualified appliances.

Eligible program participants include Duke Energy Indiana (DEI) residential customers who own operating
refrigerators and freezers used in individually metered residences.

The Program removes less efficient appliances from the electric grid and educates customers about the cost of operating older refrigerators and freezers. Many customers don't think about the cost of operating refrigerators or freezers because these 24/7 appliances function in the background without direct interaction with customers. The Program provides convenient in-home pick up and responsibly disposes of the appliance materials without impacting the environment.

The primary goal for the Program is to help customers lower their energy bills and to remove inefficient equipment from the electric grid. The Program educates customers about appliance energy consumption and how it compares to high efficiency alternatives.

The Program will implement an integrated approach to marketing this program which may include, but not limited to:

- Direct mail
- Bill inserts/messaging
- Community events
- Retail point-of sale
- Digital and broadcast media

Home Energy House Call

Home Energy House Call (HEHC) is a free in-home assessment designed to help customers reduce energy usage and energy cost. An energy specialist completes a 60 to 90 minute walk through assessment of the home and analyzes energy usage specific to the home to identify energy saving opportunities. The Building Performance Institute (BPI) certified energy specialist provides and discusses a customized report to the customer that identifies actions the customer can take to increase energy efficiency in their home. The recommendations will range from behavioral changes to equipment modifications that can save energy and reduce cost. The primary goal is to empower customers to better manage their energy.

Example recommendations might include the following:

- Turning off vampire load equipment when not in use
- Turning off lights when not in the room
- Using CFLs in light fixtures
- Using a programmable thermostat to better manage heating and cooling usage
- Replacing older equipment
- Adding insulation and sealing the home

Customers receive an Energy Efficiency Starter Kit with a variety of measures that can be directly installed by the energy specialist. The kit includes measures like CFLs, low flow shower head, low flow faucet aerators, outlet/switch gaskets, weather stripping and energy saving tips booklet.

Duke Energy partners with several third party vendors to support the assessment and operations component of the program.

Home Energy House Call targets Duke Energy residential customers that own a single family home with at least 4 months of billing history.

Leading with knowledge to the customer offers the following benefits:

- Personal touch directly to the customer positively influences customer satisfaction
- Providing the expertise of a (BPI) certified energy specialist raises awareness of efficiency opportunities

- Educating and empowering customers how to use less energy provides a personalized experience, reduces cost, builds trust and positively impacts the environment

The primary goal for the Program is to empower customers to better manage their energy usage and cost. Duke Energy will engage customers providing a personalized experience with a (BPI) certified energy specialist. Important components of the program include providing customers with free energy saving measures and educating them on how to manage their energy needs. After conducting the analysis, the energy specialist provides a one-on-one education session with the customer reviewing a customized report as well as leave-behind materials to emphasize the measures installed, the importance of each measure, and how to maintain the measure.

Program participation is primarily driven through targeted mailings to pre-qualified residential customers; however, for those who elect to receive offers electronically email marketing will be used to supplement. Additional channels to include but not limited to online awareness via the Duke Energy website as well as through online services will promote program participation as well. Please reference appendix for examples of marketing materials used in the past.

My Home Energy Report

The Home Energy Report (MyHER) is an energy efficiency program based on behavioral science that uses peer group of homes of similar size, age, type of heating fuel and geography to highlight the customer's variance in energy use when compared to the "Average Home" and "Efficient Home" of the peer group to motivate energy efficient behavior. The energy usage data features easy to read charts and visuals that illustrate how a customer's home performed in the last month and trended over the year as compared to the sample set via print and online channels. Further social motivation is introduced by establishing a value for an "Energy Efficient Home" within the peer group, as customers closest to the average are unlikely to be motivated to change their behavior.

As customers receive subsequent reports and or engage online, they learn more about their specific energy use and how they match up to their peer group. Targeted energy efficiency tips offered provide customers actionable ideas for reducing energy. The usage recommendations are relevant to specific customers based on analysis of usage patterns, housing stock and available demographic data. For example, customers with higher summer use may receive recommendations related to cooling while customers in older homes may receive air sealing tips. To encourage persistence, product specific offers rebates or audit follow-ups from other Duke Energy Ohio Programs are offered to customers based on their energy profile.

The MyHER is sent via direct mail to targeted customers with desirable characteristics who are likely to respond to the information. The reports are distributed up to 12 times per year; however delivery may be interrupted during the off-peak energy usage months in the fall and spring. Online participants will have access 24 hours per day, 7 days a week to login and view personalized usage and comparative data along with customized tips and recommendations.

The offer is presented to customers as an opt-out which allows customers to elect to not receive the reports.

Leading with information to the customer offers the following benefits:

- Timely tracking and reporting of activity

- Educating and empowering customers how to use less energy provides a personalized experience, reduces cost, builds trust and positively impacts the environment
- Providing a personal experience directly to the customer positively influences customer satisfaction

The primary objective of this program is to provide residential customers comparative usage data reports in an effort to reduce energy usage through a normative behavior approach. Delivering comparative usage data informs the customer about how they are using energy in their home in comparison to that of similar size homes and neighborhoods. Providing energy usage information to the customer promotes energy savings by empowering customers to alter their energy use. The monthly energy usage of each home is compared to the average energy usage of neighbors (top 50%) in similar home types for the same period as well as the most efficient neighbors (top 25%) in similar home types for the same period. Suggested energy efficiency improvements, given the usage profile for that home additionally provide customers actionable ideas to empower customers to be efficient with their energy usage. Additional measure-specific offers, rebates or audit follow-ups are offered to customers, based on the customer's energy profile

Providing the comparative data via print will not be marketed or require advertising. Providing the comparative data via online channels will initially be marketed through channels such as, but not limited to, direct mail and online channels. Marketing communication will be flexible and adaptable as online behavior will be evaluated consistently for engagement and response levels.

Energy Efficiency Educatio Program for Schools

The Energy Efficiency Education Program for Schools ("Program") is an energy efficiency program available in Indiana. The Program is available to students in grades K-12 enrolled in public and private schools who reside in households served by Duke Energy (the "Company"). The current curriculum administered by The National Theatre for Children ("NTC") targets K-8 grade students.

The Program provides principals and teachers with an innovative curriculum that educates students about energy, resources, how energy and resources are related, ways energy is wasted and how to be more energy efficient. The centerpiece of the curriculum is a live theatrical production focused on concepts such as energy, renewable fuels and energy efficiency and performed by two professional actors. Teachers receive supportive educational material for classroom and student take home assignments. All workbooks, assignments and activities meet state curriculum requirements.

School principals are the main point of contact and will schedule the performance at their convenience for the entire school. Once the principal confirms the performance date and time, two weeks prior to the performance, all materials are delivered to the principal's attention for classroom and student distribution. Materials include school posters, teacher guides, and classroom and family activity books.

Students are encouraged to complete a home energy survey with their family (included in their classroom and family activity book) to receive an Energy Efficiency Starter Kit. The kit contains specific energy efficiency measures to reduce home energy consumption. The kits available at no cost to all student households at participating schools, including customers and non-customers.

Eligible participants include the Company's residential customers who reside in households with school-age children enrolled in public and private schools.

The Company is supporting arts and theatre in schools while providing an important message about energy efficiency through an innovative delivery channel for children. Enhancing the message with a live theatrical production truly captivates the children's attention and reinforces the curriculum material provided by teachers.

AM Conservation, the kit vendor, pre-builds the Energy Efficiency Starter Kits which shortens the kit delivery time. When the Energy Efficiency Survey is completed and eligibility is determined, the kit is shipped and received within two to four weeks.

The National Theatre for Children is responsible for all marketing campaigns and outreach. The National Theatre for Children utilizes direct mail and email sent directly to principals for Program acquisition.

Residential Neighborhood Program

The Residential Neighborhood Program ("Program") (aka Neighborhood Energy Saver) assists low-income customers in reducing energy costs through energy education and installation of energy efficient measures. The primary goal of the Program is to empower low-income customers to better manage their energy usage.

Customers participating in the Program will receive a walk-through energy assessment and one-on-one education. Additionally, the customer receives a comprehensive package of energy efficient measures. Each measure listed below is installed or provided to the extent the measure is identified as energy efficiency opportunity based on the results of the energy assessment.

1. Compact Fluorescent Bulbs - Up to 15 compact fluorescent bulbs to replace incandescent bulbs.
2. Electric Water Heater Wrap and Insulation for Water Pipes.
3. Electric Water Heater Temperature Check and Adjustment.
4. Low-Flow Faucet Aerators - Up to three low-flow faucet aerators.
5. Low-Flow Showerheads - Up to two low-flow showerheads.
6. Wall Plate Thermometer.
7. HVAC Winterization Kits – Up to three winterization HVAC kits for wall/window air conditioning units will be provided along with education on the proper use, installation and value of the winterization kit as a method of stopping air infiltration.
8. HVAC Filters - A one-year supply of HVAC filters will be provided along with instructions on the proper method for installing a replacement filter.
9. Change Filter Calendar.
10. Air Infiltration Reduction Measures - Weather stripping, door sweeps, caulk, foam sealant and clear patch tape will be installed to reduce or stop air infiltration around doors, windows, attic hatches and plumbing penetrations.

Targeted low-income neighborhoods qualify for the Program if approximately 50% of the households have incomes of 0%-200% of the Federal Poverty Guidelines. Duke Energy analyzes electric usage data to prioritize neighborhoods that have the greatest need and highest propensity to participate. While the goal is to serve neighborhoods where the majority of residents are low-income, the Program is available to all Duke customers in the defined neighborhood. The Program is available to both homeowners and renters occupying single family and multi-family dwellings in the target neighborhoods with electric service provided by Duke Energy.

The community approach offered by the Program offers the following benefits:

- Community wide involvement raises awareness of energy efficiency opportunities
- Community leaders provide a trusted voice
- Greater acceptance is possible when neighbors and friends go through the Program together
- Efficiencies are gained by working in the same close proximity for longer periods of time
- More resources are available to the individual participants to meet their needs
- Enrolling is simple
- Implementation of measures is fast and easy
- Timely tracking and reporting of activity
- Flexibility in community events can achieve greater success

The primary goal for the Program is to empower low-income customers to better manage their energy bills. Duke Energy will engage low-income customers on a personal basis using a grass roots marketing approach to gain their trust. Crucial steps include providing customers with free energy saving measures and educating them on how to manage their energy needs. After a one-on-one education session, energy efficiency technicians provide customers with leave-behind materials to emphasize the measures installed, the importance of each measure, and how to maintain the measure.

The marketing strategy for the Program will focus on a grassroots approach. Below are some of the marketing tactics Duke Energy may utilize to meet participation goals:

- Door-to-door canvassing
- Direct mail
- Flyers
- Social media
- Door hangers
- Yard signs

- Press releases
- Community presentations and partnerships
- Inclusion in community publications such as newsletters, etc.

Agency Assistance Portal

The Agency Assistance Program ("Program") assists low-income customers in reducing energy costs through providing energy efficiency kits to eligible customers. Customers participating in the Program will receive a package of 12 compact fluorescent delivered to the customer's home.

Customers are eligible for the Program if they apply for the federally funded Low Income Home Energy Assistance Program through a low-income agency. The Program is available to both homeowners and renters occupying single family and multi-family dwellings with electric service provided by Duke Energy.

By utilizing local agencies where low-income customers seek assistance, Duke Energy can target customers most in need for energy savings.

The primary goal for the Program is to empower low-income customers to better manage their energy bills. Duke Energy will utilize low income agencies who distribute LIHEAP funds to administer the Program.

The marketing strategy for the Program will focus on utilizing the low-income agencies as the primary method of informing customers. Duke Energy will provide table tents and posters for agencies to place on display within their offices.

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Non-Residential Programs

Smart $aver® Non-Residential Prescriptive Program

The Smart $aver® Non-residential Prescriptive Incentive Program provides incentives to commercial and industrial consumers for installation of energy efficient equipment in applications involving new construction, retrofit, and replacement of failed equipment. The program also uses incentives to encourage maintenance of existing equipment in order to reduce energy usage. Incentives are provided based on Duke Energy Indiana's cost effectiveness modeling to assure cost effectiveness over the life of the measure.

Commercial and industrial consumers can have significant energy consumption, but may lack knowledge and understanding of the benefits of high efficiency alternatives. Duke Energy Indiana's program provides financial incentives to customers to reduce the cost of high efficiency equipment. This allows customers to realize a quicker return on investment. The savings on utility bills, allows customers to reinvest in their business. The Smart $aver® program also increases market demand for high efficiency equipment. Because of the increased demand, dealers and distributors will stock and provide high efficient alternatives as they see increased demand for the products. Higher demand can result in lower prices.

The program promotes prescriptive incentives for the following technologies – lighting, HVAC, pumps, variable frequency drives, food services, process equipment, and information technology equipment. Equipment and incentives are predefined based on current market assumptions and Duke Energy's engineering analysis. The eligible measures, incentives and requirements for both equipment and customer eligibility are listed in the applications posted on Duke Energy's Business and Large Business websites for each technology type.

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All non-residential customers served by Duke Energy in Indiana are eligible for the Smart $aver® program, except for those customers that choose to opt-out of the Duke Energy program.

The program is promoted through but not limited to the following;

- Trade ally outreach
- Trade ally collateral tool kits
- Midstream Distributor channel
- Duke Energy Online Savings Store
- Duke Energy Indiana Large Account Managers
- Duke Energy Energy Efficiency Engineers
- Duke Energy segment specific workshops
- Company website

Standards continue to change and new, more efficient technologies continue to emerge in the market. The Company expects to continue to add new measures to provide incentives for customers to take advantage of a broader suite of products. The Company undertakes an annual review of technologies and efficiency levels through internal sources and with the assistance of outside technical experts. The review includes the existing technology categories as well as other emerging areas for energy efficiency.

Smart $aver® Custom Rebate Program

Duke Energy's Smart $aver® Nonresidential Custom Incentive Program offers financial assistance to qualifying commercial, industrial and institutional customers (that have not opted out) to enhance their ability to adopt and install cost-effective electrical energy efficiency projects.

The Smart $aver® Custom Incentive program is designed to meet the needs of Duke Energy customers with electrical energy saving projects involving more complicated or alternative technologies, or those measures not covered by standard Prescriptive Smart $aver® Incentives.

The Custom Incentive application is for projects that are not listed on the applications for Smart $aver® Prescriptive Incentives. Unlike the Prescriptive Incentives, Custom Incentives require approval prior to the customer's decision to implement the project. Proposed energy efficiency measures may be eligible for Custom Incentives if they clearly reduce electrical consumption and/or demand.

Currently there are the following application forms that are located on the Duke Energy website under the Smart $aver® Incentives (Business and Large Business tabs).

- Application Part 1 – Administrative Information
- Applications Part 2 Worksheets – Energy Savings Calculations & Basis
    - Variable Frequency Drives
    - Energy Management Systems
    - Compressed Air
    - Lighting
    - General
    - Planning Form (Optional)

The program is promoted through but not limited to the following;

- Trade ally outreach
- Duke Energy Indiana Large Account Managers
- Duke Energy Energy Efficiency Engineers
- Duke Energy segment specific workshops
- Company website
- Non-Residential Energy Assessments

Energy Management and Information Services (EMIS) Pilot

Duke Energy Indiana's proposed Energy Management and Information Services pilot program is a systematic approach to reducing energy usage at qualified commercial or institutional customer facilities and persistently maintaining those savings over time. In order to achieve these goals, the program will deploy an energy management and information system and perform an onsite energy assessment. The EMIS will be software-as-a-service (SaaS) hosted by a third party vendor. The EMIS SaaS will use next day interval meter data from the customer's meter. The customer commits to implementing a bundle of energy-saving low cost operational based measures that meet certain financial investment criteria. Both the customer and Duke Energy also commit to periodic energy monitoring, analysis and reporting.

This program has the potential to encourage customers to be more proactive in their management of energy. Their interaction with the software and with the energy analysts will likely evolve the customers' views of energy as a manageable expense. Duke Energy Indiana needs to test this program offer with customers in order to prove that it is cost-effective. Several other U. S. utilities are rolling out programs and measures with similar components and are seeing cost-effective results, but Duke Energy needs to test it with our customers and the EMIS vendors that we have prequalified. The EMIS pilot commenced in 2014 and will continue in 2015 with the customers who were acquired during 2014.

Duke Energy Indiana: Market Assessment and Action Plan for Electric DSM Programs

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EXECUTIVE OVERVIEW

This document presents a long-term Demand Side Management (DSM) Market Potential Study (MPS) and a five-year Action Plan for residential and non-residential retail electric customers in the Duke Energy Indiana (DEI) service area. The MPS and Action Plan was prepared by Forefront Economics Inc. and H. Gil Peach and Associates, LLC. Long-term DSM savings potential is assessed from both the technical and economic perspectives. The design, implementation and cost effectiveness of specific DSM programs are addressed in the five-year Action Plan. This study considers energy efficiency (EE) and demand response (DR) technologies and programs for saving energy and reducing demand. The impact of energy prices including rate changes are beyond the scope of this study.

This study is expected to help inform utility planners regarding the extent of DSM opportunities and to provide specific program plans for acquiring savings over the short term. It is not meant to provide detailed specifications and work plans required for program implementation. Accordingly, this study provides part of the information to use in setting DSM savings goals or targets. Actual DSM goals or targets are best developed considering this study along with detailed program plans constructed with the participation of program managers and with the possible assistance of implementation contractors.

Overview of Findings

Key findings from the MPS are summarized in Table 1. All energy and demand data presented in this report are at the customer meter level (i.e., line losses are not included) unless otherwise stated.

Table 1. Usage and DSM Potential

	kWh (millions)	**Percent of Total**
Planning Year 20 (2033)		
Total Usage	35,651	100%
Technical Potential Savings - EE and Solar PV	10,737	30%
Technical Potential Savings - Energy Efficiency Only	8,843	25%
Economic Potential (@ $0.075/kWh)*	5,927	17%
Planning Year 5 (2018) – Annual Impact from Participants in Years 1 through 5		
Achievable Potential from Recommended DSM Programs (after 5 years) **	1,957	6.5%

* Refers to the energy savings that can be acquired with DSM for less cost than the cost of serving the load with traditional supply side resources.

** DSM savings shown as percent of Year 5 usage. Savings are incremental to savings already achieved through existing programs.

In this report there are three levels of DSM potential considered.

1. Technical potential – represents the level of savings that could be achieved by applying the measures identified in this report across all applicable customers without regard to cost.
2. Economic potential – represents the subset of technical potential that only includes measures that can be delivered/installed at less than the avoided cost of electric supply.
3. Achievable potential – represents savings acquired through specific program plans including annual participation estimates.

Each of these types of DSM potential is discussed in more detail in this section of the report. Development of estimates of technical, economic and achievable potential is presented in subsequent chapters.

The technical potential including solar photovoltaic (PV) shows that if the energy saving technologies identified in this report were applied across all applicable customers, without regard to market or economic constraints, weather normalized annual electricity usage could be reduced by 30 percent. Excluding solar PV technologies, the technical potential is estimated at 25 percent of annual usage. A 2009 meta-analysis of potential studies found similar results for electric measures across all customer segments.[1]

Economic potential reflects the subset of technical potential that can be acquired for less than the avoided cost of supply. Avoided costs vary significantly depending on the nature of the served load, fuel costs, distribution charges and other costs. Economic potential is presented in the body of this report in the form of a DSM supply curve showing the economic potential depending on the level of avoided cost. System avoided costs are based on long run expectations regarding the cost of supply and are therefore less volatile than short-term energy prices. After reviewing long range system avoided cost estimates a value of $0.075 per kWh was selected to estimate the economic potential as shown in Table 1.[2] Using this level for avoided cost, we estimate that two-thirds of the electric technical potential excluding solar PV is cost effective. We have included incremental measure costs and a rough estimate of DSM program delivery and administration expenses in our calculation of economic potential. More precise estimates of DSM acquisition costs are reflected in the five-year DSM Action Plan.

For reasons discussed in the section on economic potential, the marginal cost of acquiring additional customers into a program can be expected to rise as more and more customers from the target customer segment are treated by the program. Estimates of economic potential typically include a flat level of program delivery and overhead costs based on current understanding of program costs. Consequently, estimates of economic potential tend to overstate what is actually cost effective in the latter stages of customer adoption when costs are higher. This is also true of the estimate of economic potential in this report. While they have their limitations, estimates of technical and economic potential are still useful concepts for defining the relative magnitude of opportunities. Achievable potential energy savings, given specific program designs and annual participation targets refined from experience, provides the best estimate of how much energy efficiency might be actually delivered in any given year.

[1] Chandler, Sharon and Marilyn Brown, Meta-Review of Efficiency Potential Studies and Their Implications for the South. Georgia Tech Working Paper #51, August 2009. Studies examined in the Meta-Analysis reported total technical potential ranging from 24% to 33%. It is not clear from the report if solar was included in these estimates.

[2] The levelized cost at which to determine economic potential was selected from the observed range of electric avoided cost for various customer classes and types of DSM program savings analyzed with DSMore. While useful for reporting purposes, using a single level of avoided cost to determine economic potential is somewhat arbitrary. Observing the full range of economic potential as shown on the supply curves presented in the Economic Potential section of this report provides greater insight into economic potential.

The approach used to develop the set of recommended DSM programs consisted of the following steps:

(1) Conduct a market assessment for determining electric usage and characteristics across customer groups.
(2) Review the Indiana Technical Resource Manual (TRM) and our own comprehensive list of DSM technologies for saving energy.
(3) Consider the appropriateness of selected technologies for Duke's Indiana service territory in terms of markets, cost effectiveness and accessibility to products.
(4) Group the highest potential technologies into logical sets for marketing and outreach.
(5) Design program strategies to promote the technologies based on industry best practices.
(6) Consider the cost effectiveness of the designed program, including costs to Duke and to participating customers.
(7) Describe a final set of recommended program designs that make the most sense for the utility and have a strong potential for delivering cost-effective energy savings.

The process takes as a given the set of "Core" programs set forth in the Request for Proposal for a third party administrator of the 2015-2017 Core DSM Programs (Cause No 42693-S2) and results in the following set of Core and recommended Core Plus programs. DEI will, of course, make the final selection of programs to be submitted for regulatory approval.

Program Name	Cost Effective (TRC Test)	Program Type
Residential Lighting	2.16	Core
Residential Home Energy Audit	0.92	Core
Residential Low Income Weatherization	0.77	Core
Residential Appliance Recycling	2.69	Core
Residential Energy Efficient Schools	2.13	Core
C&I Energy Efficient Schools	1.01	Core
C&I Lighting Buy-Down	2.51	Core
C&I Small Business Direct Install	1.71	Core
C&I Express Rebates	2.66	Core
Residential Prescriptive	1.74	Core Plus
Residential Long-Term Lighting	NA	Core Plus
Residential Home Energy Audit and Weatherization	1.72	Core Plus
Residential Home Reports	1.30	Core Plus
C&I Prescriptive	2.86	Core Plus
C&I Custom	2.48	Core Plus
Residential Load Control	NA	Demand Response
C&I Demand Response	NA	Demand Response
NA - not applicable because there are no incremental program participants or costs during the 5-Year Action Plan		

The overall portfolio results in a Total Resource Cost (TRC) benefit-cost ratio of 1.8. All but two of the programs are cost effective from the TRC test perspective. Expected savings and program budgets are presented in Table 2 for the first five years of program operation. Program budgets are also presented on a cost per retail customer basis.

Table 2. Energy Savings and Annual Budget for Recommended Programs

Year	Cumulative kWh Savings (millions)	Cumulative MW Savings	Program Budget (millions $)	Cost per Retail Customer
2014	254	35	68.3	$82
2015	589	81	108.5	$128
2016	996	137	136.6	$160
2017	1,451	198	153.9	$179
2018	1,957	267	173.1	$199

After five years of operation the program portfolio is expected to achieve cumulative energy savings of nearly 2 billion kWh, about one-third of all economic potential.

Comparison to State of Indiana Directives

The State of Indiana adopted energy savings goals expressed as a percentage of prior usage. DSM potential identified in this study is compared to the State savings goals through 2018. Findings in this study show that a five-year DSM action plan can be developed that cost effectively meets the State targets for energy savings through 2018. Annual kWh savings are shown in the table below along with the annual targets expressed at the meter and the plant (before line losses). State targets are from Duke Energy Indiana's 2013 IRP.

Table 3. Incremental Action Plan Savings and Targets

Year	Action Plan		State Targets		Difference		Cumulative Difference	
	Meter	Plant	Meter	Plant	Meter	Plant	Meter	Plant
	(millions kWh)							
2014	254.1	274.5	300.9	325.0	-46.8	-50.5	-46.8	-50.5
2015	363.3	392.4	354.2	382.6	9.1	9.8	-37.7	-40.7
2016	436.0	471.0	409.7	442.6	26.3	28.4	-11.4	-12.3
2017	483.3	522.1	468.8	506.4	14.5	15.7	3.1	3.4
2018	534.3	577.2	527.0	569.3	7.3	7.9	10.4	11.2

Energy (kWh) savings in the Action Plan fall short of the State target in 2014 but exceed the target in 2015 through 2018. Over the five-year period the Action Plan exceeds the State targets. Savings are achieved with significant although cost-effective spending on DSM programs.

Although the State targets do not extend beyond 2019, it is constructive to compare the overall technical potential found in this study with a long-term goal of 2 percent incremental savings, a level consistent with the last year of the current State legislation. If the annual energy savings target were to be extended at 2 percent a year meeting the goal would require achieving all of economic potential by about 2023 and all of technical potential by about 2030.

Our analysis shows that the near-term State targets can be met with an aggressive but still cost-effective implementation of DSM programs. However, once this aggressive near-term implementation of DSM programs is in place, it will become more difficult to cost effectively achieve similar targets beyond 2018. Any endeavor that attempts to implement long-term annual savings of the magnitude reflected in the current State goals will involve a large-scale effort. At the full scale this is not business as usual, and at this point of the planning stage it is important to consider what might be required to achieve savings of this magnitude.

Achieving aggressive DSM targets over the long-term would likely require adopting the following DSM program planning concepts for maximizing savings:

1. Long-term commitment. Program efforts should be long-term. It may take five or six years for customers and other market players to become fully aware of energy efficiency opportunities facilitated by the Company. Neither customers nor trade allies should suddenly find that programs have been withdrawn or suddenly changed in ways that negatively affect customer or trade ally opportunities. A good "rule of thumb" is to maintain basic programs for at least five to six years and to provide a few years notice whenever program incentives or key features are to be substantially reduced or when a program is to be withdrawn.
2. Market transformation perspective. A market transformation perspective is required for selected markets. Market transformation programs will have a different strategy and cost benefit structure over time than traditional DSM programs and may require special regulatory treatment.
3. Free riders. Free riders are conventionally treated as a negative outcome; usually used to reduce the cost effectiveness of programs. While this works for traditional DSM planning, a market transformation perspective requires a more nuanced and beneficial view of free riders. As programs expand, an increase in free ridership is an indication of increasing market dominance.
4. Mix of direct and upstream programs. Programs should be staged to include a good mix of program measures delivered directly to customers and measures at the upstream distribution level. This supports transformation of the larger market.
5. Commitment to long-term deep energy savings. For example, in residential new construction, each building is considered on a 150 year time horizon and the goal is to make each building near net-zero. Each building has a long-term plan for energy efficiency improvements. Improvements are incorporated in the energy efficient mortgage and planned over time for optimal savings.[3]
6. Modifications in cost-effectiveness tests. There is considerable discussion in the US and Canada on revising cost-testing. One step may occur this year by providing more planning certainty by defining the size of the carbon adder for the TRC test.[4] There is also discussion in several jurisdictions about moving away from the TRC test. For example, New Mexico adopted the Utility Cost Test as its primary test this year, bringing the number of states that use the UCT as the primary test to six.[5] Some states have defined the discount rate in terms of low risk public rates rather than weighted average utility cost of capital. For example, Delaware has set the discount rate as equivalent to a particular public bond cost as of the day a plan is adopted. Currently this lowers Delaware's discount rate below 1 percent. Similarly, Wisconsin is using a social discount rate for cost-effectiveness testing. The rationale for using social discount rates is that funds are provided with certainty through a rate rider and are not raised through a market.

This is not to say that the long-term energy savings targets cannot be cost-effectively achieved. Our estimates of technical and economic potential are based on current levels of technology and current expectations regarding avoided supply costs. Technical potential estimates are also exclusive of price induced conservation which can lead to behavior changes and significant declines in energy consumption. Technological improvements are likely to

[3] For example, in Canada, energy audits (both retrofit and new construction) produce a rating number and the scale goes from the energy savings results of minor retrofit through passive house and near net zero to net zero when local generation is added (usually solar). Few homes are produced at the top of the scale, but the effect is to move homes up the scale. This is essentially implementing the viewpoint of long-term facilities management.

[4] In 2013, the Environmental Protection Administration recomputed the social cost of carbon (SCC) (http://www.epa.gov/climatechange/EPAactivities/economics/scc.html). According to the EPA, these values are conservative and do not currently include all of the important physical, ecological, and economic impacts of climate change. Some researchers believe these values may rise dramatically within the next twenty years. See, for example: Randers, Jorgen*: 2052 A Global Forecast for the Next Forty Years*. White River Junction, Vermont: Chelsea Green Publishing, 2012.

[5] For the most recent general survey of state practices, see: Kushler, Martin, Seth Nowak and Patti Witti, A National Survey of State Policies and Practices for the Evaluation of Rate-Payer Funded Energy Efficiency Programs. Washington, DC: American Council for an Energy Efficient Economy, Report No. U122, February 2012.

result in new applications for saving energy and reductions in the cost of existing technologies. While energy supply costs are uncertain, most of the long-term risk appears to be on the side of higher costs, in our opinion, resulting in higher levels of cost-effective savings. There will be the need to reassess targets as DSM program experience is gained, energy markets go forward, and new technologies are developed. Future market potential studies will need to be completed periodically to reflect these changes in estimates of technical, economic and achievable potential.

Alternative Scenario

An alternative scenario is currently under consideration and development that:

- Considers a large deployment of solar PV beginning with a moderate scale program in the near term and then expanding rapidly by 2020. Solar PV is technically mature and fully scalable, making it readily deployable. Solar PV is also the largest single residential measure and, after lighting, the largest non-residential measure, but it is not yet cost effective. However solar PV costs continue to decline and it may well become cost effective within the next 10 years. Solar PV is considered the foundation of the alternate scenario because it has multiple overlapping benefits: 1) it provides energy during daylight hours, reliably displacing utility demand, 2) it provides long term energy savings, 3) it diminishes the load on the distribution system, and 4) it can be readily deployed without a complex generation siting process.
- In this scenario DEI becomes a major player and investor in customer site-based solar generation. The utility would assume its historical role as an investor in electric generation resources only on a smaller project scale, allowing the lost earnings from solar generation to be offset by a return on utility investment.
- Energy efficiency savings are also expanded through aggressive weatherization and other efforts to capture deeper savings. In the alternate scenario the emphasis is on significantly reducing the use of resistance heat for space and water heating. As a response to recent codes, standards, and international competition there is a growing market of technology that can reduce these thermal loads by about two-thirds, including heat pump water heaters, ductless heat pumps and ultra-efficient heat pumps. This technology is highly deployable but it is also expensive. The alternative scenario includes a more aggressive implantation of these big ticket items that have the potential to significantly reduce residential energy use and often improve comfort at the same time.

Overview of Approach

The purpose of this section is to provide an overview of the approach used in the preparation of this DSM Action Plan. Our approach uses three components, each building off of the last. These components are Market Assessment, DSM Potential, and DSM Programs.

Market Assessment

Market assessment provides the foundation layer of the analysis and supports the work of the other two components. The objective of the market assessment component is to describe customers and loads in sufficient detail to provide an understanding of energy usage by market segment. An important aspect of this project is that the market assessment was completed using a blend of internal Duke data, service territory specific secondary data, and detailed energy modeling. By blending internal utility data with secondary data sources, a much richer market assessment is possible. Key to the market assessment layer is a rigorous analysis of actual customer billing and hourly load data to construct electric usage models for each residential and non-residential segment.

DSM Potential

The DSM potential component of the analysis builds off of the market assessment and provides an estimate of technical potential and DSM supply curves showing the amount of DSM potential available at various costs per kWh. At this stage of the analysis the savings potential of several Energy Efficiency Measures (EEM) is assessed. EEM savings potential is constructed using the Indiana TRM, secondary information documenting the industry's experience with various EEMs, and market assessment and load modeling results specific to DEI. The process of blending internal and secondary information along with energy modeling to develop the market assessment and DSM potential estimates is shown in the figure below.

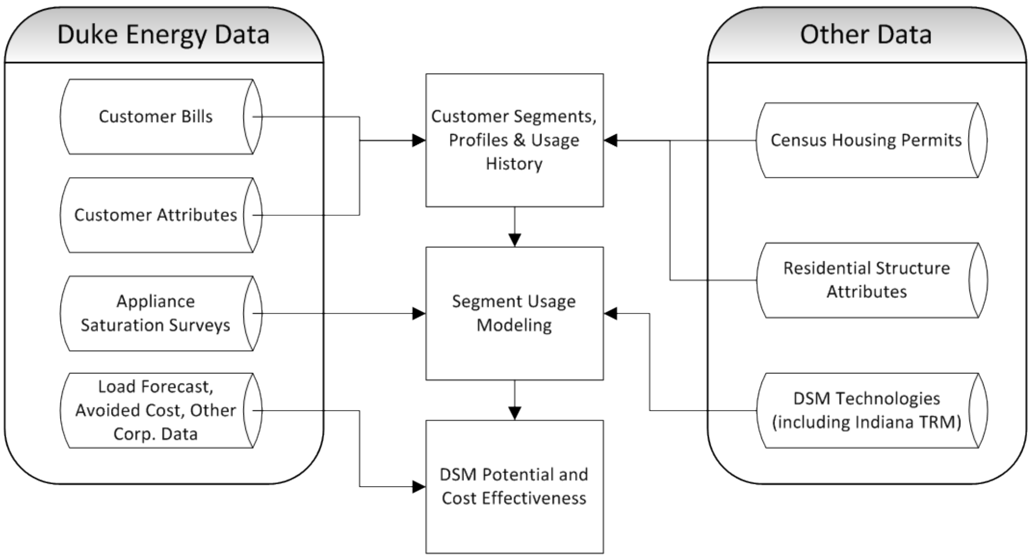

Figure 1. Overview of Market Assessment and DSM Potential Estimates

A significant benefit from this approach is that it results in end-use load profiles and DSM potential estimates by market segment that are based on customer characteristics and energy usage specific to DEI. Duke Energy Indiana service territory specific data used to construct the analysis includes:

- Monthly energy bills for over 22,000 customer sites sampled from 21 market segments.[6]
- Customer attribute information from Duke CIS, including housing type, initial service year and Standard Industrial Classification (SIC) code for non-residential customers.
- Residential Appliance Survey conducted in 2010 providing recent information on equipment and end-uses. DEI respondents were selected and analyzed separately from the broader survey.
- Hourly (8,760) load data for residential and non-residential Duke Energy rate classes.
- Size of home (square feet) and vintage of construction (year built) were obtained from residential characteristics data licensed by Duke Energy.
- Long-term load forecast for Duke Energy Indiana.

DSM Programs

DSM program design represents the final layer of the core analysis of this Action Plan. The program design process builds off of the prior two layers by mapping measures to programs through an analysis of industry practice

[6] See Appendix E for details on the segmentation and sampling strategy used in this analysis.

and, where possible, best practices from other leading electricity and combined companies. This approach balances engineering and economic characteristics of specific end-use technologies with public policy and company objectives. The goals in this effort are, to the extent possible, to incorporate the specific environmental and market characteristics of the service territory, and to orient the programs toward both a technology optimum and a participation optimum. To be effective, these goals in program design and practical implementation will be implemented and optimized within Duke Energy's established marketing framework. Strategic change comes from working closely with customers and suppliers to jointly create program success. The result is a set of recommended programs that are optimized to meet the specific needs of DEI.

Organization of Report

The first three sections following this Overview present the findings of each of the three components or "layers" of analysis discussed above: Market Assessment, DSM Potential, and DSM Programs. The final section of the main report presents program cost-effectiveness results. Several appendices following the main report provide additional documentation on various aspects of the analysis.

In this report the term Demand Side Management (DSM) refers to the planning and implementation of electric utility programs that influence customer uses of electricity in ways that will produce desired changes in the utility's load shape. As such, DSM includes traditional energy efficiency, conservation and load control programs. All energy usage numbers are 2012 weather normalized unless otherwise stated.

MARKET ASSESSMENT

Energy efficiency planning needs to be based on a sound understanding of customer characteristics. The purpose of this section is to provide a foundation for the DSM planning and analysis presented in subsequent sections. We begin with a description of the DEI service territory in terms of households, businesses and customer data. A description of the customer base precedes the presentation of energy usage models. These models are used to estimate the electric sales by end-uses, such as space heating and cooling, water heating, lighting, process energy, appliances and miscellaneous plug loads. The detailed energy usage models also provide a basis for estimating the technical potential, energy savings and cost effectiveness of a wide variety of demand side measures and programs.

Electric energy usage estimates presented in this report are normalized to long-term weather conditions by applying the energy usage models adjusted to a typical or normal year. All energy use and end-use estimates in the report have been normalized to monthly normal temperatures. Though the energy use estimates are for a normal year, the models were developed using actual usage and weather data from January 2012 through December 2012. All electric usage reported in this section represents 2012 weather normalized values unless otherwise stated.

Overview of Market Sectors

The focus of this study is on nearly 820 thousand residential and non-residential retail customers in the DEI service territory. These customers account for 27.6 billion kWh annually, as shown in Table 4.

Table 4. DEI Customers and Weather Normalized Annual Usage by Sector – Year 2012

Sector	Customers	Annual Usage (million kWh)	Percent of Total	Use per Customer (kWh/year)
Residential	708,978	9,036	32.7%	12,745
Commercial	106,411	9,056	32.8%	85,102
Manufacturing	4,547	9,558	34.6%	2,102,015
Total	**819,936**	**27,649**	**100.0%**	**33,721**

Source: Unique premise counts and billing data from CIS extract (Jan 2012 – Dec 2012).

With nearly 709,000 customers, the residential sector is far larger in terms of customer count than the non-residential sector. Although there are far fewer non-residential customers than residential, the non-residential sector accounts for nearly two-thirds of the energy consumption considered in this study.

Monthly electric loads for all three sectors are shown in Figure 2. Monthly residential loads are by far the most seasonal and, like the non-residential segments, are highest during the summer months. Although not as seasonal as the residential sector, monthly commercial loads are highest in the summer and also increase in the winter months. By contrast, manufacturing loads are nearly constant across the months except for a small summer peak in July and August, coincident with the residential and commercial summer peak.

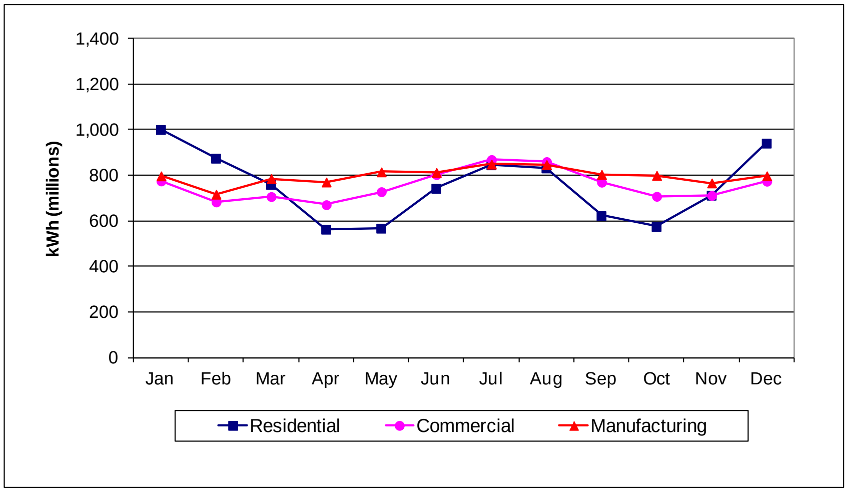

Figure 2. Total DEI Electric Sales by Sector

Detailed energy usage analysis by sector and end-use will be presented later in this section. An overview of monthly loads by end-use is presented here for the residential and non-residential sectors combined as an overview of the components of electric consumption. End-use models were estimated for each sector allowing loads to be disaggregated by major end-use. Monthly loads by end-use estimated from the models are shown in Figure 3.[7]

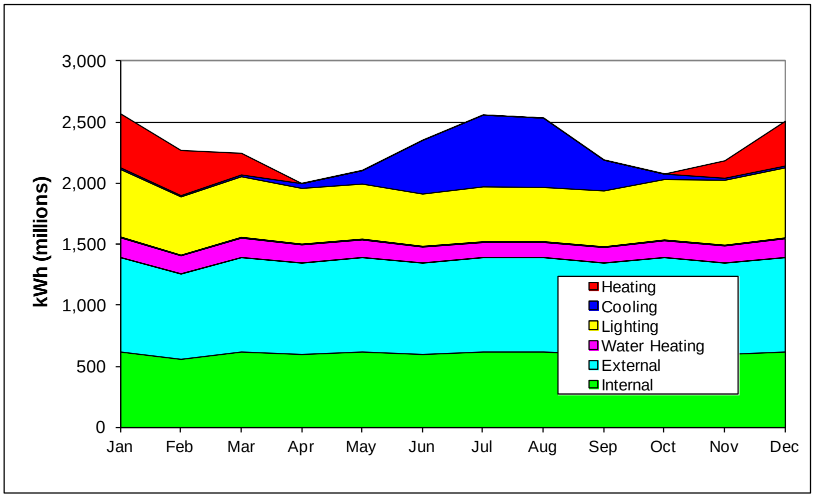

Figure 3. Total DEI Electric Sales by End-Use

Monthly shapes are characterized by a large base load with a prominent summer peak for cooling. Although slightly lower than the summer peak, space heating contributes to a winter peak. Base loads include end-uses that are not highly weather dependent, such as lighting, water heating, appliances and miscellaneous plug load uses. Annual data are shown for these same end-uses in Table 5. Base loads comprise over 85 percent of total annual usage.

[7] End-uses are described in Appendix A. Internal and external end-uses refer to uses that contribute to internal heat gains and those that do not, respectively, and are sector dependent as explained in Appendix A.

Table 5. DEI Total Annual Electric Use by End-Use

End-Use	Millions kWh	Percent
Heating	1,492	5%
Cooling	2,136	8%
Water Heating	1,706	6%
Lighting	5,869	21%
External	9,134	33%
Internal	7,312	26%
Total	**27,649**	**100%**

Source: Analysis of monthly usage

Energy and demand are both important considerations when planning DSM programs. A map of MW demand in all sectors by month and time of day is shown in Figure 4.

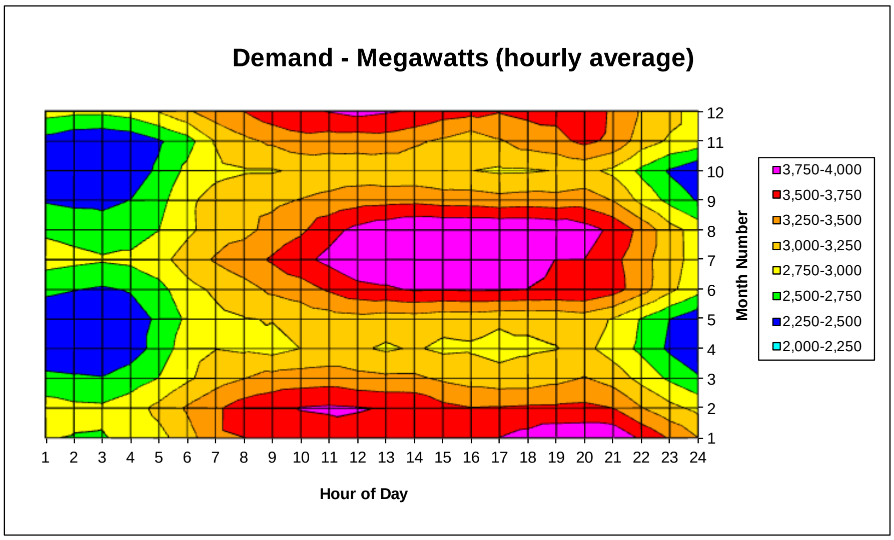

Figure 4. DEI Average Hourly Demand Map

Demand was modeled using several sources of information, including hourly load data provided for 2012. A detailed discussion of the methodology is presented in Appendix A. Demand is at its highest in July between 11 AM and 8 PM with high loads throughout the afternoon and early evening of the summer months. Energy efficiency technologies and programs with impact loads during these periods will save peak and energy. Demand is also high during the late morning hours of 10 AM to 12 PM and, again, between 5 PM to 10 PM in January, driven by residential and commercial space heating.

Residential

The market assessment presented in this section begins with a high-level view of residential housing in the DEI service area, followed by a detailed analysis of residential electric loads. We used the following sources of information for the analysis presented in this section:

1. CIS Extract obtained from Duke Energy Indiana, including monthly billing data.
2. The Duke Residential Appliance Saturation Survey (RASS), completed in 2010.
3. Hourly load data for DEI rate classes.
4. US Census housing construction permit data by county

Duke serves 709 thousand residential customers in Indiana. A simple segmentation strategy based on type of structure and vintage of construction was used to describe and model residential energy usage. The housing type (single family and multifamily) and vintage of construction (existing and new), based on meter set date, were available from the Duke Energy customer information system (CIS). This segmentation approach captures the major differences in residential housing stocks that impact energy usage and DSM opportunities. The segments were also selected to better describe cost-effective DSM opportunities which can vary significantly by type of housing and vintage of construction. Customer counts in each of the residential segments are shown in the table below.

Table 6. Residential Customers by Segment

	Single Family	Multifamily	Total
Existing Construction	582,377	115,903	698,280
New Construction	7,722	2,976	10,698
Total	**590,099**	**118,879**	**708,978**
Percent	83%	17%	100%

Source: Duke Energy CIS Data

Single family housing accounts for 83 percent of all residential customers. Multifamily housing units including duplexes, condominiums and apartment buildings, make up 17 percent of residential customers. These residential segments exhibit many differences that impact electric consumption and energy efficiency potential. These differences include size of unit, appliance penetration, building shell integrity and lifestyle attributes.

There are typically many important differences between older and newer homes that have large impacts on energy use and energy efficiency potential. Differences in the thermal integrity of the building shell and appliance penetration rates, for example, can lead to large differences in annual usage between older and newer homes. Existing construction is defined as all homes with meters installed prior to 2011. Current building practices are reflected in the new construction segment, defined as all customers connected in 2011 and 2012. It is important to have a group of homes that represent current construction practices to model and contrast the differences between existing and new housing stock.

New Construction Levels

Residential construction estimated from housing permit data for the DEI service area is shown in Figure 5. Data shown in Figure 5 are based on monthly permit data lagged to approximate the timing of construction and better align temporally with actual electric service installations. DEI has several counties for which it serves a small fraction of the total population (eg, Marion and Vanderburgh counties). Counties were only included in the construction permit analysis if the ratio of residential customers per total households was above 50 percent. Single family and multifamily residential construction in the DEI service area fell sharply from over 12,000 dwellings annually to around 4,000 following the crash of the U.S. housing market. In recent years the mix of new construction by housing type has averaged 74 percent single family and 26 percent multifamily. The mix of construction can vary significantly from year to year.

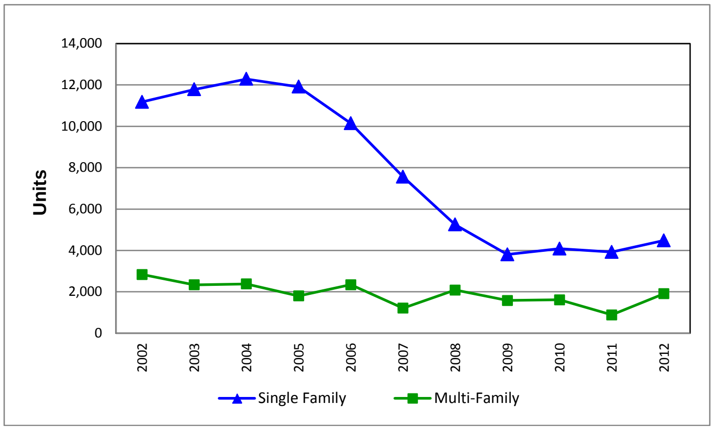

Figure 5. Residential Housing Units Permitted for Construction, DEI Service Area

Appliance Saturation Rates

Our analysis of customer usage took advantage of the Residential Appliance Saturation Survey (RASS) conducted by Duke in late 2010. Appliance saturation rates are important inputs to the segment usage models discussed later in this section. Sample sizes and results for major end-uses and appliances are shown in Table 7. Survey results are reported for categories with at least 30 respondents.

Table 7. Appliance and End-Use Installation Rates from Residential Survey

	Single Family		**Multifamily**	
	Existing	**Newer**	**Existing**	**Newer**
	n=447	**n=34**	**n=58**	**n=11**
Main Heat Fuel - Electric:	27%	35%	52%	NA
Standalone Forced Air Furnace	7%	18%	29%	NA
Heat Pump with Forced Air Furnace	10%	12%	7%	NA
Standalone Heat Pump	3%	0%	2%	NA
Other	7%	6%	14%	NA
Main Heat Fuel - Gas/Other:	73%	65%	48%	NA
Standalone Forced Air Furnace	60%	56%	41%	NA
Heat Pump with Forced Air Furnace	7%	6%	2%	NA
Standalone Heat Pump	0%	0%	0%	NA
Other	6%	3%	5%	NA
Used for Cooling:				
Central Air Conditioner	72%	82%	70%	NA
Heat Pump	15%	12%	9%	NA
Window Unit	9%	3%	18%	NA
None	5%	3%	4%	NA
Electric Water Heat	48%	50%	57%	NA
Electric Oven	88%	94%	84%	NA
Electric Range	86%	87%	87%	NA
Electric Clothes Dryer	95%	90%	71%	NA
Dishwasher	71%	91%	57%	NA
Clothes Washer	99%	97%	70%	NA

Source: Residential Appliance Saturation Survey (2010)

In order to provide a sufficiently large number of respondents in all categories, homes built in 2003 and after were classified as newer construction for the purpose of summarizing RASS results. Still, this designation did not provide for a sufficient number of completed surveys for the Newer Multifamily category.

Electricity Usage Analysis

Monthly billing data at the premise level was aggregated by the four residential customer segments used in this report. An end-use energy and demand model was then estimated using the aggregated billing data, residential survey results, detailed hourly load profiles and weather data. Model assumptions were refined to provide the best empirical fit to the actual customer billing data. Table 8 below shows annual usage for each residential segment.

Table 8. Annual Usage by Residential Segment

Segment	Premises	Average Annual kWh per Premise	Total Usage (millions of kWh)
Existing			
Single Family	582,377	13,456	7,837
Multi Family	115,903	9,267	1,074
New Construction			
Single Family	7,722	13,002	100
Multi Family	2,976	8,330	25
Total Residential	**708,978**	**12,745**	**9,036**

Source: Energy model results using monthly billing data from Duke Energy CIS

Because of the large number of homes, the existing stock of single family homes is by far the largest segment, accounting for over 85 percent of the residential sector's energy usage.

Monthly residential loads by major end-use are shown in Figure 6 and Table 9.

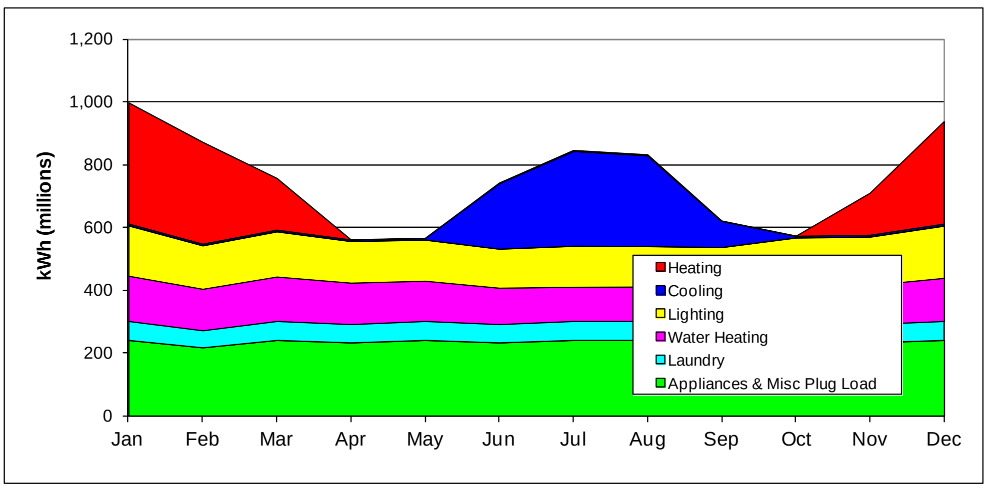

Figure 6. Monthly Residential Loads by End-Use

Table 9. Residential Sector Monthly Usage by End-Use

	Appliances & Misc Plug Load	Laundry	Water Heating	Lighting	Cooling	Heating	Total
	millions kWh						
Jan	242	61	144	161	6	386	1,000
Feb	219	55	131	139	6	325	875
Mar	242	61	141	144	6	165	759
Apr	234	59	132	133	5	0	563
May	242	61	128	131	5	0	568
Jun	234	59	115	125	209	0	743
Jul	242	61	109	131	303	0	846
Aug	242	61	109	129	290	0	832
Sep	234	59	112	133	84	0	622
Oct	242	61	122	144	6	0	575
Nov	234	59	124	155	6	134	712
Dec	242	61	137	167	7	327	941
Annual	**2,851**	**719**	**1,504**	**1,692**	**933**	**1,337**	**9,036**
Percent	32%	8%	17%	19%	10%	15%	100%

Appliances and miscellaneous plug load is the largest single end-use, accounting for nearly a third of all annual residential usage. Taken together with the other base load end-uses (water heating, laundry and lighting), base loads account for 75 percent of all residential usage. Space cooling and heating account for about 25 percent of annual energy usage but contribute significantly to the seasonal peak. Cooling, for example, is responsible for over 35 percent of all July residential kWh consumption. Charts showing the monthly usage by end-use for each of the residential segments are provided in Appendix F.

Non-Residential

The non-residential market is far less homogenous than residential. There are a greater number of basic customer types (segments) and the variation in size of customer is much larger in commercial. Non-residential customer data were segmented using site-specific SIC codes available from DEI. Number of premises and annual usage is shown by segment in Table 10. The number of premises was found to include many non-building types of electrical services (e.g. billboards and railroad controls). To better approximate the number of actual buildings and usage in each segment, a separate segment was defined for premises with less than 3,000 kWh of annual usage.[8]

Table 10. Number of Premises and Annual Usage by Non-Residential Segment

Segment	CIS Premises	Average Annual kWh per Premise	Total Usage (millions of kWh)	Percent of C&I Loads
Grocery	1,210	364,038	440	2.4%
Hospitals	284	1,464,477	416	2.2%
Lodging	726	238,580	173	0.9%
Office	42,687	64,703	2,762	14.8%
Other	6,731	31,925	215	1.2%
Other Health	3,102	138,206	429	2.3%
Restaurants	3,955	151,033	597	3.2%
Retail	8,607	128,504	1,106	5.9%
Schools	1,820	793,550	1,444	7.8%
Wholesale & Warehouse	3,958	220,210	872	4.7%
Ag, Mining, Util., & Const.	3,745	151,997	569	3.1%
Small Loads	29,586	1,089	32	0.2%
Total Commercial	**106,411**	**85,102**	**9,056**	**48.7%**
Total Manufacturing	**4,547**	**2,102,015**	**9,558**	**51.3%**
Total Non-Residential	**110,958**	**167,754**	**18,614**	**100.0%**

Source: Energy model results using monthly billing data from CIS.

[8] Although arbitrary, this level of usage was thought to effectively screen non-building premises, such as billboards and switching equipment. These small commercial load "premises" are grouped in a separate segment.

Commercial Load Analysis

Commercial energy usage by end-use is shown in Figure 7. Commercial load is characterized by a large percentage of base load with a prominent summer cooling peak.

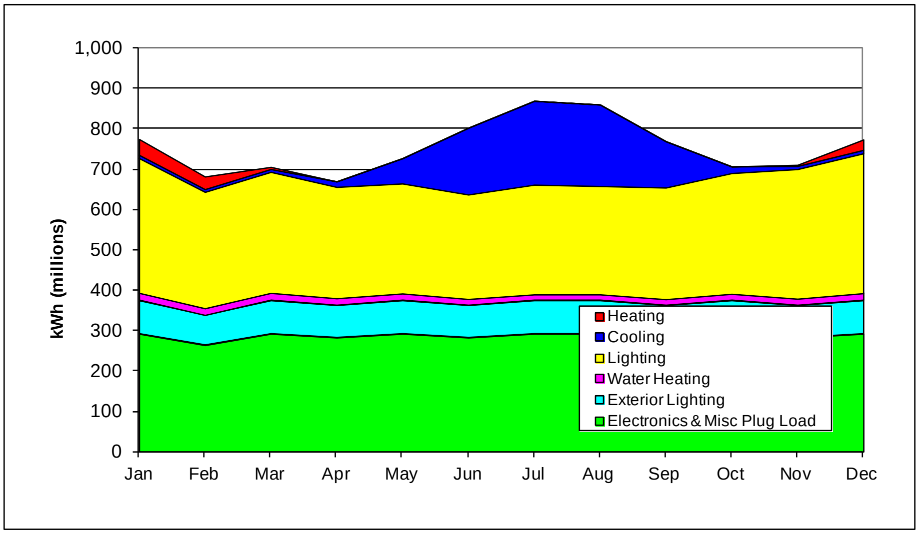

Figure 7. Monthly Commercial Usage by End-Use

Monthly load charts by end-use for each commercial segment are shown in Appendix F.

Table 11. Commercial Sector Monthly Usage by End-Use

	Electronics & Misc Plug Load	Exterior Lighting	Water Heating	Lighting	Cooling	Heating	Total
	millions kWh						
Jan	293	84	18	333	8	39	775
Feb	265	75	16	288	7	31	683
Mar	293	84	18	299	8	5	706
Apr	284	81	17	275	14	0	671
May	293	84	16	272	63	0	728
Jun	284	81	15	259	165	0	803
Jul	293	84	14	271	207	0	869
Aug	293	84	14	268	201	0	860
Sep	284	81	14	276	114	0	769
Oct	293	84	15	299	17	0	707
Nov	284	81	15	321	8	3	711
Dec	293	84	17	346	9	26	774
Annual	**3,453**	**983**	**189**	**3,507**	**820**	**104**	**9,056**
Percent	38%	11%	2%	39%	9%	1%	100%

Electronics and miscellaneous plug load and lighting make up three-fourths of annual kWh usage in the commercial sector. While cooling load accounts for a large share of summer usage, it only makes up 9 percent of annual kWh usage.

Manufacturing Load Analysis

Energy sales to manufacturing customers came to 9.6 billion kWh (unadjusted) in 2012, representing over one-third of total retail sales. As shown in Table 12, manufacturing customers cover a wide range of industries.

Table 12. Manufacturing Customers and Unadjusted 2012 Loads

SIC - Industry Name	Customers	Use Per Customer (MWh)	Total Usage (MWh)	Percent of Total
20 - Food and Kindred Products	319	2,862	912,848	9.5%
22 - Textile Mill Products	20	154	3,079	0.0%
23 - Apparel and Other Textile Products	46	288	13,270	0.1%
24 - Lumber and Wood Products	311	159	49,515	0.5%
25 - Furniture and Fixtures	94	907	85,237	0.9%
26 - Paper and Allied Products	50	10,613	530,653	5.5%
27 - Printing and Publishing	311	249	77,381	0.8%
28 - Chemicals and Allied Products	130	6,601	858,082	9.0%
29 - Petroleum and Coal Products	44	333	14,644	0.2%
30 - Rubber and Miscellaneous Plastics Products	155	4,189	649,273	6.8%
31 - Leather and Leather Products	11	111	1,219	0.0%
32 - Stone, Clay, Glass, and Concrete Products	227	3,887	882,360	9.2%
33 - Primary Metal Industries	127	18,591	2,361,066	24.6%
34 - Fabricated Metal Products	367	1,904	698,923	7.3%
35 - Industrial Machinery and Equipment	778	838	651,628	6.8%
36 - Electrical and Electronic Equipment	1,033	444	458,316	4.8%
37 - Transportation Equipment	199	5,783	1,150,901	12.0%
38 - Instruments and Related Products	106	1,077	114,197	1.2%
39 - Miscellaneous Manufacturing Industries	219	322	70,516	0.7%
Total Manufacturing	**4,547**	**2,108**	**9,583,107**	**100.0%**

Primary Metals, Transportation Equipment, and Food and Kindred Products are the largest industries in terms of energy sales in the DEI service area. Together these industries account for close to half of annual sales to manufacturing.

Total manufacturing loads are shown by month in Figure 8. Manufacturing loads are characterized by large process-related consumption that is not highly correlated with weather. Still, there is a noticeable summer cooling load that adds to the coincident summer peak.

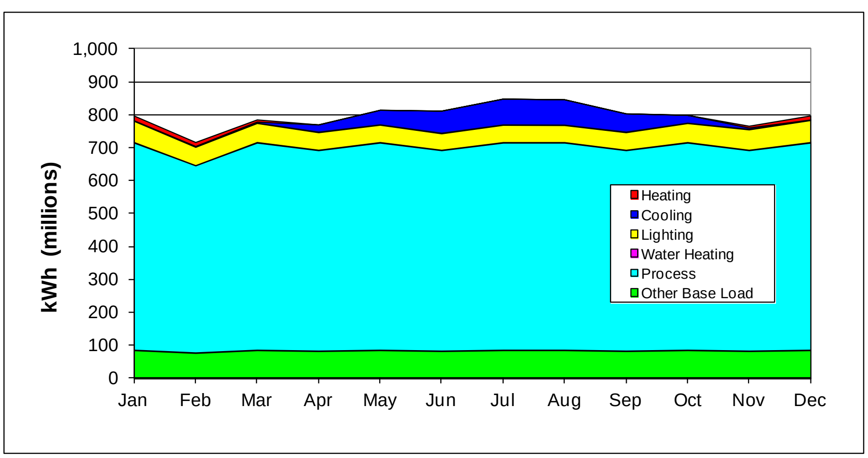

Figure 8. Monthly Manufacturing Usage by End-Use

Additional load shapes by end-use are provided in Appendix F for the following manufacturing segments: Primary Metals, Chemicals, Transportation Equipment, Food Products and Other Manufacturing.

Table 13. Manufacturing Sector Monthly Usage by End-Use

	Other Base Load	**Process**	**Water Heating**	**Lighting**	**Cooling**	**Heating**	**Total**
	millions kWh						
Jan	86	631	1.2	64	1	14	797
Feb	77	570	1.1	55	1	12	717
Mar	86	631	1.2	57	4	7	785
Apr	83	611	1.1	53	22	0	770
May	86	631	1.1	52	45	0	815
Jun	83	611	1.0	49	68	0	812
Jul	86	631	1.0	52	79	0	849
Aug	86	631	1.0	51	78	0	847
Sep	83	611	1.0	53	56	0	804
Oct	86	631	1.0	57	24	0	799
Nov	83	611	1.0	61	5	5	766
Dec	86	631	1.1	66	1	12	797
Annual	**1,008**	**7,432**	**12.8**	**670**	**384**	**51**	**9,558**
Percent	11%	78%	0%	7%	4%	1%	100%

Other base load and process end-uses account for nearly 90 percent of annual manufacturing usage and are nearly constant across months.

ENERGY EFFICIENCY MEASURES AND POTENTIAL SAVINGS

In this section we present our estimates of the energy savings potential in the DEI service area. This work builds off of the energy modeling results presented in the previous section by applying energy efficiency technologies to the model parameters discussed in Appendix A. These technologies, referred to as Energy Efficiency Measures (EEMs), cause a reduction in the load profiles of the end-uses presented in the prior section. In this section we derive estimates of technical and economic potential.

Technical Potential

Technical potential refers to the amount of energy efficiency that could be obtained if all EEMs were adopted without regard to costs. This level of savings represents the upper limit of energy efficiency opportunity. Our estimate of technical potential assumes that all customers in each sector use the most efficient available electric technology for each end-use. The base to which the technical potential is referenced is electric energy use in the base year, 2012, normalized to long-term average temperatures. This base is fundamental to any estimate of technical potential. In principle the base represents the current practice including all codes and standards currently in place. However, in this technical potential estimate, the standards in place include a phase out of most incandescent light bulbs in the 2011 to 2016 time period. When it is complete, sometime after 2016, this phase out of incandescent lighting is expected to lead to reasonably significant energy reductions of the order of 2 to 4 percent for the residential sector and 3 to 5 percent for the commercial sector.

The base year, 2012, does not include the full physical effects of this mandated more efficient lighting because the switch to the more efficient lighting has just begun and is nowhere near complete. Therefore, the technical potential as referenced to the 2012 base will slightly overstate the future savings due to lighting improvements since the 2012 base year uses more energy for lighting than it is expected to in the near future, based on current standards. Therefore, the lighting savings component of the technical potential reported here has been de-rated by 20 percent to represent the savings potential relative to the more efficient lighting situation that will prevail in the near future when the full effects of the new lighting standards are realized. This is not a large change in the full scheme of things, but it is necessary in order to align the technical potential model to the utility forecast which includes the effects of the current lighting standards.

This lighting efficiency change is the only efficiency change that is being specially treated in this technical potential estimate. It is probable that there will be other future energy efficiency codes and standards, but these future efficiency improvements are currently not specifically known. If future standards come into effect, they will be considered as contributing fully to the technical potential. Likewise, there will probably be other spontaneous efficiency improvements in various commercial and industrial sectors, but these improvements are speculative at the current time. So in the interest of managing the impact of variable efficiency levels, the end-use energy efficiency in all of the analysis sectors is assumed to remain constant; this is commonly referred to as a "frozen efficiency" analysis.

This technical potential estimate does not include changes in energy use in response to changes in energy costs (i.e. price elasticity effects). The focus of this analysis is on the savings due to physical measures that reduce energy use without diminishing comfort factors. We recognize that there can be significant energy use changes due to energy price changes, but these price elasticity related changes are not considered as being part of the technical potential. In other words, the estimate of technical potential is not adjusted for the impact of future changes in the real price of electricity.

We have restricted our analysis to technologies meeting existing electric end-uses more efficiently. The technical potential derived in this analysis does not consider fuel switching technologies, but there are significant interactions between electric efficiencies and gas usage. In particular, envelope or equipment efficiencies intended to reduce cooling energy will also often reduce the use of gas for space heating. Interior lighting efficiencies and appliance efficiencies can actually increase the use of gas for space heating.

The technical potential is derived by applying all the efficiency measures at once in the energy model so that interactions between measures are properly accounted for. For estimating the total technical potential, all the measures are applied as a package. In developing technical potential, we apply several EEMs at the same time. For example, the replacement of an electric furnace and low efficiency cooling by a high efficiency heat pump, leak tested ducts, improved lighting, and hot water flow reduction. The result of applying all these EEMs is illustrated in Figure 9. This figure is used to illustrate the derivation of technical potential and shows the energy use patterns for customers with electric furnaces that upgrade to a heat pump.

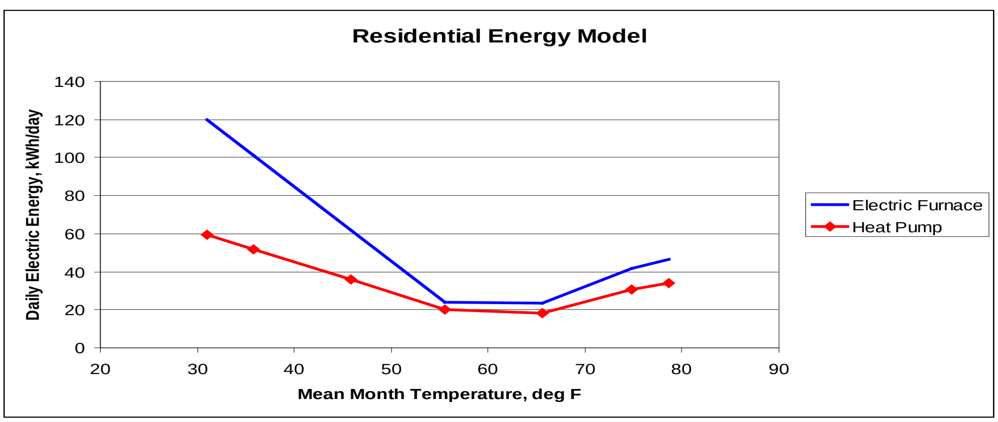

Figure 9. Residential Technical Potential Models

Figure 9 shows model results for two space heating options for an average building in the residential sector. In an energy use model of this sort, the lines specify the average daily electric usage given a particular average monthly outdoor temperature. The model can then be changed to represent physical changes to the building. Typically these models will be used to estimate the normal annual energy use by evaluating the model at each of the average monthly temperatures in a normal year.

In this illustration, the blue line is the current building energy performance model of a residential customer with an electric furnace and inefficient cooling. It shows a minimum electric energy use of about 23 kWh per day when the mean month temperature is in the 55-65°F range. In this temperature range, the building is neither heating nor cooling so this minimum is taken as the base load usage including lights, electronics, refrigeration, and all other electricity uses. As it gets colder, the electric usage for heating increases to about 120 kWh per day when it is on average 30°F outside. As the monthly temperature increases in the summer, the energy usage for cooling increases until it is about 50 kWh per day when the average monthly temperature is 80°F.

The red line shows what happens as the electric furnace is replaced by a heat pump and more efficient showerheads, lighting, and appliances are used. This more efficient building shows a lower base load energy use due to the efficient showerheads and more efficient lights and appliances. In addition, it shows significantly lower temperature sensitivity due to a more efficient space heating and cooling. In this example, the initial electric energy use of 20,600 kWh per year is reduced to 12,500 kWh per year. As is evident in Figure 9, most of the savings are associated with the improved heating efficiency.

There is a well-developed community of interest and capability directed at residential space heat and water heating efficiency. In most retrofit programs, heating efficiency is approached in the same treatment from its three logical avenues: better thermal conversion and distribution efficiency, lower thermal and infiltration losses, and better controls. The water heating savings potential is made up of savings from lower flow fixtures, lower tank standby losses, and improved water heating efficiency from hot water heat pumps and solar water heat. One of the largest components of residential potential is the use of a higher thermal conversion efficiency afforded by efficient heat pumps and air conditioners coupled to a leak tested duct system. The next largest component is lighting savings followed closely by the improved thermal shell of the structure and water heating savings.

Non-residential buildings have more complex controls than typical residential applications. Usually, there will be a boiler. Often there will be a designated energy manager. This type of situation has been the focus of energy management contractors because there are large enough energy flows to create significant dollar savings. The largest elements of savings for this group are associated with improved lighting efficiency and improved controls and motors for manufacturing customers. The thermal integrity of the shell in this group is subject to improvement especially with respect to infiltration.

Figure 10 shows the effect of applying maximum reasonable improvements to every residential and non-residential building. This reasonably aggressive application of efficiency technology leads to the technical potential shown in Table 14 below on page 26. The technical potential line shows base case energy usage after applying energy efficiency measures. When solar is included, residential technical potential includes application of solar technologies with solar water heat on fifteen percent of the buildings and a 3 kW solar electric array on one-quarter of the buildings. Non-residential technical potential includes installation of 50 kW solar electric arrays on eleven percent of buildings.

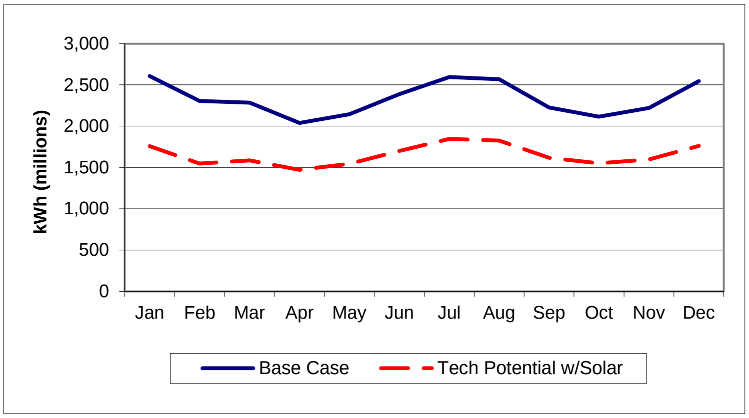

Figure 10. Technical Potential with Solar by Month (2014)

It should be noted that solar electric technology is technically fully mature. This technology has been thoroughly tested and is currently "plug and play", however the cost has not yet matured into the current cost-effectiveness range. In principle, it could be maximally applied without regard for cost to create a technical potential savings perhaps as high as 50 to 75 percent. While this argument is technically accurate, we have resisted carrying the argument this far and restricted the application of solar electric to applications on buildings where the use of existing roof surfaces and electrical distribution can reduce costs. This analysis does not include the use of large standalone megawatt scale solar fields. Nevertheless, the solar potential noted here reflects an aggressive solar deployment with a 3 kW solar array applied to 27 percent of residential sites and a 50 kW array applied to 20 percent of commercial roofs. This is a deployment applied to about half the unshaded residential roof surface.

For an electric utility the second aspect of the technical potential pertains to changes in demand proceeding from the efficiency measures. In general, changes in demand will vary from hour-to-hour and month-to-month. We have estimated an hourly demand curve for the average day of each month for the base case and for the technical potential case. Figure 11 shows the hourly demand curves for July and Figure 12 shows January to illustrate cooling and heating demand, respectively.

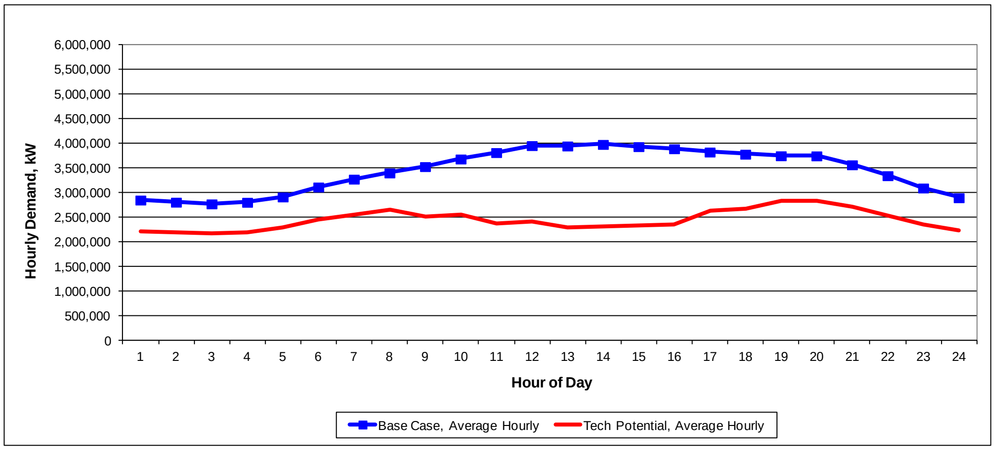

Figure 11. Technical Potential with Solar for Demand Reduction – July

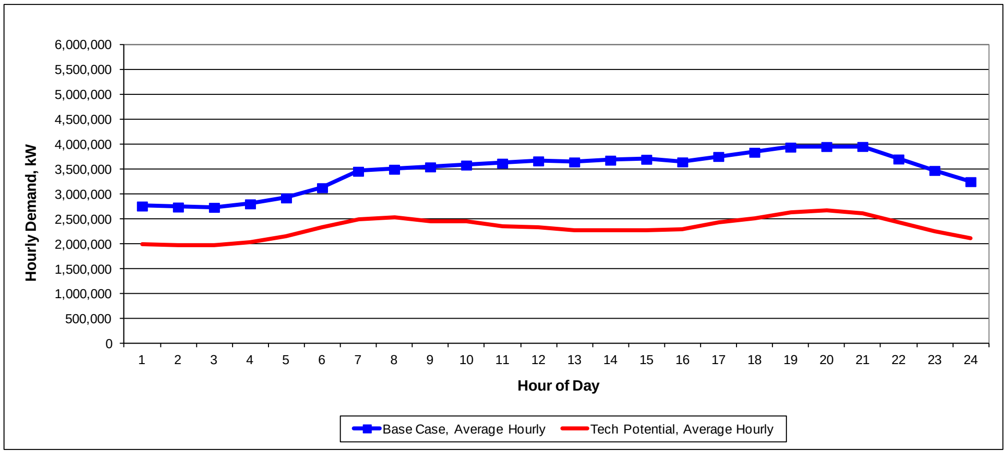

Figure 12. Technical Potential with Solar for Demand Reduction – January

A summary of the technical potential is presented in Table 14 which reports the total technical potential in terms of load at the meter after transmission and distribution losses. The technical potential estimates for demand savings are expressed for cases including and excluding the extensive solar photovoltaic (PV) which is technically achievable. The technical potential excluding PV still includes energy savings associated with solar hot water and solar passive space heating (solar siting). Our analysis of technical potential shows that it is technically possible to cut usage and demand significantly. However, these estimates are not realistic estimates of actual reductions because they are unconstrained by market, behavioral and budget considerations.

Table 14. Summary of Technical Potential Over 5, 10 and 20 Year Planning Horizons

	2014	2018	2023	2033
Base Case Energy Usage (millions kWh)	28,033	29,901	31,661	35,651
Technical Potential - Including Solar PV (millions kWh)	8,236	8,837	9,416	10,737
Percent	29%	30%	30%	30%
Technical Potential - Excluding Solar PV (millions kWh)	6,805	7,297	7,771	8,843
Percent	24%	24%	25%	25%
Base Case Summer System Peak Load (MW)	5,554	5,981	6,392	7,353
Technical Potential - Including Solar PV (MW)	2,146	2,317	2,485	2,873
Percent	39%	39%	39%	39%
Technical Potential - Excluding Solar PV (MW)	1,490	1,609	1,726	1,994
Percent	27%	27%	27%	27%
Base Case Winter System Peak Load (MW)	4,145	4,463	4,768	5,492
Technical Potential - Including Solar PV (MW)	1,472	1,589	1,704	1,971
Percent	36%	36%	36%	36%
Technical Potential - Excluding Solar PV (MW)	1,250	1,352	1,451	1,681
Percent	30%	30%	30%	31%

It is important to understand the variation of technical potential with time. In Figure 13 base case energy usage is broken down between core usage (usage that remains after removing technical potential), and potential energy savings from energy efficient retrofits, energy efficient new construction, and solar. In this figure the retrofit potential (red wedge) remains constant over time. The new construction potential (green wedge) increases in proportion to the amount of new construction. The solar potential increases slightly with time as more treeless building sites are used. As later analysis will show, the solar potential is beyond the immediate cost-effectiveness limit. But this category of potential is technically sound, very large, and homogenous. It may reasonably become cost effective within the 20-year planning window, and it is important to understand the role and size of this resource in the larger picture.

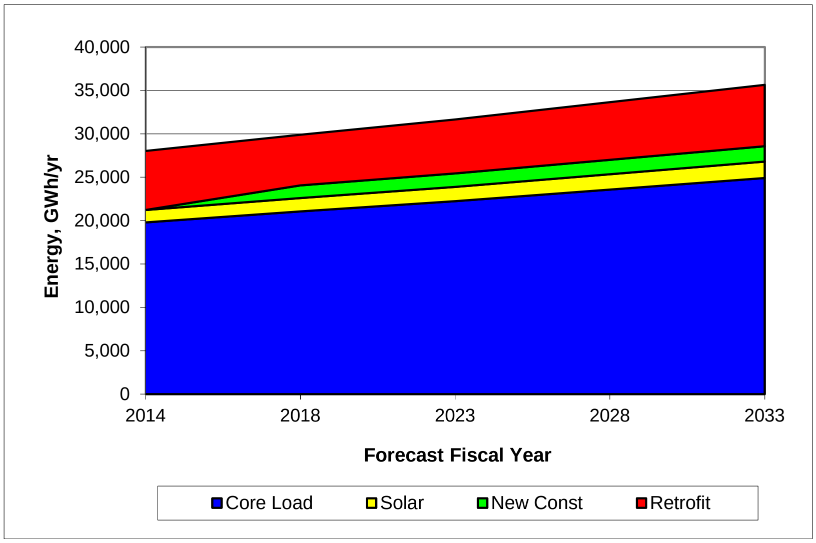

Figure 13. Technical Potential over Planning Horizon

Energy Efficiency Measure Assessment

In order to evaluate technologies for their potential in electric DSM programs it is necessary to compile detailed information at the EEM level of detail. An EEM is a device or action that causes a drop in energy usage. The objective of EEM assessment or screening is to determine the likely set of cost-effective measures which can then be used to populate DSM programs that deliver savings through standalone or bundled EEMs. An important by-product of this screening is the information necessary to construct a DSM supply curve for determining economic potential. Measure savings and the associated energy efficiency supply curves are "gross" savings meaning they have not been adjusted for free riders.

Our list of EEMs and assumptions is usually developed through an integrated approach that combines an extensive review of industry literature, the detailed analysis of DEI loads described earlier, and our own expert opinion. In this case, the State of Indiana has commissioned the development of a Technical Resource Manual (TRM) in order to assure an even-handed compliance tally with respect to State-mandated energy savings targets. In order to assure consistency with these specified and vetted EEM descriptions, all EEMs contained in the Indiana TRM of January 2013 have been substituted for the equivalent EEMs in our original EEM list. This substitution is intended to align the economic potential derived in this analysis with the EEM costs and savings as specified in the Indiana TRM. And it is also intended to align the EEM costs and savings in the program planning with the Indiana TRM that will ultimately be used to assess program performance. The resulting assumptions required to calculate EEM cost effectiveness are shown in Table 15 for residential and Table 16 for non-residential.[9] Each of these tables uses a standard layout to present the assumptions used to calculate real levelized cost (RLC) per kWh. A discussion of the cost-effectiveness approach used to evaluate EEMs follows these two tables.

Descriptions of the columns in Table 15 and Table 16 are presented below.

End-Uses	Unique EEM reference number.
EEM Description	Brief description of the EEM. See the appendixes for a more detailed description.
EEM Reference	Code to uniquely identify an EEM in this project.
Application	For residential measures only, describes the segment of residential sector where the EEM assumptions are applicable. For example, the same EEM may have different assumptions for single family and multifamily applications.
Annual kWh Savings	Annual kWh savings (gross) per customer site.
Incremental Cost	The incremental cost of installing the EEM at the typical customer site, including any incremental equipment and labor expenses. Note: "incremental" refers to the costs over and above what would have been expended for a standard efficiency measure. Costs are in 2012 dollars.
Annual O&M	Annual operation and maintenance (O&M) expenses over and above the O&M expenses incurred for standard efficiency measures. Most EEMs have zero incremental O&M expenses.
Measure Life	The average expected life of the measure.
Real Levelized Cost	The incremental cost and annual O&M expressed as a constant annual payment over the life of the measure and then divided by the annual savings. Real levelized cost provides a way of comparing EEMs with different attributes such as measure life on the same scale. No overhead or program cost is included at this point in the analysis.

[9] A cross reference table showing the corresponding TRM measure name and number is located in Appendix C for residential and Appendix D for non-residential.

Table 15. DSM Technology Assessment, Residential

End-Uses	EEM Description	EEM Reference	Application	Annual kWh Savings	Incremental Cost (dollars)	Annual O&M (dollars)	Measure Life (years)	Real Levelized Cost ($/kWh)
Customer-Sited Generation	Combined Heat Power, Micro CHP	R-1	All	5,000	10,000	25	15	0.1977
Residential Space Conditioning	Elec Furnace to SEER 15 H Pump SF	R-2	Elec SF	10,669	4,572	100	18	0.0460
	Resist to SEER 15 Heat Pump SF	R-3	Elec SF	9,542	9,322	100	18	0.0941
	Elec Furnace to SEER 15 H Pump MF	R-4	Elec MF	7,113	3,048	100	18	0.0507
	Resist to SEER 15 Heat Pump MF	R-5	Elec MF	6,361	6,215	100	18	0.0993
	Refrig Charge/Duct Tune-Up Electric	R-6	Elec	1,021	400	0	12	0.0442
	Refrig Charge/Duct Tune-Up Gas	R-7	Gas	192	400	0	12	0.2353
	SEER 13 to SEER 15 Heat Pump SF	R-8	SF Elec New	900	822	0	18	0.0781
	SEER 13 to SEER 15 Heat Pump MF	R-9	MF Elec New	600	548	0	18	0.0781
	SEER 13 to SEER 15 CAC New	R-10	SF Gas New	180	714	0	18	0.3397
	SEER 9 to SEER 15 CAC Replace	R-11	MF Gas New	779	714	0	18	0.0784
	Efficient Window AC	R-12	All	45	80	0	9	0.2503
	Cool Roofs	R-13	Elec	500	340	0	10	0.0881
	EE Windows	R-14	Elec	1,372	150	0	25	0.0078
	Programmable Thermostats	R-15	Elec	639	35	0	15	0.0053
	Ceiling Insulation (R6-R30) Electric	R-16	Elec	1,650	1,200	0	25	0.0516
	Ceiling Insulation (R6-R30) Gas	R-17	Gas	330	1,200	0	25	0.2580
	House Sealing using Blower Door Electric	R-18	Elec	1,052	400	0	15	0.0366
	House Sealing using Blower Door Gas	R-19	Gas	175	400	0	15	0.2202
	Ground Source Heat Pump	R-20	Elec	3,569	15,000	100	18	0.3875
	Wall Insulation (R3-R11) Electric	R-21	Elec	1,200	1,500	0	25	0.0887
	Wall Insulation (R3-R11) Gas	R-22	Gas	240	1,500	0	25	0.4435
	Solar Siting/Passive Design	R-23	New Elec	1,500	500	0	25	0.0237
	Energy Star Manufactured Home	R-24	New	3,792	1,963	0	18	0.0443
	Energy Star Construction	R-25	New Elec	3,979	2,617	0	18	0.0563
	Major Remodel	R-26	Elec	3,979	2,617	0	18	0.0563
	Window Film	R-27	Elec	300	125	0	5	0.0962
	Dehumidifier	R-28	All	297	45	0	12	0.0171
Load Management	Eliminate Old Refrigerators	R-29	All	1,008	180	0	8	0.0276
	Set Back HVAC with Ceiling Fan	R-30	All	250	86	0	5	0.0795
Residential Appliances	Energy Star Clothes Washers	R-31	All	202	258	0	11	0.1538
	Energy Star Dish Washers	R-32	All	125	211	0	11	0.2032
	Energy Star Refrigerators	R-33	All	150	140	0	17	0.0828
	Pool Pumps	R-34	All	436	175	0	10	0.0520
	Efficient TV	R-35	All	70	40	0	10	0.0740
Residential Lighting	Efficient Residential Lighting Makeover	R-36	All	686	75	0	7	0.0189
	Occupancy Controlled Outdoor	R-37	All	250	107	0	10	0.0554
	LED Residential Outdoor Yard Light	R-38	All	1,000	500	0	15	0.0482
	Single CFL	R-39	All	37	-1	0	5	-0.0063
	Single LED	R-40	All	61	22	0	15	0.0341
Water Heating	Tank Wrap, Pipe Wrap and Water Temp Setpoint	R-41	All	200	50	0	15	0.0241
	Low Flow Fixtures	R-42	All	596	25	0	5	0.0097
	Heat Pump Water Heaters	R-43	All	2,097	700	0	10	0.0432
	Solar Water Heaters	R-44	All	2,180	9,506	21	20	0.3598
	Efficient Plumbing	R-45	New Elec	500	500	0	25	0.0710
Miscellaneous Technologies	Ductless Heat Pump	R-46	Elec	3,224	3,000	100	18	0.1106
	Drain HX	R-47	Elec	800	800	0	20	0.0802
	Smart Plug	R-48	All	23	26	0	4	0.3244
	Heat Pump Pool Heater	R-49	All	8,000	4,000	10	15	0.0494
	Customer Report	R-50	All	193	8	8	1	0.0850
	Solar PV	R-51	All	3,000	10,000	0	25	0.2365
	In-Home Display	R-52	All	394	200	0	8	0.0785

Note: Dollar amounts are expressed in 2012 dollars.

Table 16. DSM Technology Assessment, Non-Residential

End-Uses	EEM Description	EEM Reference	Annual kWh Savings	Incremental Cost (dollars)	Annual O&M (dollars)	Measure Life (years)	Real Levelized Cost ($/kWh)
Customer-Sited Generation	Combined Heat and Power, CHP	C-1	2,000,000	300,000	75,000	25	0.0481
	Solar Electric	C-2	55,000	220,000	0	25	0.2838
C&I Space Conditioning	Small HVAC Optimization and Repair	C-3	4,719	1,200	50	5	0.0693
	Commissioning New	C-4	35,391	6,300	0	5	0.0411
	Re/Retro-Commissioning Lite	C-5	23,594	1,500	0	5	0.0147
	Low-e Windows 1500 ft2 New	C-6	9,438	7,865	0	15	0.0803
	Low-e Windows 1500 ft2 Replace	C-7	4,719	86,227	0	20	1.4663
	Premium New HVAC Equipment	C-8	13,126	6,084	250	15	0.0637
	Chiller Tune-Up	C-9	11,797	327	0	5	0.0064
	Window Film	C-10	2,359	2,039	0	10	0.1119
	Room Air Conditioner	C-11	2,359	8,728	0	12	0.4173
	Split System AC	C-12	4,719	3,834	0	15	0.0783
	Heat Pump System	C-13	11,797	6,816	0	15	0.0557
	Outside Air Economizer	C-14	2,359	574	0	10	0.0315
	Demand Controlled Ventilation	C-15	2,359	293	0	15	0.0120
	Chilled Water Reset	C-16	2,359	817	0	10	0.0448
	VFD HVAC	C-17	12,500	1,330	0	15	0.0103
	Cool Roof	C-18	2,359	1,824	0	15	0.0745
	Roof Insulation	C-19	4,719	91,679	0	20	1.5590
Design (new)	Integrated Building Design	C-20	65,632	22,236	0	25	0.0240
Motors & Drives	Electronically Commutated Motors	C-21	10,501	3,507	0	15	0.0322
	Premium Motors	C-22	3,745	412	0	15	0.0106
	Variable Speed Drives, Controls and Motor Applications Integrated	C-23	52,506	45,222	0	15	0.0830
	Single Application VSD	C-24	11,797	1,255	0	15	0.0103
Power Distribution	Energy Star Transformers	C-25	15,000	4,500	0	25	0.0213
	Efficient AC/DC Power	C-26	15,000	30,000	0	25	0.1419
Lighting	LED/Efficient Outdoor Lighting	C-27	13,126	6,084	-50	15	0.0408
	New Efficient Non-Controls Lighting Equipment	C-28	11,089	2,805	0	15	0.0244
	Retrofit Efficient Non-Controls Lighting Equipment	C-29	18,875	10,999	0	15	0.0561
	LED Exit Signs	C-30	1,180	426	0	16	0.0334
	LED Traffic Lights (10)	C-31	14,902	1,400	-400	10	-0.0147
	Perimeter Daylighting	C-32	7,876	6,690	0	18	0.0727
	C&I Lighting Controls	C-33	7,078	850	0	8	0.0186
	Commercial Skylight	C-34	4,719	5,716	0	10	0.1569
Water Heating	Low Flow Fixtures	C-35	6,000	1,000	0	10	0.0216
	Solar Water Heaters	C-36	2,500	6,000	20	25	0.1783
	Heat Pump Water Heaters	C-37	5,039	850	20	10	0.0258
Cooking and Laundry	HE Food Prep and Holding	C-38	2,847	1,110	0	12	0.0440
	Energy Star Commercial Clothes Washer	C-39	390	475	0	10	0.1579
	Restaurant Commissioning Audit	C-40	21,002	1,550	0	5	0.0170
	Steam Cooker	C-41	8,429	3,500	0	12	0.0468
	Energy Star Fryers	C-42	983	500	0	12	0.0574
	Energy Star Combination Oven	C-43	18,431	2,125	0	12	0.0130
	Energy Star Convection Oven	C-44	3,235	1,113	0	12	0.0388
	Energy Star Griddle	C-45	6,996	2,090	0	12	0.0337
	Spray Nozzles for Food Service	C-46	24,934	85	0	5	0.0008
Refrigeration	Efficient Package Refrigeration	C-47	26,253	3,892	0	15	0.0143
	Grocery Refrigeration Tune-Up and Improvements	C-48	15,752	2,986	0	5	0.0438
	Refrigeration Casework Improvements	C-49	13,126	4,332	0	10	0.0427
	VendingMiser®	C-50	1,612	215	0	5	0.0308
	Refrigerated Case Covers	C-51	25,988	6,930	0	5	0.0616
	Door Heater Controls For Cooler - Freezer	C-52	15,333	300	0	12	0.0022
	Door Heater Controls For Cooler - Refrigerator	C-53	3,245	300	0	12	0.0104
	New Energy Star Ice Machine	C-54	2,393	2,194	0	9	0.1290
	Solid or Glass Door Refrigerators, New	C-55	3,168	165	0	12	0.0059
	Strip Curtains for Coolers	C-56	1,608	358	0	6	0.0438
	Door Gaskets for Refrigerated Cases	C-57	4,719	3,217	0	4	0.1923
Other	Network Computer Power Management	C-58	5,251	338	0	2	0.0346
	High Efficiency Pumps	C-59	2,359	327	0	15	0.0133
	Engineered Nozzles	C-60	1,547	14	0	15	0.0009
	Insulated Pellet Driers	C-61	4,800	2,160	0	5	0.1039
	Injection Molding Barrel Wrap	C-62	4,969	240	0	5	0.0112
	Efficient Air Compressors	C-63	4,310	1,500	0	15	0.0335

Note: Dollar amounts are expressed in 2012 dollars.

Cost Effectiveness[10]

Cost effectiveness of each EEM is measured by the real levelized cost per kWh. Real levelized cost expresses the total incremental cost and any annual operation and maintenance expense as a constant annual payment over the life of the measure divided by annual savings.[11] The advantage of RLC is that it normalizes for differences in measure life and other EEM attributes to provide a means of comparing EEMs in terms of their relative cost effectiveness. As will be demonstrated in the next section, RLC also provides a convenient method for estimating an energy efficiency supply curve and determining economic potential.

Incremental cost for the EEM screening step is the marginal cost of installing the measure. Depending on the measure, this could be simply the cost of the high efficiency measure over and above the standard efficiency option. In other cases installation labor and site modifications may also be required for the high efficiency model and, hence, would be included in incremental cost. At this stage of analysis (EEM screening), the costs do not include program administration, implementation and evaluation. Tax credits are also not considered at this stage of the analysis.

It should be pointed out that program design may have an impact on some of the EEM screening assumptions. An owner-installed delivery option, for example, may result in lower installed cost than a contractor installation but may also result in higher savings degradation rates, depending on the measure. Such tradeoffs are important program design considerations but beyond the scope of EEM analysis. For the purposes of this stage of analysis the EEM assumptions provide a reasonable starting point for our assessment of energy efficiency options.

Energy efficiency measures in Table 15 and Table 16 have been grouped by major end-use categories. Measures considered in the screening include combined heat and power (cogeneration) and solar electric. In principle these measures can provide very large energy savings, but they are usually not cost effective. They are included in this screening to keep a broad perspective in the analysis and to reach toward a more full understanding of the possibilities and physical limits of potential.

[10] Two types of cost effectiveness analysis are presented in this report. This section deals only with technology assessment using levelized cost. More comprehensive analysis is required at the program level. See Appendix B for a discussion of each type of cost effectiveness analysis.

[11] The formula for this calculation is presented in Appendix B. A real discount rate of 5.00 percent was used based on the DEI weighted average cost of capital.

Cost Effectiveness Rankings

The residential and non-residential measures are ranked by cost effectiveness in Table 17 and Table 18, respectively. Descriptions of the columns in these tables are presented below.

EEM Reference	Unique EEM reference number.
EEM Description	Brief description of the EEM. See appendixes for a more detailed description.
Application	For residential measures only, describes the segment of residential sector where the EEM assumptions are applicable. For example, the same EEM may have different assumptions for single family and multifamily applications.
Real Levelized Cost ($/kWh)	The incremental cost and annual O&M expressed as a constant annual payment over the life of the measure and then divided by the annual savings. Entries in the EEM ranking table are sorted from least cost (lowest RLC) to highest cost measures. No overhead or program cost is included at this point in the analysis.
Annual Savings per Site (kWh)	Annual kWh savings (gross) per customer site.
Implied Sites	A derivative calculation based on the proportioned technical potential and savings per site. While the number of sites is not known the implied sites calculation should be consistent with available demographics.
Potential Annual Savings (Measure and Cumulative) (million kWh)	Total annual energy savings potential in MWh. The fundamental drivers of the technical potential estimate are the customer counts and the end-use models by customer segment derived from utility usage and demand data.

Some measures with large technical potential are shown to have moderate to high cost (e.g. heat pump water heaters and solar water heaters).

Generally measures that pertain to efficient new construction are reasonably cost effective because EEMs can be installed at the time of construction with low incremental cost impacts.

The non-residential measures are ranked in Table 18 by cost effectiveness.

Table 17. Ranked Measures, Residential

EEM Reference	EEM Description	Application	Real Levelized Cost ($/kWh)	Annual Savings per Site (kWh)	Implied Sites	Potential Annual Savings (million kWh) Measure	Cumul-ative
R-39	Single CFL	All	-0.006	37	97,619	3.6	4
R-15	Programmable Thermostats	Elec	0.005	639	97,619	62.4	66
R-14	EE Windows	Elec	0.008	1372	68,333	93.8	160
R-42	Low Flow Fixtures	All	0.010	596	244,048	145.3	305
R-28	Dehumidifier	All	0.017	297	97,619	29.0	334
R-36	Efficient Residential Lighting Makeover	All	0.019	686	341,667	234.3	568
R-23	Solar Siting/Passive Design	New Elec	0.024	1500	58,572	87.9	656
R-41	Tank Wrap, Pipe Wrap and Water Temp Setpoint	All	0.024	200	341,667	68.4	725
R-29	Eliminate Old Refrigerators	All	0.028	1008	146,429	147.6	872
R-40	Single LED	All	0.034	61	97,619	6.0	878
R-18	House Sealing using Blower Door Electric	Elec	0.037	1052	62,476	65.7	944
R-43	Heat Pump Water Heaters	All	0.043	2097	244,048	511.9	1,456
R-6	Refrig Charge/Duct Tune-Up Electric	Elec	0.044	1021	97,619	99.6	1,555
R-24	Energy Star Manufactured Home	New	0.044	3792	58,572	222.1	1,777
R-2	Elec Furnace to SEER 15 H Pump SF	Elec SF	0.046	10669	19,524	208.3	1,986
R-38	LED Residential Outdoor Yard Light	All	0.048	1000	26,943	26.9	2,013
R-49	Heat Pump Pool Heater	All	0.049	8000	293	2.3	2,015
R-4	Elec Furnace to SEER 15 H Pump MF	Elec MF	0.051	7113	19,524	138.9	2,154
R-16	Ceiling Insulation (R6-R30) Electric	Elec	0.052	1650	48,810	80.5	2,234
R-34	Pool Pumps	All	0.052	436	97,619	42.6	2,277
R-37	Occupancy Controlled Outdoor	All	0.055	250	244,048	61.0	2,338
R-25	Energy Star Construction	New Elec	0.056	3979	58,572	233.0	2,571
R-26	Major Remodel	Elec	0.056	3979	62,120	247.2	2,818
R-45	Efficient Plumbing	New Elec	0.071	500	19,524	9.8	2,828
R-35	Efficient TV	All	0.074	70	97,619	6.8	2,835
R-8	SEER 13 to SEER 15 Heat Pump SF	SF Elec New	0.078	900	97,619	87.9	2,923
R-9	SEER 13 to SEER 15 Heat Pump MF	MF Elec New	0.078	600	97,619	58.6	2,981
R-11	SEER 9 to SEER 15 CAC Replace	MF Gas New	0.078	779	97,619	76.1	3,057
R-52	In-Home Display	All	0.079	394	97,619	38.5	3,096
R-30	Set Back HVAC with Ceiling Fan	All	0.079	250	195,239	48.8	3,145
R-47	Drain HX	Elec	0.080	800	97,619	78.1	3,223
R-33	Energy Star Refrigerators	All	0.083	150	488,096	73.2	3,296
R-50	Customer Report	All	0.085	193	244,048	47.1	3,343
R-13	Cool Roofs	Elec	0.088	500	117,143	58.6	3,402
R-21	Wall Insulation (R3-R11) Electric	Elec	0.089	1200	146,429	175.7	3,577
R-3	Resist to SEER 15 Heat Pump SF	Elec SF	0.094	9542	19,524	186.3	3,764
R-27	Window Film	Elec	0.096	300	9,597	2.9	3,767
R-5	Resist to SEER 15 Heat Pump MF	Elec MF	0.099	6361	19,524	124.2	3,891
R-46	Ductless Heat Pump	Elec	0.111	3224	97,619	314.7	4,205
R-31	Energy Star Clothes Washers	All	0.154	202	292,858	59.2	4,265
R-1	Combined Heat Power, Micro CHP	All	0.198	5000	976	4.9	4,270
R-32	Energy Star Dish Washers	All	0.203	125	518,418	64.8	4,334
R-19	House Sealing using Blower Door Gas	Gas	0.220	175	244,048	42.7	4,377
R-7	Refrig Charge/Duct Tune-Up Gas	Gas	0.235	192	96,643	18.5	4,396
R-51	Solar PV	All	0.237	3000	253,810	761.4	5,157
R-12	Efficient Window AC	All	0.250	45	194,788	8.8	5,166
R-17	Ceiling Insulation (R6-R30) Gas	Gas	0.258	330	195,629	64.6	5,230
R-48	Smart Plug	All	0.324	23	146,429	3.3	5,234
R-10	SEER 13 to SEER 15 CAC New	SF Gas New	0.340	180	97,619	17.6	5,251
R-44	Solar Water Heaters	All	0.360	2180	146,429	319.2	5,570
R-20	Ground Source Heat Pump	Elec	0.388	3569	29,286	104.5	5,675
R-22	Wall Insulation (R3-R11) Gas	Gas	0.443	240	183,884	44.1	5,719
Note: Dollar amounts are expressed in 2012 dollars.							

Table 18. Ranked Measures, Non-Residential

EEM Reference	EEM Description	Real Levelized Cost ($/kWh)	Annual Savings Per Site (kWh)	Implied Sites	Potential Annual Savings (million kWh)	
					Measure	Cumulative
C-31	LED Traffic Lights (10)	-0.015	14,902	19,674	293.2	293
C-46	Spray Nozzles for Food Service	0.001	24,934	197	4.9	298
C-60	Engineered Nozzles	0.001	1,547	984	1.5	300
C-52	Door Heater Controls For Cooler - Freezer	0.002	15,333	984	15.1	315
C-55	Solid or Glass Door Refrigerators, New	0.006	3,168	984	3.1	318
C-9	Chiller Tune-Up	0.006	11,797	4,919	58.0	376
C-24	Single Application VSD	0.010	11,797	9,345	110.2	486
C-17	VFD HVAC	0.010	12,500	12,299	153.7	640
C-53	Door Heater Controls For Cooler - Refrigerator	0.010	3,245	984	3.2	643
C-22	Premium Motors	0.011	3,745	6,886	25.8	669
C-62	Injection Molding Barrel Wrap	0.011	4,969	984	4.9	674
C-15	Demand Controlled Ventilation	0.012	2,359	9,837	23.2	697
C-43	Energy Star Combination Oven	0.013	18,431	492	9.1	706
C-59	High Efficiency Pumps	0.013	2,359	2,951	7.0	713
C-47	Efficient Package Refrigeration	0.014	26,253	5,902	155.0	868
C-5	Re/Retro-Commissioning Lite	0.015	23,594	14,756	348.1	1,216
C-40	Restaurant Commissioning Audit	0.017	21,002	2,951	62.0	1,278
C-33	C&I Lighting Controls	0.019	7,078	9,837	69.6	1,348
C-25	Energy Star Transformers	0.021	15,000	4,919	73.8	1,421
C-35	Low Flow Fixtures	0.022	6,000	7,487	44.9	1,466
C-20	Integrated Building Design	0.024	65,632	11,238	737.5	2,204
C-28	New Efficient Non-Controls Lighting Equipment	0.024	11,089	11,805	130.9	2,335
C-37	Heat Pump Water Heaters	0.026	5,039	4,919	24.8	2,360
C-50	VendingMiser®	0.031	1,612	4,919	7.9	2,367
C-14	Outside Air Economizer	0.032	2,359	984	2.3	2,370
C-21	Electronically Commutated Motors	0.032	10,501	4,919	51.7	2,421
C-30	LED Exit Signs	0.033	1,180	34,430	40.6	2,462
C-63	Efficient Air Compressors	0.034	4,310	2,951	12.7	2,475
C-45	Energy Star Griddle	0.034	6,996	984	6.9	2,482
C-58	Network Computer Power Management	0.035	5,251	9,837	51.7	2,533
C-44	Energy Star Convection Oven	0.039	3,235	984	3.2	2,537
C-27	LED/Efficient Outdoor Lighting	0.041	13,126	9,424	123.7	2,660
C-4	Commissioning New	0.041	35,391	0	0.0	2,660
C-49	Refrigeration Casework Improvements	0.043	13,126	984	12.9	2,673
C-48	Grocery Refrigeration Tune-Up and Improvements	0.044	15,752	984	15.5	2,689
C-56	Strip Curtains for Coolers	0.044	1,608	984	1.6	2,690
C-38	HE Food Prep and Holding	0.044	2,847	2,951	8.4	2,699
C-16	Chilled Water Reset	0.045	2,359	984	2.3	2,701
C-41	Steam Cooker	0.047	8,429	984	8.3	2,709
C-1	Combined Heat and Power, CHP	0.048	2,000,000	30	60.0	2,769
C-13	Heat Pump System	0.056	11,797	9,837	116.0	2,885
C-29	Retrofit Efficient Non-Controls Lighting Equipment	0.056	18,875	11,805	222.8	3,108
C-42	Energy Star Fryers	0.057	983	984	1.0	3,109
C-51	Refrigerated Case Covers	0.062	25,988	984	25.6	3,135
C-8	Premium New HVAC Equipment	0.064	13,126	4,919	64.6	3,199
C-3	Small HVAC Optimization and Repair	0.069	4,719	14,756	69.6	3,269
C-32	Perimeter Daylighting	0.073	7,876	9,837	77.5	3,346
C-18	Cool Roof	0.075	2,359	9,837	23.2	3,369
C-12	Split System AC	0.078	4,719	9,837	46.4	3,416
C-6	Low-e Windows 1500 ft2 New	0.080	9,438	984	9.3	3,425
C-23	Variable Speed Drives, Controls and Motor Applications Integrated	0.083	52,506	4,919	258.3	3,683
C-61	Insulated Pellet Driers	0.104	4,800	492	2.4	3,686
C-10	Window Film	0.112	2,359	1,257	3.0	3,689
C-54	New Energy Star Ice Machine	0.129	2,393	984	2.4	3,691
C-26	Efficient AC/DC Power	0.142	15,000	9,345	140.2	3,831
C-34	Commercial Skylight	0.157	4,719	984	4.6	3,836
C-39	Energy Star Commercial Clothes Washer	0.158	390	3,935	1.5	3,837
C-36	Solar Water Heaters	0.178	2,500	5,902	14.8	3,852
C-57	Door Gaskets for Refrigerated Cases	0.192	4,719	1,967	9.3	3,862
C-2	Solar Electric	0.284	55,000	19,674	1,082.1	4,944
C-11	Room Air Conditioner	0.417	2,359	9,837	23.2	4,967
C-7	Low-e Windows 1500 ft2 Replace	1.466	4,719	984	4.6	4,971
C-19	Roof Insulation	1.559	4,719	9,837	46.4	5,018

Note: Dollar amounts are expressed in 2012 dollars.

Economic Potential

Economic potential is defined as the total energy savings available at a specified long-term avoided cost of energy. Technologies with levelized costs that are lower than the avoided cost of energy are included in estimates of economic potential. A DSM supply curve provides a flexible framework for presenting economic potential that reflects the direct relationship between the long-term marginal cost of energy supply and energy efficiency potential. Unlike point estimates, DSM supply curves show the economic potential at several levels of marginal supply cost. The incremental cost of measures does not include program delivery and administration expenses that will be required to actually achieve energy savings. In order to provide a more realistic estimate of the economic potential, a 30 percent adder for all costs associated with delivering savings through the program over and above the cost of the energy efficiency measure is added to incremental measure costs. Although the 30 percent adder is based on program budgets developed for other studies, it is meant as a rough estimate of the cost of actually acquiring the DSM resource including expenditures for program administration, vendor and delivery expenses and program evaluation. More refined estimates of each of these types of program costs will be developed in the next section.

The DSM supply curve for residential is shown in Figure 14 which shows the cumulative kWh savings from all measures listed in Table 17 with a levelized cost less than the corresponding point on the graph. Two supply curves are presented, one that only includes the incremental measure cost and one with an adder for program delivery costs, as described above. Since the supply with program delivery costs is more realistic of actual costs, it will be used to estimate the economic potential for this study.

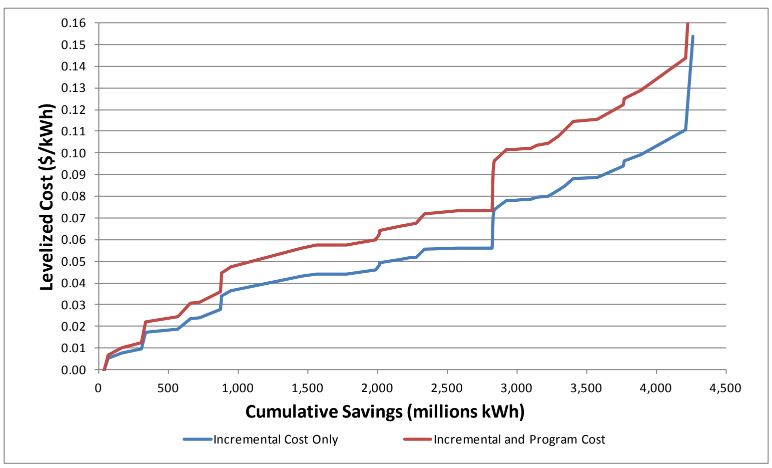

Figure 14. Residential DSM Supply Curve

Duke Energy's marginal cost of avoided supply depends on the load shape and longevity of savings.[12] As discussed in the Executive Summary of this report, $0.075 per kWh is a reasonable estimate of DEI's marginal cost

[12] Marginal cost of supply varies by time of day and season and the amount of avoided peak load. Since different measures have different load shapes, they also have different marginal supply cost. When measures are grouped into programs, these

of supply. Using $0.075 per kWh as the marginal cost of supply, residential economic potential is estimated at 2.8 billion kWh annually.

The DSM supply curve for non-residential is shown in Figure 15 and, like residential, represents an alternate format for the information in Table 18.

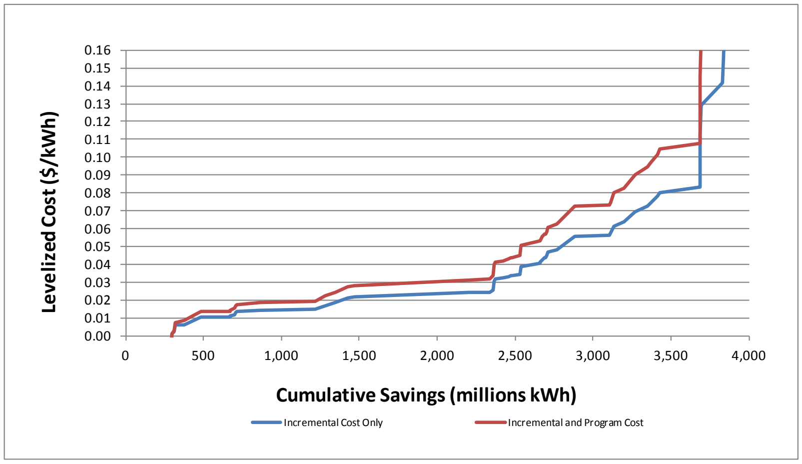

Figure 15. Non-Residential DSM Supply Curve

Figure 15 shows that much of the non-residential efficiency savings are available at levelized costs of less than $0.05 per kWh. Using an approximate marginal cost of supply of $0.075, we estimate annual economic potential in the non-residential sector to be 3.1 billion kWh. Our estimate of total economic potential in both segments is 5.9 billion kWh annually at $0.075 marginal cost of supply. Economic potential is shown at various points along the supply curve in Table 19.

Table 19. Economic Potential (millions of kWh) at Varying Levelized Costs

Levelized Cost ($/kWh)	Residential	Commercial	Industrial	Total
0.050	944	1756	778	3477
0.060	1986	1912	789	4687
0.070	2277	1979	790	5046
0.075	2818	2103	1006	5927
0.080	2818	2103	1006	5927
0.090	2818	2188	1012	6017
0.100	2835	2301	1069	6204

Estimates of economic potential show which technologies are cost effective to install at a certain level of avoided cost given the installed incremental cost, program delivery costs and expected savings. One limitation of the approach is the application of one avoided cost to all measures. Differences in the shape of energy savings can lead to large differences in avoided costs between measures. This level of analysis is reflected in program cost

differences are reflected in the breakeven marginal cost of energy supply for that program which represents the cost that the program must fall under in order to be cost effective.

effectiveness but is not considered at this stage of the analysis. For this reason the cost effectiveness of measures should also be tested within the context of whole program designs when developing a program portfolio.

While useful for understanding the potential for cost-effective energy efficiency, economic potential does not fully consider barriers to adoption that are encountered in the actual delivery of energy efficiency programs. Examples of adoption barriers are customer awareness of technologies, incentives and programs, customer acceptance of newer technologies over standard practices and delivery channel limitations. Some, though not all, of these barriers can be partially or fully overcome with greater program spending.

Each program is unique. In the early stages of some new energy efficiency program these barriers may only be encountered at insignificant levels or not experienced at all. But, for other programs (and in combination with the geography and circumstances of each utility service territory), major program uptake problems may be experienced for a program or a sector of programs from the beginning. If problems are encountered, a root cause analysis can be carried out to isolate relevant factors that give particular strength to barriers to program acceptance and pilots can be employed to test new product packages including level of incentives and program communications and delivery methods. Sometimes investments in the delivery channel, such as training to increase the number of qualified trade allies, may also be required.

What this means is that the marginal cost of acquiring additional customers into a program rises as more and more customers from the target customer segment are treated by the program. Estimates of economic potential typically include a flat level of program delivery and overhead costs based on current understanding of program costs. Consequently, estimates of economic potential tend to overstate what is actually cost effective in the latter stages of customer adoption. This is also true of the estimate of economic potential in this report. While they have their limitations, estimates of technical and economic potential are still useful concepts for defining the relative magnitude of opportunities. Achievable potential (energy savings given specific program designs and annual participation targets refined from experience) provides the best estimate of how much energy efficiency might be actually delivered in any given year. The achievable potential stemming from specific programs operated over a five-year period is presented in the next section of this report.

DSM PROGRAMS

Up to this point in the study, we have been looking at the technical and economic potential for savings from measures with preliminary stand-ins for program costs. This section of the report provides information on the proposed program portfolio and estimates of achievable potential. For DEI, the portfolio consists of Core programs to be administered through a common statewide Third Party Administrator (TPA) and Core Plus programs for which Duke is the Program Administrator. This is due to Indiana's dual administrator system, which is somewhat similar to New York's but is better organized.[13]

Many of the parameters (including, for some programs, specific energy conservation measures) of the programs to be administered by the TPA have been set in the Request for Proposal (RFP) for the TPA. Many others (including, for some programs, the list of measures to be offered by a program) are open, to be proposed in the responses of prospective TPA vendors to the RFP. This means that the TPA programs are somewhat constrained and yet somewhat open. So, as much as seemed reasonable, the program designs we have constructed for the Core part of the overall portfolio generally follow the descriptions in the RFP and in many places use exact language from the RFP. Where matters were left open in the RFP we have often provided specification and where measures were open to proposal in the RFP we have specified measures.

While this two administrator system is in place, it is also possible that Indiana may adopt a three administrator system by permitting its largest industrial customers to self-direct. Timing is such that the three administrator proposal will not be resolved by the time this study is completed. This program portfolio does not assume the three administrator system.

It does, however, take the two administrator system (with the TPA) into account. The two administrator system does not affect program costs or savings projections, but it is possible that for the Core programs, and with the benefit of ongoing implementation experience, some of the personnel projected as Duke staff might be considered additional costs of the TPA at some points during the portion of the five years during which the TPA is operative. For this study, some Core programs are assumed to persist beyond the five years during which the TPA is operative while others are projected to end within the five-year period. For example, the lighting program effort is explicitly shifted over to a parallel Duke program in 2019. These shifts in the program portfolio over time are anticipated whether or not the bifurcated (Core and Core Plus) model is maintained beyond 2020.

[13] In Indiana, the utilities cooperate to design statewide programs and select the statewide program administrator through a competitive bidding process. The statewide administrator reports to a committee made up of the utilities and other members of the DSMCC. In contrast, New York's statewide administrator is an independent state economic development agency with statutory authority in many ways parallel to that of the state public utility commission and separate from the utilities. The order establishing the dual state and utility program administrators in New York envisioned the relationship as competitive as well as cooperative.

Following the Indiana Evaluation Framework[14], it is understood that one goal of the Demand Side Management program ramp-up is to provide a portfolio of well-balanced programs to serve all customers and sectors. Also, so long as the overall portfolio is cost effective on the TRC test, the portfolio may include some programs that are not individually cost effective from the TRC perspective – see text box.

> The Indiana Core program portfolio is required to be cost effective based on the TRC test. That is, the cost to acquire energy efficiency resources needs to be equal to or less than the cost to acquire resources from new power supplies. However, individual programs are not required to be cost effective as long as the fit within a portfolio that is cost effective. This policy allows the development and testing of pilot programs or the launching of new programs or programs that have higher start-up or operational costs, but which are expected to be cost effective once lower cost operations are achieved. It also allows the offering of programs that may not be cost effective but help provide a balanced set of energy efficiency services across all customer segments. *Indiana Evaluation Framework*, Pp. 17-18)

The overall program package is ambitious, and is sized to achieve one-third of the identified cost-effective potential within the first five years of operation. This high level of activity necessarily involves high levels of outreach, either directly by advertising and trade ally networking, or indirectly through upstream or point of purchase buy-downs. The annual savings estimated for the total program package distributed by general measure type is shown in Figure 16.

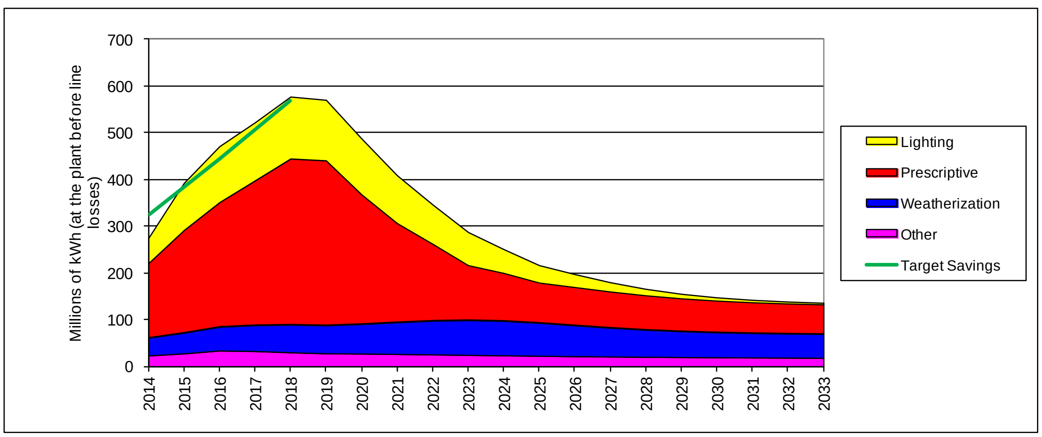

Figure 16. Savings by General Measure Category

As was noted in the Executive Summary of this report, Figure 16 shows that program savings fall short of the target in 2014 but exceed the rising targets through 2018 .[15] Cumulatively over the first five years of the Action Plan (2014-2018) program savings exceed the target. However, after 2018, maintaining a 2 percent per year savings target (the level in the last year specified of the IURC order) well exceeds the projected savings from the total program portfolio for those years. In spite of the attenuated savings in the years after 2020, the total savings for the

[14] *Indiana Evaluation Framework*, September 25, 2012 with updated measure life tables as of February 2013. Prepared for the Indiana Demand Side Management Coordination Committee; Submitted by the Indiana Statewide Core Program Evaluation Team. For cost tests, please see Pp. 15-18.

[15] Annual targets are from Duke Energy Indiana's 2013 IRP and based on Indiana Utility Regulatory Commission Cause No. 42693 Phase II Order, approved on Dec. 9th 2009. (page 31)

full 20-year period totals nearly 60 percent of the cost-effective savings which suggests very high and broad program participation. For example, over the 20 years of the forecast the slate of programs is expected to result in the weatherization of 200,000 low income homes and 60,000 conventional income homes and participation levels in prescriptive programs sufficient to cover all residential and non-residential customers multiple times. Details of program activity levels are provided later in this report.

Notice also in this figure, that the savings manifest two patterns with respect to time: 1) the long slow growth typical of utility programs, such as the savings shown for the weatherization and other programs, and 2) the ten year burst of savings associated with lighting and the prescriptive programs. This burst of savings is due to a broad transformation in the market for lighting and for efficient electric HVAC products, and it accounts for more than two-thirds of the near term savings (pre-2020) of the overall program package.

In fact a fundamental aspect of the overall program strategy is to achieve savings by accelerating the market transformation of lighting and HVAC technologies. However, whenever high levels of market transformation are active, the issue of net-to-gross will become relevant. In the cost effectiveness of these programs we have assumed a separately considered net-to-gross ratio for each program which respects the underlying issue of free riders but also which maintains a maximum program participation rate.

While the current program projections produce near-term yields that meet the targets provided in the Phase II Order, market potential studies should be updated every two years to accommodate dynamic changes in regulatory perspectives, changing consumption patterns and efficiency gains driven by future technologies.

The programs presented later in this section are listed in the following table:

Program Name	**Core**	**Core Plus**	**Demand Response**
Residential Lighting	X		
Residential Home Energy Audit	X		
Residential Low Income Weatherization	X		
Residential Appliance Recycling	X		
Residential Energy Efficient Schools	X		
C&I Energy Efficient Schools	X		
C&I Lighting Buy-Down	X		
C&I Small Business Direct Install	X		
C&I Express Rebates	X		
Residential Prescriptive		X	
Residential Long-Term Lighting		X	
Residential Home Energy Audit and Weatherization		X	
Residential Home Reports		X	
C&I Prescriptive		X	
C&I Custom		X	
Residential Load Cycling			X
C&I Demand Response			X

There is no individualized proposal for a multifamily program, but residents of multifamily dwelling units are served through rebate programs and the Residential Lighting Core Program. If desired, Duke can address multifamily buildings (common areas plus apartments) through the C&I Prescriptive and C&I Custom Programs. If a special subprogram for multifamily is desired, it can be modeled on Con Ed's Multifamily Electric and Gas program or Ameren Missouri's low income multifamily weatherization program. In a prescriptive approach, programs of this type primarily address lighting and low cost measures, such as faucet aerators and showerheads. In the custom approach they may address whole building analysis including HVAC equipment.

Figure 17 shows the full portfolio and the phasing of Core and Core Plus programs, both residential and commercial and industrial.

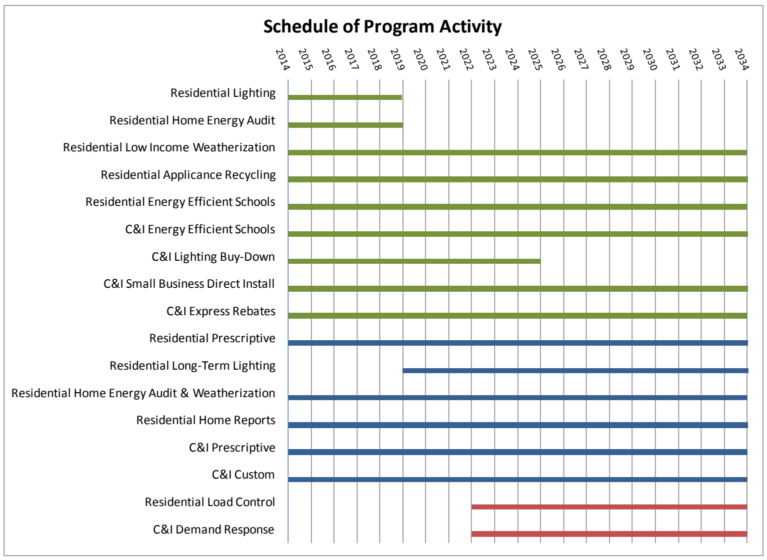

Figure 17. Schedule of Program Activity

The structure for each program description below consists of a brief introduction, the program rationale, a list of the measures included in the program (along with an average per unit projected energy savings per program participant[16]), a brief discussion of delivery channels and marketing and a note on special considerations when applicable. It has been noted where best practices are available. Also, relevant program tools are noted where available.[17]

[16] Note that we recommend freedom for each program administrator to add or subtract measures and to raise or lower rebates based on ongoing program experience in order to meet performance targets.
[17] In the development of this section of the study we used the published resources of the Consortium for Energy Efficiency, the American Committee for an Energy Efficiency Economy and the work of E-Source as well as other sources and experience.

General Considerations for Program Tracking

Program tracking should be designed to meet state regulatory requirements for documentation to insure sufficiently detailed recordkeeping to know you are keeping all bits of information necessary to insure smoothly flowing cost recovery for the utility. Several utilities have developed their own tracking systems or purchased a system for adaptation. This is the safest approach to insuring full regulatory compliance with regulatory information needs.[18] In addition to the DSM tracking systems in the market, generally, experienced program vendors will have their own tracking systems. When they bid to become a program delivery agent for Duke, the bid will include the information flow from their own tracking system. A program delivery agent's tracking system will likely have been optimized through experience in delivering very similar programs for many program administrators in many jurisdictions. But it will likely be especially suited specifically for the type(s) of program(s) they offer. It does not hurt to permit them to run their own internal tracking system but it is generally a best practice to have the delivery agents do the uploading into the utility's tracking system.

Most of what works and does not work in tracking systems is learned by doing so it is useful to study vendor systems. The program manager should insure that the vendor managing each program has an excellent tracking system, whether it is internal to the specific vendor or it is Duke's tracking system. It works best to require the vendor to transfer information to the Duke system if a Duke system is used. Otherwise staffing will have to be provided not only to oversee the system and insure quality control but also to do a massive amount of data entry. Another reason to have a standardized Duke tracking system is that some program vendors will have a system that is excellent for their own purposes but may leave out critical bits of information or report information in a form that has to be translated to a Duke preferred format.

Depending on regulatory requirements, it may be necessary to capture baseline information for each measure rebated and other financial information. For many measures, the Indiana Technical Reference Manual may provide a deemed value with an assumed baseline. If the commission states in advance that it will accept that level of information for baseline measures in a program it greatly simplifies the amount and types of data to be collected. At the same time, if possible, and as a check on assumptions, it is useful to collect actual baseline information and related information of the type Duke now collects for its custom program measure upgrades. Sooner or later, deemed values may be questioned and a solid backup with actual baseline information would prove invaluable should that circumstance arise (e.g., technical data about equipment being replaced, operational hours and the like).

It is important to recognize that program planning and reporting is done on a per customer basis as well as a per measure basis. The vendor should track by customer ID as well as track individual orders/measures so as to be able to produce reports on numbers of participants as well as on orders and quantities of materials ordered and/or installed. This will improve the efficiency of tracking both for reporting purposes and evaluation.

[18] Normally, this would mean talking with other lead utilities to get the benefit of their experience and finding a tracking system vendor. A key concern is how the system software will be updated over subsequent years; it is important not to accept a contract that voids warranty work on the system after your own IT people begin to change it.

The bottom line is that the program tracking system will be used to provide a level of accuracy, precision and confidence in results that is stipulated by regulatory authorities for reporting on programs. Contained within this requirement are the comprehensive program data elements necessary for communication of the program activities to a regulator. Cost recovery may be dependent on the diligence with which the tracking database is maintained.

Data requirements will vary with the specifications for each program and sometimes by project marketing and promotional activities within major programs. In some cases, Technical Resource Manual (TRM) deemed values or inputs and outputs from TRM equations may be operationalized as little applets for tracking purposes. For other programs (e.g. custom programs), utility billing meter information will provide a sufficient level of detail required to assess program impacts at the tracking system level. In other cases, isolation of circuits and spot metering or other types of assessments may be required for program managers to understand impacts prior to the arrival of evaluators, and this kind of information can be built into the tracking system for certain program types. Often, for larger customers with custom programs short term instrumentation and spot metering with engineering review can serve both program intelligence and evaluation purposes. It is particularly important to define the baseline for each program and collect the information necessary to document baseline conditions. For energy programs it is essential to capture kWh values, and for demand response programs it is essential to capture kW values. And for some programs both kWh and kW will be important to track.

For ease of implementation, it will be useful to develop spreadsheet tools that do any calculations that may be required for programs that use TRM calculating methods.

For Demand Response (DR) programs, 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 any expected and unexpected rebound effects. Demand Response is an area in which information for the program manager and information required for evaluation are essentially identical.

A special concern for program tracking for appliance recycling programs is 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 pickup, 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.

Program Assumptions

In this section the essential characteristics of each program are presented in the table below. A description of each program is presented in the next section.

Table 20. Program Assumptions

	Per Participant Savings and Costs							Program Cost Assumptions			
Program Name	**Annual Energy Savings (kWh)**	**Annual Coincident Peak Savings (kW)**	**Installed Cost**	**Incentives**	**Pct of Incremental Costs**	**Savings Life (years)**	**Net-to-Gross Ratio**	**EE Staffing (Annual FTE)**	**Start Up (1st year only)**	**Costs per Partici-pant**	**EM&V (pct of program costs)**
CORE											
Res Lighting	323	0.0	$100	$50	50%	11.7	0.60	0.5	$100,000	$10	5.2%
Home Energy Audit	719	0.1	$159	$159	100%	10.2	0.90	0.5	$50,000	$350	5.2%
Low Income Weatherization	1,886	0.3	$742	$742	100%	14.0	1.00	0.8	$125,000	$1,750	4.6%
Appliance Recycling	1,008	0.2	$40	$40	100%	8.0	0.75	0.3	$0	$140	5.7%
Res Energy Efficient Schools	385	0.0	$87	$87	100%	8.4	0.95	0.5	$250,000	$10	5.1%
C&I Energy Efficient Schools	53,711	8.4	$13,227	$6,613	50%	9.7	0.95	0.3	$25,000	$12,000	5.1%
C&I Lighting Buy-Down	8,632	1.4	$0	$0	NA	15.0	0.85	0.3	$85,000	$3,024	5.0%
Small Business Direct Install	4,663	0.7	$1,969	$1,969	100%	14.2	0.90	1.0	$50,000	$600	5.0%
C&I Express Rebates	7,283	1.1	$2,287	$1,144	50%	13.9	0.65	0.5	$75,000	$100	5.0%
CORE PLUS											
Res Prescriptive	1,705	0.2	$1,033	$517	50%	16.7	0.85	0.5	$50,000	$50	2.6%
Res Long-Term Lighting	640	0.1	$237	$119	50%	13.8	0.75	0.5	$20,000	$10	5.0%
Home Energy Audit & Weatherization	3,176	0.5	$1,266	$633	50%	15.2	1.00	0.5	$35,000	$750	5.8%
Home Reports	193	0.0	$0	$0	NA	1.0	1.00	0.2	$20,000	$12	8.3%
C&I Prescriptive	12,061	1.9	$3,084	$1,542	50%	10.9	0.70	1.5	$20,000	$0	5.2%
C&I Custom	121,563	7.8	$15,224	$12,612	83%	10.8	0.70	1.5	$125,000	$3,750	17.6%
Res Load Control	0	1.1	$435	$435	100%	10.0	1.00	1.0	$0	$10	4.0%
C&I Demand Response	0	511.7	$3,100	$3,100	100%	10.0	1.00	1.0	$0	$500	4.0%

Core Programs

Indiana decided to set up a two administrator system with statewide Core programs and utility service territory specific Core Plus programs. This section provides information on the Core programs.

Residential Lighting

The Residential Lighting Program goal is to increase the use of Energy Star (ES) qualified lighting products utilized in residences. The Demand Side Management Coordinating Committee (DSMCC) has initially chosen a retail point-of-purchase buy-down program as the delivery channel. This program acts as a midstream buy-down program that works to reduce the incremental cost differential between ES lighting products and non-efficient baseline products. This program type is a proven and cost-effective delivery method that allows significant savings while performing market transformation activities through rebates offered via regional retail outlets to induce the purchase and installation of residential ES products.

Rationale

Incremental costs are the primary hurdle for the implementation of energy efficient lighting products in the current market. Past program experiences suggest that in the absence of price-reducing rebates, volume sales of energy efficient lighting products can be expected to decline significantly.

Measures

Measures are shown in the table below.

Table 21. Measures and Incentives – Residential Lighting

Measures	Measure Number	Incentive	Measure Savings (kWh)	Measure Incidence Rate per Participant	Measure Savings per Average Participant (kWh)
Occupancy Controlled Outdoor	R-37	50%	250	0.15	38
LED Residential Outdoor Yard Light	R-38	50%	1,000	0.05	50
CFL (6)	R-39	50%	220	0.40	88
LED (6)	R-40	50%	368	0.40	147
Total Savings per Average Participant					323 kWh

The TPA will determine the products and the incentive amount for any ES lighting offers. Products offered in the program may include CFLs, LEDs, and specialty CFLs & LEDs with screw-in bases, provided the products are Energy Star qualified and cost effective (i.e., produce a planning TRC above 1.00).

Delivery Channels and Marketing

By design this program uses retail outlets as the primary delivery channel. Other delivery channels may include an online sales portal. Marketing and promotional responsibilities of the TPA include the following:

- Provide sufficient lead-time and market projections to assure that adequate inventory is available during promotional periods.
- Establish/maintain good relationships with retailers and the ability to secure attractive shelf location of the promotional product during incentive periods.
- Develop and implement effective consumer marketing in order to raise consumer awareness of the program and drive customer traffic to participating retail locations.
- Develop program specific informational materials.
- Invest in consumer education regarding the program and selected products.
- Develop in-store displays both shelf-talkers and larger aisle displays.
- Develop take-away brochures for distribution to store customers to identify and promote the products included in the program.
- Be responsible for placement and verification of motivational promotion items.
- With the cooperation of DEI, the TPA will secure placement of public service ads (free and/or paid) to motivate participation in the program on radio and television.
- Coordinate with big box stores in running periodic promotions.

In addition to TPA activities, DEI will promote the program on its website, through bill stuffers and in call center scripts. Efficiency Indiana will provide additional parallel promotions.

Special Considerations

The budget for this program will be refined with experience. The passage of the 2007 Energy Independence and Security Act has deemed that a higher lumen per watt lighting efficiency be implemented nationwide in 2020. The Indiana TRM reflects this adjustment with a reduced savings level for CFL lamps beginning in 2014. Consequently, this program is modeled to remove CFL bulbs from the approved lighting measure list in 2019. Since it is unclear if this will continue to be a Core program after that date, an extension of this program with a refined list of approved measures has been implemented after 2019 under the Residential Core Plus program list.

Residential Home Energy Audit

The Residential Home Energy Audit Program is a continuing Core Program. This program is designed to generate savings by targeting electrically heated and/or electrically water heated homes for the installation of low cost energy efficiency measures.

This service will be provided to all electrically heated homes/water heated homes, including low income and non-low income homes. Gas customers are provided with energy efficient lights (CFLs, LEDs and/or halogens). The TPA is required to utilize an energy analysis software tool acceptable to the DSMCC that analyzes home efficiency characteristics and provides a comprehensive report of energy use and payback periods for recommended measures. Also, the TPA is required to obtain appropriate billing history for customers of the Participating Utilities prior to scheduled audits.[19]

Rationale

The program strives to increase direct customer interaction with the offering of low-cost-efficiency measures and a low-impact energy efficiency audit. This program will provide opportunity for future savings as a feeder to other programs offered by Duke Energy Indiana. The goals of the Residential Home Energy Audit Program are the direct installation of low-cost energy savings measures, to help customers analyze and understand their energy use, to recommend appropriate weatherization measures, and to encourage additional energy savings.

Measures

Measures are shown in the table below.

Table 22. Measures and Incentives – Residential Home Energy Audit

Measures	Measure Number	Incentive	Measure Savings (kWh)	Measure Incidence Rate per Participant	Measure Savings per Average Participant (kWh)
CFL (6)	R-39	100%	220	1.00	220
LED (6)	R-40	100%	368	1.00	368
Tank Wrap, Pipe Wrap & Water Temp Setpoint	R-41	100%	200	0.05	10
Low Flow Fixtures	R-42	100%	596	0.20	119
Smart Strip (7-plug)	R-48	100%	23	0.10	2
Total Savings per Average Participant					719 kWh

Delivery Channels and Marketing

This program has a single delivery channel in the form of a software-assisted residential in-home whole-house audit and measure installation. The Residential Home Energy Audit Program will primarily target residential customers with electric-heat homes in the State of Indiana who are interested in assessing their home energy use. The program should focus on electric-only homes or be designed to only provide measures that have electric savings in

[19] It is recommended that the Third Party Administrator for this program utilize an energy analysis platform that includes historic billing data for the generation of the whole-house report and the effects of proposed and implemented measures on the homes energy use profile. An example of this type of software is the TREAT software platform developed by Performance Systems Development.

homes that have natural gas for space and/or water heat. Consideration will be given to coordinating a joint program with local gas utilities to drive a "whole-house" audit approach. Eligible residential participants are single family owner-occupied houses and single family houses not owner-occupied but where service is in the name of the occupants. Also, eligibility is restricted to houses built prior to January 1, 2010 and which have not had a utility sponsored audit in the last three years.

This program should be promoted by Duke Energy Indiana through its website and through direct mail, bill inserts, and radio and TV. Similar communications should be conducted by Energizing Indiana. Canvassing may be needed for enrollment of hard-to-reach groups, such as the elderly, low income, and non-English speaking persons. In this case low-cost canvassing may be used to increase program participation rates. Whenever a residential customer participates in a program, promotional materials should be provided to promote participation in the other residential programs.

Tools

The Indiana Community Action Association (INCAA) which coordinates the local Community Action Agencies (CAAs) offers training in how to conduct residential energy audits through its Intelligent Weatherization™ Skills Verification Program.

We recommend that a test-in/test-out protocol be utilized for each home. This will produce a more comprehensive assessment of program savings performance.

The Buildings Performance Institute is also an excellent source of training, standards and audit software.

Residential Low Income Weatherization

The Residential Low Income Weatherization Program is a continuing Core Program. This program will serve customers up to and including 200 percent of the Federal Poverty Level. It is modeled on the federal Weatherization Assistance Program (WAP). It is designed to provide the installation of energy efficient and weatherization measures in qualified homes, educate customers on ways to reduce electrical energy use, and to provide a post-installation exit survey with the homeowner to ensure proper installation and customer satisfaction. Outreach efforts will be designed to include traditionally hard-to-reach groups, such as the elderly and non-English speaking households. Homes with electric space or water heating are emphasized as targets for measure implementation.

Within the direction of the program, priority will be given to:

- Single parent households with children under 18 years of age living in dwelling.
- Households headed by occupants over 65 years of age.
- Disabled homeowners as defined by the Energy Assistance Program.
- Households with high energy intensity usage levels.

It is expected that the homes served by these program elements will be primarily single family owner-occupied homes and manufactured owner-occupied homes.[20]

Rationale

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

- Like other DSM programs, a core objective is to provide energy savings (DSM savings).
- 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.
- Provide DSM service to customers who otherwise could not obtain DSM improvements due to cost.
- Due to problems with low income housing stock, address health and safety concerns.

Though cost tests are calculated, these programs are generally approved for equity reasons.[21]

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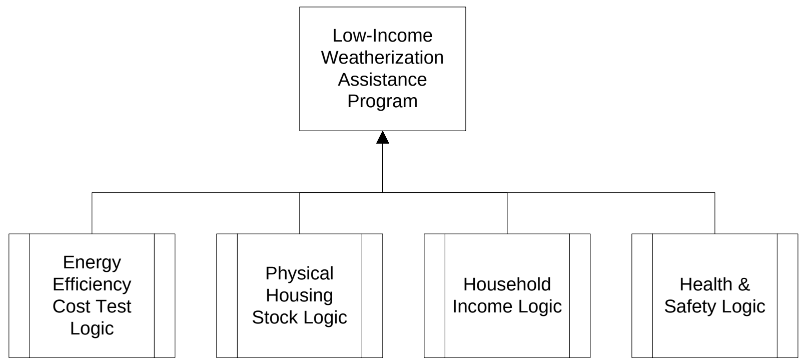
[20] We recommend that Duke looks into adding renter-occupied homes to the target market for this program, recognizing that there are barriers associated with split incentives and additional effort and cost is often involved in working with landlords.

[21] For low income programs, program cost effectiveness is an issue but not the primary issue; although still an important calculation. Due to 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.*, they are not judged with a strict "total resource cost" test). 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 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. For a more recent summary of jurisdictional approaches to valuing low income programs please also see: Peach, H. Gil, "The TRC and Low Income", paper for the Low Income Subcommittee, Nevada Energy Collaborative, May 2012 https://dl.dropbox.com/u/12011114/The%20TRC%20and%20Low-Income.pdf).



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. Instead, 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. California places emphasis on a "Modified Participant Test" and Utility Cost Test/Program Administrator Cost Test that includes "non-energy benefits" for screening measures for low income programs. A measure is accepted into the program if it passes either test and a current measure may not be removed from the program for failing these tests.[22] Thus, California found it acceptable to obtain a TRC test result for the Southern California Edison Low-Income Energy Management Assistance Program of 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. The California commission is trying to insure weatherization services to all low income houses over a set number of years.

[22] In addition, in California several measures (including furnaces and furnace repairs, water heaters and water heater repairs and, in warmer climate areas of the state, air conditioners and air conditioner repairs) are deemed for inclusion and are not cost tested.

Measures

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

Table 23. Measures – Residential Low Income Weatherization

Measures	Measure Number	Measure Savings (kWh)	Measure Incidence Rate per Participant	Measure Savings per Average Participant (kWh)
Refrigeration Charge/Duct Tune-Up Electric	R-6	1,021	0.050	51
Efficient Window AC	R-12	124	0.150	19
Programmable Thermostat	R-15	639	0.125	80
Ceiling Insulation	R-16	1,650	0.150	248
House Sealing	R-18	1,052	0.400	421
Wall Insulation (R3-R11) Electric	R-21	1,200	0.100	120
Eliminate Old Refrigerator *	R-29	789	0.050	39
Occupancy Controlled Outdoor Lighting	R-37	250	0.050	13
CFL (6)	R-39	220	1.000	220
LED (6)	R-40	386	1.000	386
Tank Wrap, Pipe Wrap & Water Temp Setpoint	R-41	200	0.125	25
Low Flow Fixtures	R-42	596	0.475	283
Total Savings per Average Participant				1,886 kWh

* Savings for R-29 is the difference between old refrigerator usage from Indiana TRM less new refrigerator usage from Energy Star calculator (top freezer, 15 CUF) with incremental cost of $450 and an 8 year measure life.

In addition to implementing the above measures, the contractor will also work with other weatherization funding programs to optimize home energy savings potential on a whole-house basis. Contractors will also be required to identify any potential health and safety issues that may need to be addressed and will coordinate the repair of health and safety improvements, with a target expense limit of $750. Efforts should be used to take advantage of non-DSM funding sources prior to using program funds for health and safety issues. Refrigerator and Window AC measures, in the table above, have adjusted savings values that reflect changes in the delivery mechanism appropriate to this type of program.

Delivery Channels and Marketing

This program is physically provided via the canvassing, outreach and registration efforts of the TPA who will then be required to perform on-site program measure implementation. The TPA (TPA) and the TPA's program delivery contractors will be responsible for recruitment.

Marketing for this program is expected to be coordinated with the state weatherization program, which already has outreach activity through the sub-grantee agencies. Further, the federal/state WAP program comes with a full set of weatherization guidelines for health and safety, materials and equipment, installation standards and quality control and inspection standards. The Community Action Agencies serve the portion of the Indiana population that qualifies for this program through a broad set of helping and community-based programs. Since qualifying households come in to contact with CAAs for a variety of services it will be important to work with them for recruitment of households into the program. Because CAAs do not sell energy, their funding for services must come from outside organizations and programs. For this reason, program planning should include a fee payment to CAAs for each qualifying referral that completes the program.

State, religious and private social services agencies should be used as sources of recruitment. In particular, medical facilities and visiting home nurses providing Medicaid services have been found useful in other jurisdictions (MA, DC) in providing low income referrals for weatherization. Wherever low income people meet for services can provide new referral networks.

Marketing and promotional efforts include the use of utility bill stuffers for customer education. The program can also be mentioned in communications with customers regarding energy efficiency program options, the Duke website, the Energizing Indiana website. In addition, the call center staff should be provided scripts to handle calls by customers for information.

Separate from the energy efficiency programs, customer relations, credit and collections staff should be trained to refer electric heat customers who are experiencing payment problems if they are within the income range to be eligible for the programs. In particular, qualifying payment-troubled customers could be provided a bill credit, or arrearage forgiveness, for agreeing to participate in the program.

Canvassing efforts will be utilized by the TPA and its service delivery contractors to provide education and outreach for the program and register potential customers for later program implementation visits. Canvassing measures may be used to increase the effectiveness of outreach efforts. This may be supplemented using radio, TV and direct mail.

Tools

The INCAA, which coordinates the local CAAs throughout Indiana, provides weatherization training through the Intelligent Weatheriation™ Indiana Skills Verification Program. This program provides training classes and materials that cover the full range of residential weatherization skills including Shell Retrofit, Infrared Thermography, Zone Pressure Diagnostics, Daily Safety Test Out Procedures, Mobile Home Weatherization, High Performance Insulation, Crew Leader Training, Retrofit Installer: Mechanical, Carbon Monoxide and Combustion Analysis, and several other courses.

Beyond training, the federal/state WAP provides comprehensive weatherization standards and quality control methods. It is a best practice to coordinate utility low income weatherization funding with the WAP program.

Special Considerations

This program is unusual, in that, the costs of equipment and installation for improvement to houses is fully paid by the utility and other coordinated funding sources. There is no direct household monetary payment. In general, analyses of state low income weatherization services find that, due to funding limitations, only a small portion of the technically eligible market can be served with completed whole-house weatherization each year, so that the number of eligible houses grows at a rate faster than the rate of program completions. This causes a service dilemma in which service providers are tempted to dilute programs so as to do "something" for many low income households rather than do complete whole-house weatherization work. The assumption here is that complete whole-house weatherization will be the focus of the program. If so, then the major constraint on the participation curve is the level of yearly funding.

For ease of administration, we recommend that all costs associated with the implementation of this program, including costs associated with health and safety repairs on a per-house basis, be treated as an accounting exercise for the program as a whole rather than on an individual house basis.[23] This approach will enable work to move forward quickly without delays to arrange funding coordination between sources for each house. Any necessary balancing of costs with federal or state program dollars can be done post-implementation by melding the results of Duke and non-Duke jobs performed within the Duke service territory, and, if necessary balancing among accounts can be shifted to the following year. This will simplify direct implementation and project reporting.

Currently, households that have been weatherized as part of the American Recovery and Reinvestment Act or as part of a utility-sponsored program or CAA program within the past ten years will be ineligible for the Low Income Weatherization Program. We recommend changing this requirement to apply only to homes that have been provided full whole-house weatherization services. In other words, eligibility should be based on the physics of the house rather than whether or not the house has been touched by a program in the past. The weatherization provided should complete whole-house weatherization. There is an apparently low whole-house effort in the first year Core Program evaluation of this program type.

Residential Appliance Recycling

The Residential Appliance Recycling Program is a continuation of a current program type administered by the utilities as a new Core Program. 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. The goal of the Residential Appliance Recycling Program is to (1) remove older inefficient refrigerator/freezers that can be eliminated or replaced with new Energy Star equipment and (2) produce long term energy savings. Key objectives include:

- Providing professional services to the customers, maintaining on time and courteous service.
- Provide scheduled pickup within 14 days of initial contact by the customer.
- Issue checks to the customer within 21 days of unit pickup

[23] A long-standing barrier to low income weatherization has been coordination of funding among utility, federal, and private (e.g., foundation grant) sources. The problem is amplified by different entities having different budget years and by the annual uncertainty in the timing and amount of federal WAP and Low Income Home Energy Efficiency Program dollars. Treating the accounting on a program basis rather than on a house basis means that work will not be held up and the necessary balancing can be done off to the side of the program implementation push. Allowing for balancing to occur across two years can insure meeting the requirements of various agency "true-up" procedures. Work will still be affected by budget constraints on the allocation of jobs according to funding source availability, but less so than if work proceeds on a basis of requiring such balancing for each house rather than for the program as a whole.

This program targets households with second refrigerators or freezers.[24] The program will provide free refrigerator and or freezer pickup. The contractor will pick up, disable, and recycle the unit(s). Once Duke Energy receives verification that the refrigerator has been recycled, the customer will receive a $40 incentive. This number is based on the $30 to $50 incentives offered by other companies.[25]

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. The Program Administrator 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.

Measures

Measures are shown below.

Table 24. Measures and Incentives – Residential Appliance Recycling

Measures	Measure Number	Measure Savings (kWh)	Measure Incidence Rate per Participant	Measure Savings per Average Participant (kWh)
Eliminate Old Appliances	R-29	1,008	1.0	1,008

The goal of marketing and promotion is to grow the program, partly through "word-of-mouth" communication among friends and relations. However, each program is unique. Service territory geography and social characteristics can also affect program uptake; customer decisions on participation in this program are multifaceted. In some service territories this kind of program has a slower uptake and presents a highly challenging situation for marketing and promotion.[26]

Delivery Channels and Marketing

This program is based on a single delivery channel mechanism provided by the TPA to perform the necessary function of customer registration, scheduling and pick up of the recycled appliance, and its delivery to the recycler.

Duke Energy Indiana has been administering this program so it is likely to be generally known to many customers. Nevertheless, a key to marking and promotion is repetition of message and placement of message in contexts that will attract attention. Therefore, this program will be marketed directly to consumers through regular radio advertisements, bill inserts, direct mailing materials, the company website and scripts developed for customer call centers. 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).

[24] The option of including primary refrigerators should be included. This option should work if the grid perspective of the Uniform Methods Protocol for this program type is adopted for program evaluation purposes.

[25] Wisconsin Public Service offers a $50 incentive, but we believe Duke Energy's program will be successful with the lower incentive amount.

[26] Duke Energy Indiana has been the Program Administrator, but operation will be shifted to Efficiency Indiana.

Point of purchase locations will often provide a free appliance pickup with the delivery of a new unit. Very often these secondary units are then taken to a retrofit facility and then placed on the secondary market. The development of agreements for recycling with point of purchase vendors to acquire these secondary units should be implemented within the delivery of the program.

Any contact with residential customers through other programs should be used to communicate and promote this program.

The TPA should conduct statewide and local campaigns to make residential customers aware of this program and to promote participation. These campaigns should use radio, TV, and the Duke Energy Indiana and Efficiency Indiana websites.

Tools

A special concern for program tracking for this program is 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 pickup, 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.

The two primary program vendors for this type of program are Appliance Recycling Centers of America, Inc. (ARCA)[27] and JACO Environmental, Inc. (JACO)[28]. Both organizations have extensive knowledge of effective marketing approaches.

Special Considerations

Currently the program excludes commercial refrigerators. We recommend inclusion of similar model refrigerators and freezers from commercial customers. The eligibility of equipment should be based on vintage and model type rather than sector since the objective is to remove certain equipment from the grid.

Residential Energy Efficient Schools

The residential component of the Energy Efficient Schools program is a traditional efficiency education program that is provided to students in grades 5 and 6 for all K-12 schools in the state. For Duke Energy Indiana, the program will target grade 5. This program provides educational material that is designed to be interactive and interesting to the targeted age group. In addition, a kit of low-cost energy efficiency measures will be provided to each student for installation at home.

[27] Appliance Recycling Centers of America, Inc. (ARCA), 7400 Excelsior Blvd., Minneapolis, MN 55426 [952-930-9000] [www.arcainc.com].

[28] JACO Environmental, Inc. (JACO), 7115 Larimer Road, Everett, WA 98208 [425-290-6291] [www.jacoinc.net].

Rationale

This program takes the form of a traditional educational outreach program for the implementation of energy efficiency products and to generate future energy savings through behavioral changes. In addition to energy efficiency subjects, public service topics in the form of electrical safety issues may also be addressed in the educational material provided. The most important value of this program is in the area of practical education to support rational lifetime personal decisions in the area of energy efficiency. The measured savings associated with the program are produced through the installation of low-cost measures, and the process of providing these measures in a take-home kit has proven to be an effective method of product placement.

Measures

Measures are shown in the table below.

Table 25. Measures and Incentives – Residential Energy Efficient Schools

Measures	Measure Number	Incentive	Measure Savings (kWh)*	Measure Incidence Rate per Participant	Measure Savings per Average Participant (kWh)
CFL (3)	R-39	100%	77	1.0	77
LED (3)	R-40	100%	129	1.0	129
Low Flow Fixtures	R-42	100%	179	1.0	179
Total Savings per Average Participant					385 kWh

* Savings values associated with measures provided by this program have been reduced to reflect the lower implementation rates determined for this program by the 2012 program cycle independent evaluation.

Delivery Channels and Marketing

Delivery of the program will be implemented through direct contact with school administrative personnel. The development of an effective and interactive educational kit will be developed in accordance with the Indiana Common Core State Standards. Teacher and student incentives may be developed to support high program participation.

This program should provide educational materials and conservation kits directly to students within a classroom-based or assembly-based presentation.

Special Considerations

The budget for this program includes program materials development, scheduling and implementation of presentation, the production of presentation materials and efficiency kits and may include additional costs associated with the development of implementation incentives and follow-up and tracking system costs.

Residential Building Code Support

Due to its nature, the Residential Building Code Support Program is still under development. This description of program operations and savings is strictly based on hypothetical scenarios. The final savings and costs associated with this program are yet to be determined. The goal of the building code compliance enhancement program is to lead the State of Indiana on a multi-year path to embracing building code support.

Rationale

The implementation of updated building codes is the most effective methods for shifting building stock to higher efficiency levels through its gradual replacement by new construction built to higher standards. The difficulties associated with accurate and timely implementation of higher code standards are recognized to be a major risk within this process.

Measures

This program is still under development, no measures currently exist for implementation toward the achievement of program goals. In order to properly advance the concept in Indiana, a deliberate and well thought-out stakeholder process should be executed to:

- Define guiding principles and a framework for developing a program
- Establish a baseline with respect to building activity, generally which is below code required levels
- Develop an EM&V framework for capturing motion toward code compliance, either in terms of compliance rates or partial compliance
- Parse out the energy savings attributable to increased code awareness
- Develop comprehensive, high quality training
- Collect input from interested stakeholders, such as homebuilders, building officials (local and state), architects, engineers, energy raters, product manufacturers, building trades (carpenters, electricians, etc.), and the Demand Side Management Coordination Committee
- Develop a process for simple and complete plan reviews and inspections

Delivery Channels and Marketing

The delivery channels and marketing for this program will be developed as part of the program process.

Special Considerations

It is recommended that costs associated with the development of this program are carried within portfolio overheads until measurable savings can be attributed to program activities.

C&I Energy Efficient Schools

The C&I Energy Efficient Schools Program targets schools for on-site audit and feeds into other utility sponsored programs for the implementation of cost-effective energy efficiency measures. The school audit program will be available to all K-12 schools in the Duke Energy Indiana service territory, except those that previously participated in the 2012 School Audit program. The program will promote the installation of energy efficient measures and operating procedures in K-12 school buildings and will also attempt to leverage opportunities for collaboration and coordination of school programs provided by gas utilities.

The duties of the TPA of this program are as follows:

- Development and implementation of a school energy audit program.
- Delivery of program marketing by identifying, targeting and securing schools to participate in the program.
- Schedule energy audits with participating schools.
- Perform energy audit for participating schools.

The Administrator will determine the audit protocol with the approval of the DSMCC. At least one on-site visit must be included in all audits. The Administrator is required to define in their proposal the maximum length of time between the on-site visit and the delivery of the audit report. As part of the bid response the Administrator shall provide an example of the Audit Report.

The audits may include the following components:

- An executive summary which shall include a project summary chart.
- A minimum of one year of energy data: demand (if applicable), kWh used per month, total cost, $/kWh, load factor, load shapes (if available). Energy data should include monthly gas data and other fuels.
- Inventory of all significant energy users and all energy sources.
- Possible and recommended EEMs and operational changes, with cost, savings, and simple payback.
- Analyzed, but not recommended, EEMs with justifications.
- Information on applicable Participating Utility DSM programs and financing mechanisms or opportunities available to implement capital projects (both Core and Core Plus).
- List of potential measures requiring more in-depth analysis to determine feasibility.
- All audits should be hand delivered to the Participating Customers, preferably to the financial decision maker who was identified on the application. The contractor’s cost shall include the costs of conducting this presentation meeting with the Participating Customers to deliver the audit, explain the report, explain the applicable programs, and discuss an implementation plan.
- Develop and implement a strategy to encourage implementation of audit findings.
- Follow-up with each participating school regarding implementation of audit findings.
- Provide specific information about each program’s performance (measure installations for the month and year-to-date, energy savings results (e.g. gross and net), budget expenditures and performance metric results (e.g. productivity, participating utility satisfaction, and accuracy)).

Rationale

Recent reductions in state education budgets for K-12 schools have significantly reduced an already inadequate supply of available funding for necessary energy efficiency retrofits within this sector. Costly site-wide retro commissioning audits are considered to be a significant hurdle to the implementation of energy saving retrofits and the introduction of measures through existing efficiency programs. Within this environment, a site-wide audit and a comprehensive series of behavioral recommendations for further energy efficiency gains will produce significant savings results within this sector.

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. The incentive level for these measures is listed as 50 percent of incremental costs.[29] The audit will be 100 percent incented to support marketing and promotion of this program.

Table 26. Measures and Incentives – C&I Energy Efficient Schools

Measures	Measure Number	Incentive	Measure Savings (kWh)	Measure Incidence Rate per Participant	Measure Savings per Average Participant (kWh)
Small HVAC Optimization and Repair	C-3	50%	4,719	0.10	472
Re/Retro-Commissioning Lite	C-5	50%	23,594	1.00	23,594
Chiller Tune-Up	C-9	50%	11,797	0.04	472
Outside Air Economizer	C-14	50%	2,359	0.02	47
VFD HVAC	C-17	50%	12,500	0.05	625
Cool Roof	C-18	50%	2,359	0.01	24
LED/Efficient Outdoor Lighting	C-27	50%	13,126	0.70	9,188
Retrofit Efficient Non-Controls Lighting Equipment	C-29	50%	18,875	0.70	13,213
LED Exit Signs	C-30	50%	1,180	0.60	708
C&I Lighting Controls	C-33	50%	7,078	0.40	2,831
Low Flow Fixtures	C-35	50%	6,000	0.02	120
Vending Miser® (3)	C-50	50%	4,836	0.50	2,418
Total Savings Per Average Participant					53,711 kWh

School energy audits will provide a list of possible and recommended energy efficiency measures (EEMs) and operational changes, with cost, savings and simple paybacks. It will also provide a list of potential EEMs that were analyzed but not recommended and ones that may be cost effective but need further study. The utilization of effective financing mechanisms, such as on-bill finance or the leverage of state or federal grants for the implementation of measures, will also be explored.

Delivery Channels and Marketing

Delivery of the program will be implemented through direct contact with school administrative personnel. Schools are highly organized bureaucratic institutions with several levels of decision making and significant outreach will be necessary to clear program participation and enlist support within multiple levels of school organizations. This

[29] Lighting measures included in this list are also provided through the C&I Prescriptive and Lighting Buy-down programs. Care must be taken to ensure that measures acquired through these programs are not double counted.

will include direct school or school corporation outreach with a focus on key school decision makers, booths at school related trade shows, telephone contact, joint marketing with other program partners, and use of web-based and e-mail outreach to schools, school corporations, and key school decision makers.

We recommend personal contact and personal follow-up at the different levels of organization necessary to secure clearance and support. The necessary extent of contacts and follow-ups to cultivate relationships is likely a large investment of time and effort, and the extent required will be discovered as outreach proceeds and follows through to successful audits.

C&I Lighting Buy-Down

The C&I Lighting Buy-Down Program is a program designed to assist in providing a market transformation force for the implementation of high performance (HP) T-8 lamps and ballasts. Current national standards have prohibited the importation and manufacture of T-12 lamps within the United States. This program is designed to ensure that a high percentage of replacement units for existing T-12s will be the HP T-8s as opposed to standard T-8 fixtures. The C&I Lighting Buy-Down Program encourages wholesale lighting equipment distributors to stock and sell high efficiency alternatives to baseline T-8 lamps. The program works toward this goal by using wholesale, point-of-purchase incentives to buy down the incremental cost of energy efficient products through manufacturer and distributor partnerships, and through the education and communication with their contractor and end-use consumers via outreach, in-store events and sales training.

The TPA will:

- Work with distributors and manufacturers to develop a process to offer buy-downs on T-8 lamps on a year-round basis
- Obtain discount pricing on T-8 lamps from manufacturers and determine what additional buy-down is necessary to generate cost-effective sales to meet MWH goals
- Develop a customer tracking methodology to insure that only Participating Utility customers are purchasing lamps and that the attribution is going to the correct Utility
- Determine what products will be offered in the program

In addition, the TPA will manage all aspects of the program with manufacturers and distributors including:

- Coordination with manufacturers on products and discount
- Coordination with distributors on stocking products in sufficient quantities to ensure no lapse in available program products
- Coordination with distributors on training of personnel
- Participation with manufacturers on cooperative promotions and short term additional discount promotions
- Ensuring products are sold only to Participating Utility customers
- Reporting data
- Other duties as assigned or needed

Rationale

The rational for this program is to take strategic advantage of the Energy Security and Independence Act of 2007. The Energy Security and Independence Act of 2007 has implemented a ban on the importation and manufacturing of T-12 lamps and ballasts for the United States. Consequently, the remaining stores of T-12 lamps are being depleted, resulting in increased costs. Eventually this trend will lead to the forced replacement of all T-12 fixtures within the Duke Energy Indiana service territory.

The C&I Lighting Buy-Down Program is established to remove the incremental costs between standard T-8 ballasts and lamps and HP T-8 ballasts and lamps. This buy-down is targeted to reach manufacturers of this equipment through local distributors to allow a leveraged reduction in final costs to the end market user. The increased performance of the HP T-8 lamp justifies its implementation at a higher rate now and will lead to a rapid transformation of the current lighting market, leading to further efficiency gains in future years.

The success of this program is likely based on lowering the cost of HP T-8s below the market cost of standard T-8s as the market for lighting is largely driven by cost and advice of lighting contractors.

Measures

Since the intention of this program is to ensure that a new, higher efficiency fixture and lamp are installed to replace a currently obsolete one, the total savings calculated are based on the differential between the higher efficiency HP T-8 equipment as compared to a standard T-8 fixtures and lamps. This savings value was provided in the Indiana TRM. The total potential count of T-12 fixtures in place for retrofit was estimated using comparative market and lighting studies and adjusting for new construction installations. For the purposes of this study, the average estimated annual savings per 3-lamp replacement from T-12 to HP T-8 in a commercial use setting is 62.2 kWh.

Delivery Channels and Marketing

Delivery of this program is performed by the TPA in the form of direct contact and negotiation with manufacturers, distributors, trade allies, and others who may be associated with commercial HP T-8 production and supply.

All marketing and promotion will follow the approval process agreed upon by the TPA Subcommittee and TPA before implementation. TPA field representatives will use regular store visits as an opportunity to interact with distributors and trade allies to determine impression of the C&I Lighting Buy-Down Program and help to answer any questions. All marketing and promotion will follow the approval process agreed upon by the TPA Subcommittee and TPA before implementation. Direct mail, web-based promotions, educational materials, FAQ's, promotions and limited-time bonus incentives will all be used and coordinated with manufacturers and distributors to increase awareness and spur sales.

Special Considerations

Costs associated with the implementation of the C&I Lighting Buy-Down Program will be generated through per unit sales and negotiated tracking costs. Additional costs may be generated through manufacturer and distributor outreach as well as through the development and implementation of specific packaging and marketing signage for program promotion at the point of sale.

C&I Small Business Direct Install Program

The C&I Small Business Direct Install Program is designed to provide a point of entry to other energy efficiency programs for business with less than 200 kW of peak load. The program is intentionally limited in scope and serves as a feeder program to comprehensive programs and broader rebate programs. The program objectives are to promote the installation of prescriptive efficiency measures to targeted customers to:

- Lower electric energy consumption.
- Assist customers in managing their electric energy costs.
- Build market based activity which will capture near and long term energy and demand savings.
- Encourage C&I customers to participate in other Core and Core Plus programs.

Measures

Measures are shown below.[30]

Table 27. Measures – C&I Small Business Direct Install

Measures	Measure Number	Incentive	Measure Savings (kWh)	Measure Incidence Rate per Participant	Measure Savings per Average Participant (kWh)
Efficient Outdoor lighting LED	C-27	100%	2,625	0.5	1,313
Retrofit Lighting	C-29	100%	3,775	0.7	2,643
LED Exit Signs	C-30	100%	236	0.6	142
C&I light Controls	C-33	100%	1,416	0.4	566
Total Savings Per Average Participant					4,663 kWh

This is a continuation of an existing program with the 2015-2017 Third Party Administrator. The duties of the TPA include:

- Target appropriate customers based on utility-supplied data.
- Provide mechanism for customers to enroll in the program through various platforms.
- Provide appropriate measures to customers based on needs.
- Administrator may decide to target different sectors or provide different measures (i.e. a T8 lighting program and a refrigeration program).
- Administrator may elect to provide the installation through a network of contractors or other trade allies.
- Track and report installation and non-installation of measures and provide an explanation of the reasons any measure was not installed.

[30] Measures included in this list are also provided through the C&I Prescriptive and Lighting Buy-Down Programs. Care must be taken to ensure that measures acquired through these programs are not double counted.

Delivery Channels and Marketing

The delivery channel for this program is in the form of direct contact with small businesses for the direct implementation of measures and recommendations. In general, this is a difficult market to serve because small businesses have neither staff nor time to address energy efficiency. Therefore, direct canvassing may be a very important marketing strategy. Specific promotional approaches can include:

- Trade ally outreach dedicated staff
- Trade ally rollout meetings
- Trade ally advisory group
- Web-based marketing
- Email marketing to trade allies and potential Participating Customers
- Limited time bonus incentives
- Education materials
- Frequently Asked Questions ("FAQs")
- Training and coordination with Participating Utility appropriate account representatives
- Cooperative advertising

Direct canvassing and flyer distribution at local businesses in high-density regions during normal business hours is expected to be the most comprehensive outreach platform. This approach is designed to allow the program implementer direct access to the company owner/decision maker for the potential scheduling of program implementation activities.

Marketing and promotional activities for the program may take the following forms:

- Radio and TV spots, though TV is such a dispersed geographic service territory it may be expensive.
- Local small business advocacy organizations and their sponsored events will be used for placement of program information for distribution.
- Utility communications, such as bill stuffers, direct mail and mention on the Duke Energy Indiana website.
- Similar communications should be provided from Efficiency Indiana.

The TPA will be required to:

- Promote the program in the marketplace through contractors and participating groups or associations.
- Be responsible for building awareness with market providers, so as to encourage use of the program, including individual meetings with market providers and participating groups or associations.
- Maintain active participation in major trade associations located in target areas.
- Document personal contacts each month with selected program dealers (phone, in-person).

C&I Express Rebates

The C&I Express Rebate program is a prescriptive program that reduces the incremental costs associated with pre-screened efficiency products that are proven to be effective and qualify for program participation. Incentive rates are provided at 50 percent but may vary depending on participant response rates.

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 energy efficiency investments (e.g. HVAC systems or energy management systems). The C&I Express Rebate proposed incentives will help remove that barrier. This program will work in parallel to the C&I Core Plus rebate program. The combined effort of these rebate programs are a major contributor to the entire DSM effort.

Measures

Measures are shown below.

Table 28. Measures – C&I Express Rebates

Measures	Measure Number	Incentive	Measure Savings (kWh)	Measure Incidence Rate per Participant	Measure Savings per Average Participant (kWh)
Single Application VSD	C-24	50%	11,797	0.02	236
LED/Efficient Outdoor Lighting	C-27	50%	13,126	0.15	1,969
New Efficient Non-Controls Lighting Equipment *	C-28	50%	4,719	0.80	3,775
LED Exit Sign	C-30	50%	1,180	0.10	118
LED Traffic Lights (10)	C-31	50%	14,902	0.01	149
C&I Light Controls	C-33	50%	7,078	0.10	708
Vending Miser® (3)	C-50	50%	4,836	0.05	242
Efficient Air Compressor	C-63	50%	4,310	0.02	86
Total Savings Per Average Participant					7,283 kWh
* Savings values for this measure have been adapted to reflect an adjustment to the mix of lighting measures offered through the program.					

Delivery Channels and Marketing

Delivery for this program consists of the collection of rebate applications and the provision of rebate checks to applicants. Marketing activities provided by the TPA will:

- Determine the products and the incentive amount for efficient products offered through the program.
- Establish/maintain good relationships with retailers and the ability to secure attractive shelf location of the promotional product during incentive periods.
- Develop and implement effective consumer marketing in order to raise consumer awareness of the program and drive customer traffic to participating retail locations.
- Develop program specific informational materials.
- Invest in consumer education regarding the program and selected products.
- Develop in-store displays both shelf-talkers and larger aisle displays.
- Develop take-away brochures for distribution to store customers to identify and promote the products included in the program. The TPA will be responsible for placement and verification of this type of motivational promotion.

- Secure the placement of public service ads (free and/or paid) to motivate participation in the program on radio and TV, with possible assistance provided by DEI.
- Coordinate with big box stores in running periodic promotions.

Special Consideration

Currently this program provides a measure delivery that is complimentary to the Core Plus C&I Prescriptive Program. This dual provision of rebates for various efficiency products is recognized as causing potential confusion among the customer base. Consideration should be made going forward to consolidating the two programs offered within a single delivery mechanism.

Core Plus Programs

Within Indiana's dual administrator system, the Core Plus programs are offered in addition to the Core programs. They are intended to serve the unique needs of the service territory and are administered by the Company.

Residential Prescriptive

The Residential Prescriptive Program is a Core Plus program that is an expansion of the current Core Plus Duke Smart$aver HVAC Install Program. The expanded program will provide rebates to Duke Energy customers toward the purchase of energy efficient products, such as heat pump water heaters, selected consumer electronics, and cool roof materials, as well as the current program offerings for efficient HVAC equipment installation.

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 ES program and the overall success of the ES strategy as demonstrated by the gradual increase in energy efficiency of base case (non-ES) equivalent products. Refrigerators may be included based on analysis as new ES 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 CEE tiers.

Rationale

Residential products incentives improve the implemented 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.[31]

[31] 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.

Measures

Representative measures are shown in the table below.

Table 29. Measures and Incentives – Residential Prescriptive

Measures	Measure Number	Incentive	Measure Savings (kWh)	Measure Incidence Rate per Participant	Measure Savings per Average Participant (kWh)
Elec Furnace to SEER 15 Heat Pump SF	R-2	50%	10,669	0.05	533
SEER 13 to SEER 15 Heat Pump SF	R-8	50%	900	0.15	135
SEER 13 to SEER 15 CAC New	R-10	50%	180	0.10	18
Efficient Window AC	R-12	50%	45	0.03	1
EE Windows	R-14	50%	1,372	0.05	69
Programmable Thermostats	R-15	50%	639	0.10	64
Efficient Dehumidifiers	R-28	50%	297	0.05	15
Energy Star Clothes Washer	R-31	50%	202	0.05	10
Energy Star Refrigerators	R-33	50%	150	0.05	8
Pool Pumps	R-34	50%	436	0.01	4
Efficient TV	R-35	50%	70	0.10	7
Heat Pump Water Heater	R-43	50%	2,097	0.12	252
Ductless Heat Pump	R-46	50%	3,224	0.14	451
Total Savings Per Average Participant					1,567 kWh

Delivery Channels and Marketing

Delivery of the program is performed by the collection and processing of rebate applications provided by the participant after the purchase of qualified efficiency products. 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.[32, 33]

The basic marketing goals for the appliance program elements come from the CEE and are provided below:[34]

- Consumers understand and value the benefits from energy-efficient features.
- Retail sales force is knowledgeable about ES 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 ES 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 CEE retail appliance or a Top Ten™

[32] See the WECC paper on residential appliances at http://www.aceee.org/utility/ngbestprac/wecc.pdf. Note that this paper is for a natural gas clothes washer program, however "lessons learned" regarding relationships and promotion would apply across appliance programs.
[33] A review of rebates offered across the US indicates 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/.
[34] CEE's National Residential Home Appliance Market Transformation Strategic Plan, December 2000 (http://www.cee1.org/resid/seha/seha-plan.php3).

level ES appliance. Though we refer to the efficient alternative as Energy Star, we really mean Tier 3 or Top Ten™ appliances.

General goals for Duke and the program delivery agents are as follows:

- Establish/maintain good relationships with retailers and the ability to secure attractive shelf location/aisle positioning of the promotional product during incentive periods.
- Develop and implement effective consumer marketing in order to raise consumer awareness of the program and drive customer traffic to participating retail locations.
- Develop program specific informational materials.
- Invest in consumer education regarding the program and selected products.
- Develop in-store displays, both shelf-talkers and larger aisle displays. Take-away brochures will be developed for distribution to store customers to identify and promote the products included in the program. Duke Energy Indiana's program delivery agents will be responsible for placement and verification of this type of motivational promotion.
- Promote the program on its website, through bill stuffers and in call center scripts.
- Secure placement of public service ads (free and/or paid) to motivate participation in the program on radio and TV, and coordinate with big box stores in running periodic promotions.
- Identify and develop trade allies to push these products.

Special Considerations

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

Residential Long-Term Lighting

The Residential Long-Term Lighting Program is a Core Plus Program that is essentially identical in design and scope to the Core Residential Lighting Program. This program is designed to meet continued residential sector lighting needs and promote energy efficient lighting products after compact fluorescent lamps are no longer listed as ES products subsequent to the 2020 implementation of the lumens per watt requirements found in the Energy Independence and Security Act of 2007.

Rationale

Incremental costs are the primary hurdle for the implementation of energy efficient lighting products in the current market. Past program experiences in multiple service territories indicate that, in absence of price-reducing rebates, volume sales of energy efficient lighting products can be expected to decline significantly.

Measures

Measures are shown in the table below.

Table 30. Measures and Incentives – Residential Long-Term Lighting

Measures	Measure Number	Incentive	Measure Savings (kWh)	Measure Incidence Rate per Participant	Measure Savings per Average Participant (kWh)
Occupancy Controlled Outdoor	R-37	50%	250	0.60	150
LED Residential Outdoor Yard Light	R-38	50%	1,000	0.25	250
LED (6) *	R-40	50%	300	0.80	240
Total Savings per Average Participant					640 kWh
* Savings value adjusted down to reflect changes in future lighting baselines.					

Delivery Channels and Marketing

By design this program uses retail outlets as the primary delivery channel. Duke Energy Indiana's program delivery contractors will:

- Provide sufficient lead-time and market projections to assure that adequate inventory is available during promotional periods.
- Establish/maintain good relationships with retailers and the ability to secure attractive shelf location of the promotional product during incentive periods.
- Develop and implement effective consumer marketing in order to raise consumer awareness of the program and drive customer traffic to participating retail locations.
- Develop program specific informational materials.
- Invest in consumer education regarding the program and selected products.
- Develop in-store displays, both shelf-talkers and larger aisle displays. Also, take-away brochures for distribution to store customers will be developed to identify and promote the products included in the program. Duke's program delivery contractors will be responsible for placement and verification of this type of motivational promotion.
- Promote the program on its website, through bill stuffers and in call center scripts.
- Secure placement of public service ads (free and/or paid) to motivate participation in the program on radio and TV, possibly with the assistance of Duke Energy Indiana.
- Coordinate with big box stores in running periodic promotions.

As a continuation of the current Core Residential Lighting Program, this program is essential to ensure continued residential sector efficiency gains as new lighting technologies are developed and incremental costs continue to be a hurdle to the average home for the implementation of these measures.

Residential Home Energy Audit and Weatherization

The Residential Home Energy Audit and Weatherization Program is a Core Plus program that is an expansion of the current Core Residential Low Income Weatherization Program. The program is designed to meet the weatherization needs of residents of single family detached electrically heated homes that do not qualify for the Core Residential Low Income Weatherization Program. The program is designed to directly install high cost measures *and provide an on-bill finance option for no-money down options of implementation*.[35] In addition a significant portion of customers are intended to also be referred to other program offerings with measures not included in the weatherization program.

Rationale

The implementation of an audit, leak test and weatherization treatment program for existing electrically heated housing stock is consistent with industry standards for achieving the goal of dramatically improving the energy usage profiles within the residential sector. The offering of cost-effective weatherization measures and installation services with an appropriate incentive can overcome out-of-pocket cost barriers that have previously prevented the capture of this potential market share. For the purpose of program recommendations, a measure incentive of 50 percent of incremental costs is indicated for this program. However, customer response and cost effectiveness of the measure will determine whether some measures may require a higher incentive level.

Measures

Representative measures are shown in the table below.

Table 31. Measures and Incentives – Residential Home Energy Audit and Weatherization

Measures	Measure Number	Incentive	Measure Savings (kWh)	Measure Incidence Rate per Participant	Measure Savings per Average Participant (kWh)
Refrig Charge/ Duct Tune-Up Electric	R-6	50%	1,021	0.15	153
Efficient Window AC *	R-12	50%	124	0.15	19
Programmable Thermostats	R-15	50%	639	0.25	160
Ceiling Insulation	R-16	50%	1,650	0.30	495
House Sealing	R-18	50%	1,052	0.80	842
Wall Insulation (R3-R11) Electric	R-21	50%	1,200	0.20	240
Eliminate Old Refrigerator *	R-29	50%	789	0.05	39
Occupancy Controlled Outdoor Lighting	R-37	50%	250	0.005	13
LED (12) *	R-40	50%	600	0.10	600
Tank Wrap, Pipe Wrap and Water Temp Setpoint	R-41	50%	200	0.25	50
Low Flow Fixtures	R-42	50%	596	0.95	566
				Total Savings Per Average Participant	3,176 kWh
* Savings values adjusted to reflect changes in the size of application and delivery mechanism used in program.					

[35] Participation projections do not assume on-bill financing (OBF) or on-bill payment (OBP) since either of these would require legislative action. Time will tell if it will be necessary to increase incentives in order to reach participation goals.

Delivery Channels and Marketing

Similar to the state Low Income Weatherization Core program, this program provides an all-inclusive mechanism proposed for the implementation of a whole-house weatherization and energy audit. This program is physically provided via the canvassing, outreach and registration efforts of the Duke program contractor who will perform on-site program measure implementation. *The provision of on-bill financing is key to allowing significant housing stock retrofitting and high incident cost measure treatment.*

Delivery channels for this program may consist of the following:

- Primary to direct outreach campaigns, a detailed winter heat load and summer cooling load billing analysis should be conducted to determine high use winter heat load homes and high summer cooling load homes within the service territory. A direct contact from administrator personnel via bill insert, phone or canvassing is preferred as a primary enrollment method.
- Marketing and promotional efforts include the use of utility bill stuffers for customer education; also mention of the program in communications with customers regarding energy efficiency program options, the Duke website, the Energizing Indiana website, and call center staff should be provided scripts to handle calls by customers for information.
- One promotional and marketing platform is radio and TV advertisement directed at targeted audiences. Internet advertisement methods are also increasing in precision and have recently increased ability to reach target markets.
- Canvassing efforts will be utilized to provide education and outreach for the program and register potential customers for later program implementation visits.

Special Considerations

This is a very important program that fills the need for regular residential customers that are not met by other program offerings that provide significant material improvements under a comprehensive whole-house approach.

Residential Home Reports

The Residential Home Reports Program 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. This program differs from most other programs in that savings is "black boxed" and is counted for one year at a time.

Rationale

Customer report programs 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 a definite percentage 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.

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 32. Measures – Residential Home Reports

Measures	Measure Number	Incentive	Measure Savings (kWh)	Measure Incidence Rate per Participant	Measure Savings per Average Participant (kWh)
Customer Report	R-50	100%	193	1.0	193

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. Duke has considerable experience with this program type so that participation levels will be set with reasonable certainty in advance, and participants may be replaced as necessary to compensate for opt-outs. As this program matures, different groups of customers may be targeted for participation.

Delivery Channels and Marketing

Since the program content is marketing and promotion/corporate communications there is not a special marketing plan or delivery channel other than the actual Customer Reports. Instead, the program manager will determine which customers should be included and which excluded from the program (targeting). Once the program manager determines the eligible customers, a best practice is for the total group eligible for the program to be split using random assignment conducted by the third party independent evaluator.[36] Also, frequency of reports may be quarterly or varied. A more recent development has been the attempt to drive customers to a website where they will put in information about themselves, their homes and their living patterns so as to receive more highly tailored suggestions to save energy. Generally, it has been found that the percentage of targeted customers who become attached to the website is small but savings for this small group is higher than for customers who do not develop a focus on the website.

[36] State and Local Energy Efficiency Action Network. 2012. *Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations.* Prepared by A. Todd, E. Stuart, S. Schiller, and C. Goldman, Lawrence Berkeley National Laboratory. http://behavioranalytics.lbl.gov.

C&I Prescriptive

The C&I Prescriptive Program is a continuation of a current program type. The program targets non-residential customers eligible for electric prescriptive measures. These include commercial, industrial, institutional, educational and government agencies, both for-profit and non-profit, public and private.

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 energy efficiency investments (e.g. HVAC systems or energy management systems). Duke Energy's proposed incentives will help remove that barrier.

Measures

For this program type, some utilities simply offer an approved list of equipment for which rebates are available. New measures may be added to the list that become available and meet approval guidelines, often these new measures may be suggested by a customer or trade ally.

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. The incentive level for these measures is 50 percent of incremental cost of the efficient unit as compared with baseline.

Table 33. Measures and Incentives – C&I Prescriptive

Measures	Measure Number	Incentive	Measure Savings (kWh)	Measure Incidence Rate per Participant	Measure Savings per Average Participant (kWh)
Premium New HVAC Equipment	C-8	50%	13,126	0.15	1,969
Window Film	C-10	50%	2,359	0.04	94
Split System AC	C-12	50%	4,719	0.07	333
Electrically Commutated Motors	C-21	50%	10,501	0.07	735
Premium Motors	C-22	50%	3,745	0.07	262
Transformers	C-25	50%	15,000	0.004	60
HE Food Prep and Holding	C-38	50%	2,847	0.02	57
Restaurant Commissioning Audit	C-40	50%	21,002	0.07	1,470
Steam Cooker	C-41	50%	8,429	0.05	421
Energy Star Fryers	C-42	50%	983	0.05	49
Energy Star Combination Oven	C-43	50%	18,431	0.05	929
Energy Star Convection Oven	C-44	50%	3,235	0.05	162
Energy Star Griddle	C-45	50%	6,996	0.05	350
Spray Nozzles for Food Service	C-46	50%	24,934	0.03	748
Efficient Package Refrigeration	C-47	50%	26,253	0.05	1,313
Refrigeration Casework Improvements	C-49	50%	13,126	0.05	656
Refrigerated Case Covers	C-51	50%	25,988	0.04	1,040
Door Heater Controls for Cooler - Freezer	C-52	50%	15,333	0.04	613
Door Heater Controls for Cooler - Refrigerator	C-53	50%	3,245	0.04	130
New Energy Star Ice Machine	C-54	50%	2,393	0.02	48
Solid or Glass Door Refrigerators, New	C-55	50%	3,168	0.04	127
Strip Curtains for Coolers	C-56	50%	1,608	0.04	64
Door Gaskets for Refrigerated Cases	C-57	50%	4,719	0.04	189
Network Computer Power Management	C-58	50%	5,251	0.03	158
High Efficiency Pumps	C-59	50%	2,359	0.04	94
Total Savings Per Average Participant					12,061 kWh

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. Also, Duke Energy has substantial experience with this program type across several jurisdictions. For these reasons we would normally expect this program to easily communicate to customers and to have high uptake in program participation.

However, this program type may require more extraordinary focus, effort and innovation in Indiana. There are two factors that lead to this perspective. First, Indiana is trying out a "two administrator" concept while best practice for energy efficiency has long been "one-stop shopping."[37] Second, Indiana has not yet determined if the largest C&I customers will be self-administering their own energy efficiency programs and coordinating with and providing energy savings results to their utility, or whether they will be served through utility administered programs[38]. DEI will not be able to meet their stipulated energy conservation goals without the participation of these customers. Suppressed uptake may also be due to inadequate customer awareness levels of program offerings. However, on the plus side, it is important to note that unlike most other programs, participants may return repeatedly to this program to purchase additional products.

Delivery Channels and Marketing

Delivery for this program consists of the collection of rebate applications and the provision of rebate checks to applicants. Most successful programs work through a focus on strategic marketing. We recommend this program be promoted though the following activities:

- Some general advertising, primarily in the form of brochures and mailings targeted to potential program participants and potentially radio, at additional cost.
- Continued posting of a comprehensive and continually updated measures list on Duke Indiana's website.
- Work directly with business associations to provide program details to customers.
- To the extent that these customers have account representatives, the account representatives should communicate the advantages offered by the program to C&I customers. For the largest firms, the best contact is usually directly with those firms through the assigned account representative (for large firms, the account representative should be an officer or a very high ranking manager who works in relationship with a firm over many years).
- Providing trade show tabling and conference presentations.

Tools

Specific implementation pilots should be developed that will provide specialized measures that are implemented through trade allies at no cost to participating customers. For example, a direct install commercial LED/Halogen replacement program for small and medium commercial customers and a high-efficiency walk-in refrigerator compressor motor exchange program, among others.

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[37] In nearly all jurisdictions, either the individual utilities are the program administrators (e.g. California and Ohio) for DSM programs, or a corporate but quasi-public entity is created as the state or provincial DSM administrator (e.g. the Oregon Energy Trust and the Efficiency Nova Scotia Corporation). Indiana and New York currently use both a statewide administrator (New York State Energy Research and Development Administration in New York and Efficiency Indiana in Indiana) and the individual utilities to serve as program administrators. In reviewing New York evaluations, process evaluations tend to document customer confusion over what are perceived as competing programs. Certainly from a marketing perspective it is preferable to have a very clear and repeated message, and "one-stop shopping" is simpler than dealing with two administrators.

[38] Essentially, this would be equivalent to creating a three administrator pattern for Indiana.

Although we have not included an audit expense, the program could be run with or without a simple audit. Audit costs, if any, would also be incented at 50 percent with reimbursement of full cost for audits when measures are installed that pass a cumulative energy savings criterion or cost-effectiveness score. If audits are offered they may be delivered by utility staff or by a program delivery vendor selected for this program. Alternatively, the utility can work with trade ally firms that do C&I retrofits of various types as their core business to stimulate program activity. Trade ally firms then bundle audits with prospective retrofit work and utility rebates. This requires utility screening and recommendation for approved trade allies.

The goal of the audit capability is to move more product if initial response is slow. If an audit program delivery vendor is selected, accountability to the utility is contractual and straightforward. If independent trade allies are used to stimulate the market, there may be expenses to the utility for initial training, requirements, for certification and for maintaining certification of firms and their staff employees. Accountability to the utility would be worked out as a part of that package.

Another tool is the "no touch" audit, such as New Buildings Institute's First View, which extracts information out of billing data that can indicate potential customer benefit from program participation without going to the utility. Retroficiency is another vendor for this type of tool, their product uses hourly data for a more focused approach. In this way likely buildings are identified from utility records, and buildings for which there will be little energy benefit will be culled out.

We suggest the best practice is to offer audits through trade allies due to the need to increase uptake by the program and meet overall goals. We expect "no touch" as the wave of the future and recommend it as the primary approach to reach customers with high potential benefits if there is an additional need to move more product. However, work in this area is new and not fully formed.

Special Considerations

If there is slow uptake after one year, then a strategy of economic investment, in trade allies may be undertaken. These investments may take the form of targeted subsidies (SPIFFS) for product sales. This strategy is useful for mid-sized and smaller firms, but generally not with the largest firms.

C&I Custom

The C&I Custom Program is a continuation of a current program type. This program, due to its nature, should look at both the gas and electric energy savings potential.[39] The program targets only C&I accounts. The program is designed to develop exceptionally productive energy savings opportunities customized for and in cooperation with the customer. Because it is structured to meet the specific needs of the customer, both electric and natural gas measures will be included, though only electric energy savings is accounted for in this report. Each project will be individually designed. The recommended program incorporates three subprograms: medium C&I, large C&I, and new construction integrated building design beyond code. The basic idea is a single custom program with several tailored delivery channels that may change over time.

The incentive will be the amount required to lower the customer payback to two years, up to a maximum of 50 percent of the incremental cost of the electric energy efficiency measures. The remaining costs, which do not affect electricity savings but may result in natural gas savings and process improvements for more efficient production, will be the responsibility of the customer. It is expected that some projects will need to be carried out within a narrow time window as dictated by site-specific operation schedules. In this scenario, evaluation requirements may consist primarily of short-term instrumentation and spot metering. The simple payback for projects under this program will be set to insure that cost-effective projects are selected that will meet the customer's internal hurdle rate for projects and to insure DSM cost recovery.

Rationale

Some C&I customers will offer special opportunities for energy savings, either brought to Duke Energy by the customer (or the customer's ESCO), or as identified by company account representatives and engineers. By supplying a negotiated incentive that provides a portion of the costs associated with the development of projects, plus a 50 percent buy-down of incremental electric efficiency project costs, customer projects will be more likely to move forward.

Development will consist of an engineering study to isolate the cost and yield of high energy efficiency alternatives to standard practices and equipment experience will show what buy-down percent is enough to attract projects. We start at 50 percent buy-down of incremental cost of the high efficiency alternative. If the 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 75 to 90 percent buy-downs in this program sector. If, on the other hand, uptake appears too fast then the incentive could be lowered, but we have seen this happen only at a single utility and believe it is unlikely to happen again.[40] The program administrator should have the freedom to raise or lower the

[39] A total energy perspective will be the perspective of the customer and it is the appropriate engineering perspective for Duke, its delivery agents and trade allies involved with this program. The customer cares about the real bottom line and of the effect of upgrades on production. Marketing and promotion of this program requires taking a customer perspective rather than an electric utility perspective.

[40] In this case, the utility had been ordered to secure all cost-effective electric energy conservation. Much was cost effective because the utility's primary source of generation was oil and oil prices were moving up rapidly. This caused cost-effective DSM subsidies to move up rapidly and it was enough to tip a balance on customer uptake. Moving too fast caused electric

percentage of buy-down offered by the program to assist in meeting company production targets on a case by case basis.

Successful models for this program are the Bonneville Power Administration Energy Smart Industrial Program; the San Diego Gas & Electric and Mid-American Large Bid Programs and the Xcel Energy Large Industrial Process Improvement Program.

At the high extreme, a philosophy that may be associated with this program is to provide a per-unit embedded energy and environmental impact quotient for industry products produced on site. This energy quotient is not based solely on the per-unit energy aspects of production but also applies energy costs associated with distribution, customer implementation, usage, customer decommissioning, recycling and/or deposition/disposal. This is extreme because lifecycle energy savings is not considered a traditional function of the utility industry in providing service to C&I customers. However, it is the larger perspective within which more traditional DSM programs are a functional subtype. This kind of program perspective is future-oriented and can be expected to take on substance under potential future energy and carbon reduction scenarios, with associated cost-recovery mechanisms yet to be developed for practical cost recovery. Sources for this kind of program philosophy are William McDonough & Michael Braungart, *Cradle to Cradle, Remaking the Way We Make Things* (New York: North Point Press, 2002) and Amory B. Lovins & Rocky Mountain Institute, *Reinventing Fire, Bold Business Solutions for the New Energy Era* (Vermont: Chelsea Green Publishing, 2011). Currently, these sources should be viewed as inspirational and of pointing towards a future manifestation for this program type which will become more practical over a decadal time horizon.[41]

Measures

Measures are shown in the table below.

Table 34. Measures and Incentives – C&I Custom

Measures	Measure Number	Incentive	Measure Savings (kWh)	Measure Incidence Rate per Participant	Measure Savings per Average Participant (kWh)
Customer Specified (Large)	N/A	*	250,000	0.40	100,000
Customer Specified (Medium)	N/A	*	30,000	0.50	15,000
Integrated Building Design	C-20	*	65,632	0.10	6,563
Total Savings Per Average Participant					121,563 kWh
* Cost share of each project proposal based on a target two-year simple payback of incremental cost for a set period determined for each project and payment is limited to 50% of energy efficiency incremental project costs.					

rates to rise due to an increasing DSM adder. Not moderating at that point caused rates to continue to rise. This is similar to the situation of solar in France where very successful net metering rules tipped a social balance and lead to a very successful participation of solar generation at the customer level but also results in a run-up of rates.

[41] One of the most intelligent ideas in these sources is to bring in a specialist to look at a customer's products and find ways to reduce inputs while improving quality and life cycle value. This is beyond what utilities do but it is an intelligent direction in which to proceed, a kind of 'compass to steer by'. However, even though this is a clear direction, a utility can only go as fast and far in this direction as regulatory relations permit. Currently we operate in a DSM paradigm established in the mid-1980's in which the problems were different.

Due to the custom nature of this program, a large number of participants is not expected in any of the initial program years. Each participant, in this type of program, is special. Tailoring of the program to specific customers makes each one 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 well for custom settings. A best practice is to recognize the unique baseline for each site, which will depend on the business operating procedures and culture of the customer organization as well as on interactive equipment as much or more than on market factors.

Delivery Channels and Marketing

Delivery of this program is provided through the program delivery agents and DEI program staff. This program has moderate scale, large scale and new construction components. Traditional marketing platforms (i.e. mailings, radio, Internet) are to be used to increase general customer base awareness for specific types of measures that may be implemented within a custom project. There are several initial platforms to use for marketing and promotion and others may be developed through trial and error:

- For large-scale C&I custom program development, a detailed cost-effectiveness study is often required for the justification of very large project retrofits. These studies are often beyond the scope for the client and can typically be performed by a specialist consultant. The costs associated with these evaluations can be quite high and these costs may be offset by the utility within the overall project incentive. Recruiting the largest customers is essentially negotiation rather than marketing and is best done by or with the close sponsorship of account managers. Usually, for the top customers, these managers are intimately familiar with customer operations and maintain a strong utility to industry relationship over many years on a personalized basis. The participation of these largest customers is produced through unique negotiations with each customer that may involve packages that go beyond traditional DSM and may include customer commitments for continued long-term service and/or special industrial rates[42].
- Moderate-sized C&I customers can be approached through program delivery agents or by trade allies specialized in particular industrial or commercial sectors. Also, some program administrators offer a "Kaizan Blitz"[43] [44] type of program delivery service.
- Working with architects and design firms, implementation of integrated building design above code programs require a separate mode of implementation that aggressively attracts regional construction and design firms to provide efficient material and design alternatives to their customers. Motivation to participate in the project involves an incentive provided to the customer that is based on the target project's savings above baseline building codes.

For compressed air projects, a successful approach is offered by NSTAR Electric.[45] Another model of successful program development and implementation can be seen as a form of public private partnership between the local utility and regional or state governments for the implementation of necessary critical public infrastructure. A

[42] Duke Indiana may not currently participate in such negotiations but it is one model that has proved to be effective.

[43] A Kaizen Blitz is a short-term workshop activity within a medium-sized organization that can produce results through employee-designed approaches to discrete process and equipment improvements. It is a way for teams to carry out creative problem solving and process improvements.

[44] For further information see: *Energy Trust of Oregon, Kaizan Blitz Program*, Kim Crossman and Dan Brown, American Council for an Energy Efficient Economy, Proceedings of the 2009 Summer Study.

[45] See: Compressed Air Leak Detection and Remediation Program (www.compressedairchallenge.org and www.nstaronline.com/business/energy_efficiency). The value of this program is simply a look at another utility's approach to compressed air.

region wide street-lighting conversion to LED roadway lighting can fit within this model.[46] Examples of successful and innovative program designs are Pacific Power's Energy FinAnswer and Energy FinAnswer Express programs. The Pacific Power approach is useful for the way it bundles financing into all kinds of carefully constructed custom projects. Other programs of this type include the Mid-American Large Bid Program. This program is interesting in that it controls cost effectiveness by having customers bid-in possible projects and then selects the top projects offering the best return. The Xcel Energy Large Industrial Process Improvement Program is a further example of a large utility custom program.[47]

It is expected that these will be high return projects in terms of savings achieved. The key 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, but will think and participate from a customer perspective to lower overall energy use and cost and to reduce the per-unit price of product.[48]

Tools

The development of cost-effective project analysis can often be complex and a web-based downloadable provisional worksheet for various types of medium-sized efficiency projects, similar to the ones currently offered by DEI on its website, can assist the medium-sized customer to gauge their qualifications for incentives.[49]

Special Considerations

Detailed engineering studies may be required for medium- and large-scale customers. Provision for equipment and expertise associated with the development and implementation of baseline metering protocols will also be made by the program administrator as part of a functional delivery mechanism.

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[46] An example of this is the product development agreement put into place between Nova Scotia Power and the provincial government of Nova Scotia for the product development, manufacture, distribution and program implementation of high-efficiency roadway lighting. See: http://www.nspower.ca/en/home/residential/customernewsletter/nov2012/ledstreetlights.aspx

[47] The following links correspond to the references in this paragraph: http://www.pacificpower.net/bus/se/epi/california/ilc/ef.html, http://www.pacificpower.net/bus/se/epi/washington/ilc/fe.html, http://www.midamericanenergy.com/ee/ia_bus_eff_bid.aspx, and http://www.xcelenergy.com/Save_Money_&_Energy/Find_a_Rebate/Process_Efficiency_-_MN)

[48] Again, this is not a standard electric utility perspective, but it is the customer's perspective and it is the perspective to use to win with this program.

[49] Duke Indiana currently offers this type of downloadable tool for the custom program on their website.

Demand Response Programs

While not currently peak constrained, the capability for providing a demand response mechanism is a primary and universal activity for electrical utilities and should be maintained. Economic events are called each year and these are projected to increase in frequency toward the end of the planning horizon. In a dispatch program, a switch can be engaged to send a signal that directly reduces load. Direct load control is an important approach to peak reduction since it is low cost and is a dispatch program.

Residential Load Control

The Residential Load Control Program contains the existing residential AC cycling program and also includes the newly planned thermostat control program. The program is expected to be a precursor to the eventual system-wide implementation of these technologies. The company will have its own internal preferences as to meter types and brand(s). Generally these are digital meters with a one-way or two-way radio frequency or Internet communications capability. Generally, the required technology supports direct load control, a feature that allows automatic adjustments to central air conditioning units during periods of peak demand during summer months in exchange for price incentives on electric rates, and direct control of thermostats (HVAC) with local override.

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.

Measures

Measures are shown below.

Table 35. Measures – Residential Load Control

Measures
DLC – Residential AC
DLC – Climate Controller

Duke Energy has considerable experience with this program type so it is expected that participation goals and ramp rate can be set administratively with high reliability. We would expect participation to increase over the program cycle.

Delivery Channels and Marketing

Delivery channels for this program involve the collection and registration of active participants and the delivery of incentives for participation in the program. Marketing should take advantage of current concerns for mitigating climate problems by emphasizing a green marketing theme.

Proposed marketing efforts should include mention of the program in communications with customers regarding energy efficiency program options. These include bill inserts, recognition window stickers for participating homes, media coverage of how to manage electric bills, customer service representatives, and promotion using the Duke Energy 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.

The upkeep and maintenance of this program type is important to allow short start-up and implementation time scales under varying and often unpredictable scenarios of future peak supply constraints.

C&I Demand Response

The C&I Demand Response Program is a continuation of a current program type. One subprogram continues the current load curtailment program; the other adds a C&I AC cycling program component. This C&I AC cycling program is modeled on Duke's existing residential AC cycling program. For the ongoing curtailment program, the interruption period will be defined by MISO interconnection rules. The program is limited to load curtailment and the previously included local generation option is excluded. Duke currently offers several load curtailment options to large C&I customers. We recommend keeping these programs and gradually extending them. We do not assume the existence of a smart grid and while we recommend consideration of two-way meters for immediacy and certainty of verification, we assume a one-way signal with time of use meters for backup recording. Direct load control is an important approach to peak reduction because it is low cost to the company and can be dispatched.

AC cycling is modeled on the current residential program but here applies to commercial customers[50]. It extends peak reduction to a wider market of medium-sized commercial and small industrial customers with a load reduction program focused on air conditioners

Measures

Measures are shown below.

Table 36. Measures – C&I Demand Response

Measures
Load Control – AC Cycling
Load Control – Call Options

Duke has considerable experience with this program type so it is expected that participation goals and ramping rate can be set with high reliability. Since the service territory is limited, relatively small participation is expected throughout the program cycle.

[50] While not critically necessary under current operation regimes, it is generally understood that this will become a necessary measure within the C&I DR program during the latter half of the program study period.

The Call Option tiers for program registration are detailed below:

Table 37. Customer Incentive - C&I Demand Response/Call Option

Participation Option	Maximum Number of Economic Curtailment Periods	Maximum Number of Emergency Curtailment Periods*	Annual Premium Credit Rate**	Time of Year for Economic Events
PS-0/10	0	5 per year	$10/kW	Year-round
PS-5/10	5		$16/kW	June-Sept
PS-10/10	10		$22/kW	June-Sept
PS-15/10	15		$28/kW	Year-round
*Emergency Events may be called year-round **Payment is allocated by month.				

Delivery Channels and Marketing

Delivery channels for this program involve the collection and registration of active participants and the delivery of incentives for participation in the program.

The marketing and promotional plan should include the following considerations:

- Mention of the program in any communications with C&I customers regarding energy efficiency program options, and on the Company website
- Bill inserts
- Recognition window stickers for participating businesses
- Promotions using the Duke Energy website

Results from the recent evaluation of the corresponding residential sector Power Manager program suggest many residential customers are more aware of participant bill credits than of AC cycling events when called. If this turns out to be true for the small commercial sector, the program extension should work well.

Special Considerations

Duke Energy has considerable experience enlisting large C&I customers and is not under pressure to expand this program type since DEI is not currently capacity constrained. Still, it is wise to maintain programs in this area, knowing that they can be useful for economic events now and that their relevance for both economic and emergency needs will increase over time. For the air conditioning subprogram, the small 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 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 Participation and Achievable Potential

The number of participants in each program was subjectively determined in the first five years covered by the Action Plan considering recent program history, the relevant customer population, elements of program design including incentive levels and the energy savings targets set by the State of Indiana. The number of participants in each EE program was also modeled using an adoption curve ("S" curve) approach. Parameters of the model were subjectively determined for each program in order to achieve an expected curve shape and long term adoption rate. Near term adoption rates were then blended with the longer term adoption curve predicted participation rates. The projected number of "active" participants in each program was then calculated as the cumulative adoption less prior year participants past the end of the life of savings for that program. Over the five-year horizon of the Action Plan, the Home Reports program with an assumed life of savings of one year is the only program for which prior year participants drop off in the estimation of cumulative program participation. It is also important to restate that this study does not include participants in Duke DSM programs prior to 2013 in our estimates of program participation. Incremental and active (cumulative) program participants over the five-year Action Plan are shown in Table 38 and Table 39.

Table 38. Incremental Participants by Program

Program	2014	2015	2016	2017	2018
CORE					
Res Lighting	121,800	121,800	121,800	121,800	121,800
Home Energy Audit	12,056	12,725	13,395	14,065	14,735
Low Income Weatherization	2,693	4,936	7,180	8,526	9,873
Appliance Recycling	6,774	10,161	15,242	13,548	11,008
Res Energy Efficient Schools	31,905	31,905	31,905	31,905	31,905
C&I Energy Efficient Schools	35	40	40	40	40
C&I Lighting Buy-Down	-	3,416	3,843	4,270	4,484
Small Business Direct Install	-	2,850	5,700	5,700	6,840
C&I Express Rebates	5,280	5,940	6,600	5,940	5,610
CORE PLUS					
Res Prescriptive	35,450	56,720	70,900	88,625	106,350
Home Energy Audit & Weatherization	558	1,115	1,673	2,230	2,565
Home Reports	147,500	147,500	147,500	147,500	147,500
C&I Prescriptive	4,000	5,200	6,400	7,600	8,800
C&I Custom	22	28	33	39	39

The Core Plus Residential Long-Term Lighting Program and the two Demand Response Programs included in this plan do not have any incremental participants until after the first five years of the Action Plan and are, therefore, not included in the participation, savings and cost tables. The Residential Long-Term Lighting program supersedes the Core Residential Lighting program. While not currently peak constrained, the capability for providing a demand response mechanism is a primary and universal activity for electrical utilities and should be maintained.

In the long run, the number of active participants can fall over time since prior year participants past the end of the savings life are not counted as active.

Table 39. Active (Cumulative) Participants by Program

Program	2014	2015	2016	2017	2018
CORE					
Res Lighting	121,800	243,600	365,400	487,200	609,000
Home Energy Audit	12,056	24,781	38,176	52,241	66,975
Low Income Weatherization	2,693	7,629	14,809	23,335	33,208
Appliance Recycling	6,774	16,935	32,177	45,725	56,732
Res Energy Efficient Schools	31,905	63,810	95,715	127,620	159,525
C&I Energy Efficient Schools	35	75	115	155	195
C&I Lighting Buy-Down	-	3,416	7,259	11,529	16,013
Small Business Direct Install	-	2,850	8,550	14,250	21,090
C&I Express Rebates	5,280	11,220	17,820	23,760	29,370
CORE PLUS					
Res Prescriptive	35,450	92,170	163,070	251,695	358,045
Home Energy Audit & Weatherization	558	1,673	3,345	5,576	8,140
Home Reports	147,500	147,500	147,500	147,500	147,500
C&I Prescriptive	4,000	9,200	15,600	23,200	32,000
C&I Custom	22	50	83	121	160

Average savings per participant and the number of incremental and active participants in any given year are used to estimate incremental and cumulative program savings in that year. Incremental and cumulative energy and demand savings are shown for gross (before net-to-gross effects) and net achievable potential by program and planning year in Table 40 below. About 55 percent of the energy (kWh) savings from DSM programs over the first five years is from residential customers. The two prescriptive programs for residential and non-residential customers account for nearly half of total energy savings.

Table 40. Achievable Energy and Demand Potential by Program and Year

Program	Gross Savings							Net Savings					
	2014	**2015**	**2016**	**2017**	**2018**	**Pct of Total**	**NTG Ratio**	**2014**	**2015**	**2016**	**2017**	**2018**	**Pct of Total**
Millions of kWh - Incremental													
CORE													
Res Lighting	39.3	39.3	39.3	39.3	39.3	9%	0.60	23.6	23.6	23.6	23.6	23.6	7%
Home Energy Audit	8.7	9.2	9.6	10.1	10.6	2%	0.90	7.8	8.2	8.7	9.1	9.5	3%
Low Income Weatherization	5.1	9.3	13.5	16.1	18.6	3%	1.00	5.1	9.3	13.5	16.1	18.6	4%
Appliance Recycling	6.8	10.2	15.4	13.7	11.1	3%	0.75	5.1	7.7	11.5	10.2	8.3	3%
Res Energy Efficient Schools	12.3	12.3	12.3	12.3	12.3	3%	0.95	11.7	11.7	11.7	11.7	11.7	4%
C&I Energy Efficient Schools	1.9	2.1	2.1	2.1	2.1	1%	0.95	1.8	2.0	2.0	2.0	2.0	1%
C&I Lighting Buy-Down	0.0	29.5	33.2	36.9	38.7	7%	0.85	0.0	25.1	28.2	31.3	32.9	7%
Small Business Direct Install	0.0	13.3	26.6	26.6	31.9	5%	0.90	0.0	12.0	23.9	23.9	28.7	5%
C&I Express Rebates	38.5	43.3	48.1	43.3	40.9	10%	0.65	25.0	28.1	31.2	28.1	26.6	8%
CORE PLUS													
Res Prescriptive	60.5	96.7	120.9	151.1	181.4	29%	0.85	51.4	82.2	102.8	128.5	154.2	31%
Home Energy Audit & Weatherization	1.8	3.5	5.3	7.1	8.1	1%	1.00	1.8	3.5	5.3	7.1	8.1	2%
Home Reports	28.5	28.5	28.5	28.5	28.5	7%	1.00	28.5	28.5	28.5	28.5	28.5	9%
C&I Prescriptive	48.2	62.7	77.2	91.7	106.1	19%	0.70	33.8	43.9	54.0	64.2	74.3	16%
C&I Custom	2.7	3.3	4.0	4.7	4.7	1%	0.70	1.9	2.3	2.8	3.3	3.3	1%
Total	**254.1**	**363.3**	**436.0**	**483.3**	**534.3**	**100%**		**197.3**	**288.1**	**347.8**	**387.5**	**430.3**	**100%**
Millions of kWh - Cumulative													
	2014	**2015**	**2016**	**2017**	**2018**	**Pct of 2018**	**NTG Ratio**	**2014**	**2015**	**2016**	**2017**	**2018**	**Pct of 2018**
CORE													
Res Lighting	39.3	78.6	117.9	157.2	196.5	10%	0.60	23.6	47.2	70.7	94.3	117.9	8%
Home Energy Audit	8.7	17.8	27.5	37.6	48.2	2%	0.90	7.8	16.0	24.7	33.8	43.4	3%
Low Income Weatherization	5.1	14.4	27.9	44.0	62.6	3%	1.00	5.1	14.4	27.9	44.0	62.6	4%
Appliance Recycling	6.8	17.1	32.4	46.1	57.2	3%	0.75	5.1	12.8	24.3	34.6	42.9	3%
Res Energy Efficient Schools	12.3	24.6	36.8	49.1	61.4	3%	0.95	11.7	23.3	35.0	46.7	58.3	4%
C&I Energy Efficient Schools	1.9	4.0	6.2	8.3	10.5	1%	0.95	1.8	3.8	5.9	7.9	10.0	1%
C&I Lighting Buy-Down	0.0	29.5	62.7	99.5	138.2	7%	0.85	0.0	25.1	53.3	84.6	117.5	8%
Small Business Direct Install	0.0	13.3	39.9	66.4	98.3	5%	0.90	0.0	12.0	35.9	59.8	88.5	6%
C&I Express Rebates	38.5	81.7	129.8	173.0	213.9	11%	0.65	25.0	53.1	84.4	112.5	139.0	9%
CORE PLUS													
Res Prescriptive	60.5	157.2	278.1	429.2	610.6	31%	0.85	51.4	133.6	236.4	364.8	519.0	34%
Home Energy Audit & Weatherization	1.8	5.3	10.6	17.7	25.9	1%	1.00	1.8	5.3	10.6	17.7	25.9	2%
Home Reports	28.5	28.5	28.5	28.5	28.5	1%	1.00	28.5	28.5	28.5	28.5	28.5	2%
C&I Prescriptive	48.2	111.0	188.1	279.8	385.9	20%	0.70	33.8	77.7	131.7	195.9	270.2	18%
C&I Custom	2.7	6.0	10.0	14.7	19.4	1%	0.70	1.9	4.2	7.0	10.3	13.6	1%
Total	**254.1**	**588.9**	**996.4**	**1451.2**	**1957.1**	**100%**		**197.3**	**457.0**	**776.3**	**1135.3**	**1537.1**	**100%**
MW - Incremental													
	2014	**2015**	**2016**	**2017**	**2018**	**Pct of Total**	**NTG Ratio**	**2014**	**2015**	**2016**	**2017**	**2018**	**Pct of Total**
CORE													
Res Lighting	5.6	5.6	5.6	5.6	5.6	10%	0.60	3.3	3.3	3.3	3.3	3.3	7%
Home Energy Audit	1.1	1.1	1.2	1.3	1.3	2%	0.90	1.0	1.0	1.1	1.1	1.2	2%
Low Income Weatherization	0.8	1.5	2.2	2.6	3.0	4%	1.00	0.8	1.5	2.2	2.6	3.0	5%
Appliance Recycling	1.0	1.5	2.3	2.0	1.7	3%	0.75	0.8	1.1	1.7	1.5	1.2	3%
Res Energy Efficient Schools	1.5	1.5	1.5	1.5	1.5	3%	0.95	1.4	1.4	1.4	1.4	1.4	3%
C&I Energy Efficient Schools	0.3	0.3	0.3	0.3	0.3	1%	0.95	0.3	0.3	0.3	0.3	0.3	1%
C&I Lighting Buy-Down	0.0	4.6	5.2	5.8	6.1	8%	0.85	0.0	3.9	4.4	4.9	5.1	8%
Small Business Direct Install	0.0	2.0	4.1	4.1	4.9	5%	0.90	0.0	1.8	3.7	3.7	4.4	6%
C&I Express Rebates	5.9	6.6	7.4	6.6	6.2	12%	0.65	3.8	4.3	4.8	4.3	4.1	9%
CORE PLUS													
Res Prescriptive	6.4	10.2	12.8	16.0	19.1	23%	0.85	5.4	8.7	10.8	13.6	16.3	24%
Home Energy Audit & Weatherization	0.3	0.6	0.9	1.2	1.3	1%	1.00	0.3	0.6	0.9	1.2	1.3	2%
Home Reports	4.2	4.2	4.2	4.2	4.2	7%	1.00	4.2	4.2	4.2	4.2	4.2	9%
C&I Prescriptive	7.7	10.0	12.3	14.6	16.9	22%	0.70	5.4	7.0	8.6	10.2	11.8	19%
C&I Custom	0.2	0.2	0.3	0.3	0.3	0%	0.70	0.1	0.1	0.2	0.2	0.2	0%
Total	**34.9**	**50.0**	**60.1**	**66.0**	**72.5**	**100%**		**26.8**	**39.4**	**47.7**	**52.6**	**58.0**	**100%**
MW - Cumulative													
	2014	**2015**	**2016**	**2017**	**2018**	**Pct of 2018**	**NTG Ratio**	**2014**	**2015**	**2016**	**2017**	**2018**	**Pct of 2018**
CORE													
Res Lighting	5.6	11.1	16.7	22.2	27.81	10%	0.60	3.3	6.7	10.0	13.3	16.7	8%
Home Energy Audit	1.1	2.2	3.4	4.7	6.01	2%	0.90	1.0	2.0	3.1	4.2	5.4	3%
Low Income Weatherization	0.8	2.4	4.6	7.2	10.25	4%	1.00	0.8	2.4	4.6	7.2	10.2	5%
Appliance Recycling	1.0	2.6	4.9	6.9	8.56	3%	0.75	0.8	1.9	3.6	5.2	6.4	3%
Res Energy Efficient Schools	1.5	2.9	4.4	5.9	7.34	3%	0.95	1.4	2.8	4.2	5.6	7.0	3%
C&I Energy Efficient Schools	0.3	0.6	1.0	1.3	1.63	1%	0.95	0.3	0.6	0.9	1.2	1.5	1%
C&I Lighting Buy-Down	0.0	4.6	9.8	15.6	21.63	8%	0.85	0.0	3.9	8.3	13.2	18.4	9%
Small Business Direct Install	0.0	2.0	6.1	10.2	15.16	6%	0.90	0.0	1.8	5.5	9.2	13.6	7%
C&I Express Rebates	5.9	12.5	19.8	26.5	32.71	12%	0.65	3.8	8.1	12.9	17.2	21.3	10%
CORE PLUS													
Res Prescriptive	6.4	16.6	29.4	45.3	64.45	24%	0.85	5.4	14.1	25.0	38.5	54.8	26%
Home Energy Audit & Weatherization	0.3	0.9	1.7	2.9	4.23	2%	1.00	0.3	0.9	1.7	2.9	4.2	2%
Home Reports	4.2	4.2	4.2	4.2	4.22	2%	1.00	4.2	4.2	4.2	4.2	4.2	2%
C&I Prescriptive	7.7	17.7	29.9	44.5	61.39	23%	0.70	5.4	12.4	21.0	31.2	43.0	21%
C&I Custom	0.2	0.4	0.6	0.9	1.24	0%	0.70	0.1	0.3	0.4	0.7	0.9	0%
Total	**34.9**	**80.7**	**136.6**	**198.4**	**266.6**	**100%**		**26.8**	**62.0**	**105.5**	**153.9**	**207.7**	**100%**
NTG (Net-to-Gross) Ratio is multiplied by gross savings to calculate net savings.													

PROGRAM COST EFFECTIVENESS

Program cost-effectiveness analysis answers the question of would we be better off with the EE program compared to not having the program. The answer almost always depends on who is asking the question. In other words, better off from whose perspective? Standard DSM cost-effectiveness analysis includes five perspectives. Four of which will be addressed in this report:

- Total Resource Cost (TRC)
- Participant
- Ratepayer Impact (RIM)
- Utility Cost (also known as Administrator Cost)

A detailed discussion of cost-effectiveness methodology, including the standard tests listed above, is included in Appendix B. In this section, we present the results of the cost-effectiveness analysis beginning with a discussion of assumptions. Cost-effectiveness results are then presented for each perspective and EE program.

Expected Program Costs

Program spending includes the cost of incentives and other program specific expenses including evaluation. It also includes costs for fully-loaded program staffing, administration and indirect expenses that support the overall EE effort. Program spending over the five-year Action Plan is shown in Table 41. Detailed program spending estimates are included in tables at the end of this section.

Table 41. Program Spending

	Planning Year				
	2014	**2015**	**2016**	**2017**	**2018**
EE Program Budget (millions $)	68.3	108.5	136.6	153.9	173.1
Incentives	65%	61%	61%	62%	63%
Program Admin and Delivery	27%	33%	33%	32%	32%
EM&V	5.4%	4.5%	4.4%	4.3%	4.1%
Indirect EE Spending	2.4%	1.5%	1.2%	1.1%	0.9%

Incentives are the largest cost category. Program administration and delivery are mostly comprised of payments to vendors for delivery-related services and to a lesser extent internal staffing. Evaluation measurement and verification costs are expected to average around four to five percent. Program spending includes indirect program expenses that support the overall EE effort. For example, program databases for tracking all programs are mostly in place but will require on-going development expenditures. Our estimates of these annual expenditures are shown in Table 42 below.

Table 42. Annual Indirect Program Expenses

Item	Amount
Information Technology and Systems	$ 200,000
Staff Development and Training	$ 280,000
Program R&D	$ 550,000
Building Code Support	$ 80,000
Trade Organization Memberships	$ 120,000
DSM Marketing and Customer Awareness	$ 300,000
Other Miscellaneous	$ 100,000
Total	$ 1,630,000

It is important to understand that actual expenditures will vary from planned expenditures in their timing and distribution between specific DSM programs. For this reason it is important for the program administrator to have flexibility in the administration of DSM program funding without having to obtain approval from the Public Utility Commission.

Miscellaneous Program Assumptions

Energy savings and demand expected from the programs are based on the designs and assumptions presented earlier in this report. Key assumptions affecting the annual savings and program cost effectiveness are shown in Table 20. The savings life of each program is calculated from the life of individual measures within the program weighted by measure savings. The life of a program represents the duration of energy savings flowing from a participant in the program.

The net-to-gross ratio captures the effects of free-riders (participants in the program who would have installed the energy efficient measures without the program) and spillover effects (program induced savings happening outside of the program). A ratio of 1.0 means the net effect is the same as the gross effect. Ratios less than 1.0 imply a greater level of free-rider effects than spillover effects in the program. NTG ratios in this study vary by program ranging from 0.6 to 1.0. These assumptions are based on subjective professional opinion. Accurate estimates are beyond the scope of this study and involve specialized research that can cost several hundred-thousand dollars.

Avoided Costs

The avoided or marginal cost associated with a reduction in energy and demand is of primary importance when evaluating the cost effectiveness of DSM programs. These costs represent the value of avoided electric energy and demand. DEI’s costs are the reduction in the cost of supply compared to what it would have been without the reduction in loads, and include all incremental energy, transmission and distribution costs as well as the cost of avoided capacity. These costs were embedded in the DSMore cost-effectiveness model supplied by Duke. Hourly savings load shapes developed by Forefront for each program were entered into the DSMore software for modeling program cost effectiveness.

Cost Effectiveness Results

In this section, the findings of the cost-effectiveness analysis which provides a systematic comparison of the program benefits and costs discussed in previous sections are presented. Results are shown for the four perspectives mentioned at the beginning of this section.

The TRC perspective is the broadest of the cost-effectiveness tests presented below. As the name implies, TRC shows the total cost of the resource relative to supply side resources. The Utility Cost Test only considers costs paid by the program administrator and generally results in a higher benefit-cost ratio than the TRC unless the utility pays for the full cost of installation. The Participant Test shows the economics of program participation from the participant's perspective and reflects benefits from lower bills and incentive payments. Elements of program design, such as incentive payments, can greatly impact participant economics. For most utility EE programs the lost revenue calculation in the RIM Test exceeds the avoided cost of supply causing the programs to fail the RIM Test.

Test results were calculated over the first five years of program operation. From the TRC perspective, all programs, expect for the Residential Home Energy Audit and Low Income Weatherization programs, are cost effective. As explained earlier, the Core Plus Residential Long-Term Lighting Program and the two Demand Response Programs included in this Plan do not have any incremental participants until after the first five years of the Action Plan and are, therefore, not included in the table below. Emphasis in this plan is placed on energy savings required in the near term, especially the first five years of this Action Plan.

Table 43. Cost Effectiveness Results – Benefit-Cost Ratios by Test

EE Program	Utility	TRC	RIM	Participant
CORE				
Res Lighting	2.49	2.16	0.90	2.38
Home Energy Audit	0.89	0.92	0.54	3.48
Low Income Weatherization	0.77	0.77	0.51	NA
Appliance Recycling	2.55	2.69	0.91	NA
Res Energy Efficient Schools	2.04	2.13	0.81	NA
C&I Energy Efficient Schools	1.22	1.01	0.59	2.93
C&I Lighting Buy-Down	2.51	2.51	0.83	NA
Small Business Direct Install	1.59	1.71	0.69	NA
C&I Express Rebates	3.36	2.66	0.87	3.03
CORE PLUS				
Res Prescriptive	2.82	1.74	0.95	1.79
Home Energy Audit & Weatherization	2.44	1.72	0.93	2.43
Home Reports	1.30	1.30	0.66	NA
C&I Prescriptive	3.93	2.86	0.90	3.07
C&I Custom	2.30	2.48	0.75	5.88

Indirect EE expenses, those costs not directly attributable to a specific EE program, are not included in the program-specific cost-effectiveness analysis. They are included in the TRC for the overall EE portfolio (all programs) which produces an overall TRC benefit-cost ratio 1.8.

Program Cost Details

Provided below are detailed program spending estimates included in various tables. The term 'incentives', as used in the Cost Effectiveness section of this report, refers to the installed incremental cost that is incurred by the utility.

Table 44. Total Program Costs

Program	2014	2015	2016	2017	2018	Pct of 5 Yr Total	Incentives	Variable	Fixed	EM&V	Total
CORE											
Res Lighting	7,886,405	7,786,405	7,786,405	7,786,405	7,786,405	6%	78%	16%	1%	5%	100%
Home Energy Audit	6,592,427	6,883,062	7,223,697	7,584,332	7,944,967	6%	29%	65%	1%	5%	100%
Low Income Weatherization	7,440,806	13,186,895	18,977,983	22,472,636	26,027,289	14%	28%	66%	1%	5%	100%
Appliance Recycling	1,369,820	1,979,480	2,893,970	2,589,140	2,131,895	2%	21%	72%	1%	6%	100%
Res Energy Efficient Schools	3,682,809	3,432,809	3,432,809	3,432,809	3,432,809	3%	79%	9%	6%	5%	100%
C&I Energy Efficient Schools	1,001,966	1,090,033	1,170,033	1,190,033	1,190,033	1%	23%	41%	4%	31%	100%
C&I Lighting Buy-Down	205,000	10,881,528	12,232,906	13,624,285	14,329,974	8%	0%	94%	1%	5%	100%
Small Business Direct Install	130,000	7,839,562	15,552,124	15,552,124	18,571,149	9%	72%	22%	1%	5%	100%
C&I Express Rebates	7,032,604	7,818,430	8,679,255	7,818,430	7,408,017	6%	87%	8%	1%	5%	100%
CORE PLUS											
Res Prescriptive	20,888,034	33,040,254	41,225,067	51,468,584	61,712,101	33%	89%	9%	0%	2%	100%
Home Energy Audit & Weatherization	977,050	1,713,100	2,484,150	3,295,199	3,777,829	2%	42%	50%	2%	6%	100%
Home Reports	1,930,400	1,910,400	1,910,400	2,090,400	1,910,400	2%	0%	91%	1%	8%	100%
C&I Prescriptive	6,720,241	8,570,413	10,550,586	12,470,758	14,370,930	8%	94%	0%	1%	5%	100%
C&I Custom	767,960	732,950	822,939	912,929	912,929	1%	48%	14%	21%	16%	100%
Total Program Spending	**66,625,521**	**106,865,319**	**134,942,323**	**152,288,063**	**171,506,726**	**99%**					
General EE Spending	**1,630,000**	**1,630,000**	**1,630,000**	**1,630,000**	**1,630,000**	**1%**					
Total DSM Budget	**68,255,521**	**108,495,319**	**136,572,323**	**153,918,063**	**173,136,726**	**100%**					

Table 45. Incentives

Program	2014	2015	2016	2017	2018
CORE					
Res Lighting	6,117,405	6,117,405	6,117,405	6,117,405	6,117,405
Home Energy Audit	1,912,002	2,018,225	2,124,447	2,230,669	2,336,892
Low Income Weatherization	1,997,431	3,661,957	5,326,483	6,325,199	7,323,914
Appliance Recycling	270,960	406,440	609,660	541,920	440,310
Res Energy Efficient Schools	2,767,759	2,767,759	2,767,759	2,767,759	2,767,759
C&I Energy Efficient Schools	231,466	264,533	264,533	264,533	264,533
C&I Lighting Buy-Down	0	0	0	0	0
Small Business Direct Install	0	5,612,562	11,225,124	11,225,124	13,470,149
C&I Express Rebates	6,038,604	6,793,430	7,548,255	6,793,430	6,416,017
CORE PLUS					
Res Prescriptive	18,314,534	29,303,254	36,629,067	45,786,334	54,943,601
Home Energy Audit & Weatherization	352,887	705,775	1,058,662	1,411,549	1,623,282
Home Reports	0	0	0	0	0
C&I Prescriptive	6,167,241	8,017,413	9,867,586	11,717,758	13,567,930
C&I Custom	277,460	346,825	416,189	485,554	485,554
Total	**44,447,749**	**66,015,576**	**83,955,169**	**95,667,233**	**109,757,345**

Table 46. Other Variable Costs (excluding EM&V)

Program	2014	2015	2016	2017	2018
CORE					
Res Lighting	1,218,000	1,218,000	1,218,000	1,218,000	1,218,000
Home Energy Audit	4,219,425	4,453,838	4,688,250	4,922,663	5,157,075
Low Income Weatherization	4,711,875	8,638,438	12,565,000	14,920,938	17,276,875
Appliance Recycling	948,360	1,422,540	2,133,810	1,896,720	1,541,085
Res Energy Efficient Schools	319,050	319,050	319,050	319,050	319,050
C&I Energy Efficient Schools	420,000	480,000	480,000	480,000	480,000
C&I Lighting Buy-Down	0	10,331,028	11,622,406	12,913,785	13,559,474
Small Business Direct Install	0	1,710,000	3,420,000	3,420,000	4,104,000
C&I Express Rebates	528,000	594,000	660,000	594,000	561,000
CORE PLUS					
Res Prescriptive	1,772,500	2,836,000	3,545,000	4,431,250	5,317,500
Home Energy Audit & Weatherization	418,163	836,325	1,254,488	1,672,650	1,923,548
Home Reports	1,770,000	1,770,000	1,770,000	1,770,000	1,770,000
C&I Prescriptive	0	0	0	0	0
C&I Custom	82,500	103,125	123,750	144,375	144,375
Totals	**16,407,873**	**34,712,343**	**43,799,754**	**48,703,430**	**53,371,981**

Table 47. Fixed Program Costs

Program	2014	2015	2016	2017	2018
CORE					
Res Lighting	151,000	51,000	51,000	51,000	51,000
Home Energy Audit	101,000	51,000	51,000	51,000	51,000
Low Income Weatherization	351,500	226,500	226,500	226,500	226,500
Appliance Recycling	25,500	25,500	25,500	25,500	25,500
Res Energy Efficient Schools	421,000	171,000	171,000	171,000	171,000
C&I Energy Efficient Schools	70,500	45,500	45,500	45,500	45,500
C&I Lighting Buy-Down	85,000	50,500	50,500	50,500	50,500
Small Business Direct Install	50,000	137,000	137,000	137,000	137,000
C&I Express Rebates	126,000	51,000	51,000	51,000	51,000
CORE PLUS					
Res Prescriptive	101,000	51,000	51,000	51,000	51,000
Home Energy Audit & Weatherization	86,000	51,000	51,000	51,000	51,000
Home Reports	40,400	20,400	20,400	20,400	20,400
C&I Prescriptive	173,000	153,000	153,000	153,000	153,000
C&I Custom	278,000	153,000	153,000	153,000	153,000
Totals	**2,059,900**	**1,237,400**	**1,237,400**	**1,237,400**	**1,237,400**

Table 48. EM&V Costs

Program	2014	2015	2016	2017	2018
CORE					
Res Lighting	400,000	400,000	400,000	400,000	400,000
Home Energy Audit	360,000	360,000	360,000	380,000	400,000
Low Income Weatherization	380,000	660,000	860,000	1,000,000	1,200,000
Appliance Recycling	125,000	125,000	125,000	125,000	125,000
Res Energy Efficient Schools	175,000	175,000	175,000	175,000	175,000
C&I Energy Efficient Schools	280,000	300,000	380,000	400,000	400,000
C&I Lighting Buy-Down	120,000	500,000	560,000	660,000	720,000
Small Business Direct Install	80,000	380,000	770,000	770,000	860,000
C&I Express Rebates	340,000	380,000	420,000	380,000	380,000
CORE PLUS					
Res Prescriptive	700,000	850,000	1,000,000	1,200,000	1,400,000
Home Energy Audit & Weatherization	120,000	120,000	120,000	160,000	180,000
Home Reports	120,000	120,000	120,000	300,000	120,000
C&I Prescriptive	380,000	400,000	530,000	600,000	650,000
C&I Custom	130,000	130,000	130,000	130,000	130,000
Total	**3,710,000**	**4,900,000**	**5,950,000**	**6,680,000**	**7,140,000**

APPENDIX A. METHODOLOGY

At the root of most DSM analysis there is some form of energy usage model. The model that is often used in larger multi-utility DSM planning synthesizes estimates from demographics applied to engineering prototypes. This approach is easy to apply to individual measures and to small groups of measures where the result of all the measures is small relative to the total energy sales. But the simple synthesis approach becomes unstable where a large or comprehensive technical potential is contemplated because the simple sum may not include measure interactions, and can result in inflated (or seriously deflated) savings estimates. Also demographic information and market penetration information are more accurate applied to large regions, but lack precision when applied to smaller regions. Under this circumstance, the cumulative errors due to lack of precision can compound into large errors.

Therefore, in this case, where a technical potential will be derived from a maximum application of a wide variety of interacting measures and applied to a relatively small region, we have opted to approach the estimate with a "calibrated engineering model". With this approach we will true the models to the current actual energy sales by fitting a relatively simple algebraic model to the recorded energy use (and demand) and the associated average monthly temperatures. This approach has the strong advantage of starting the analysis from a verifiable energy use situation. Another significant advantage of this approach is that it is somewhat empirical, and the data fitting process will reveal large unusual energy use situations, if they exist. Finally, it is particularly important to be able to establish a reasonably bounded estimate of the aggregate energy under conditions representing the full technical potential, which requires the explicit treatment of measure interactions afforded by the engineering modeling approach.

Within conditioned spaces, heating and cooling energy will be influenced by lighting and other internal gains and by large scale refrigeration. This results in an interaction of energy savings measures. Another form of measure interaction is related to changes in thermal conversion efficiency. Whenever there is a load reduction measure, the net realized energy savings will also be dependent on an assumed thermal conversion efficiency. Where a thermal conversion efficiency is changed at the same time as a load reduction, the result is interactive, and it is important to consider the effect of both measures simultaneously. In this case, where a wide range of efficiency and load reduction measures will be applied, it is particularly important to be able to deal with measure interactions in an orderly way.

The model has been devised and structured with explicit variables to express in physical or engineering terms, the measures and treatments involved in attaining the full technical potential. This includes variables for conversion efficiency, load reductions and thermal and electrical solar energy measures. The model will also estimate the changes in peak demand associated with the applied efficiency measures. The following discussion will be in two parts: the first part for the energy model, and the second part for the demand model.

Energy Model

Nature of the Data

A brief review of the energy sales and the associated average temperature, as illustrated in Figure 18 and Figure 19, shows that the daily average energy use has a close relationship to temperature.

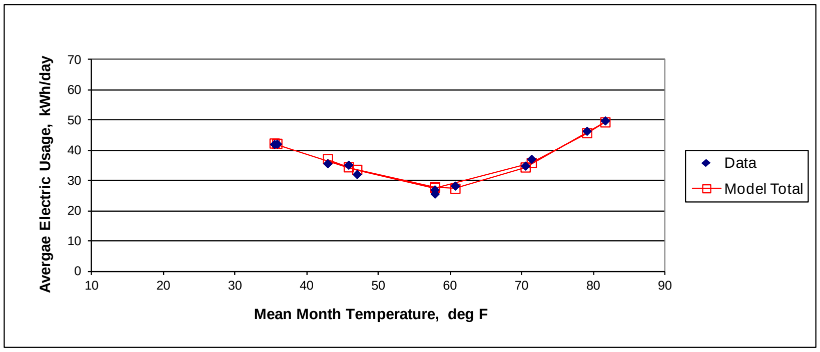


Figure 18. Average Monthly Electricity Usage 2012 - Existing Single Family

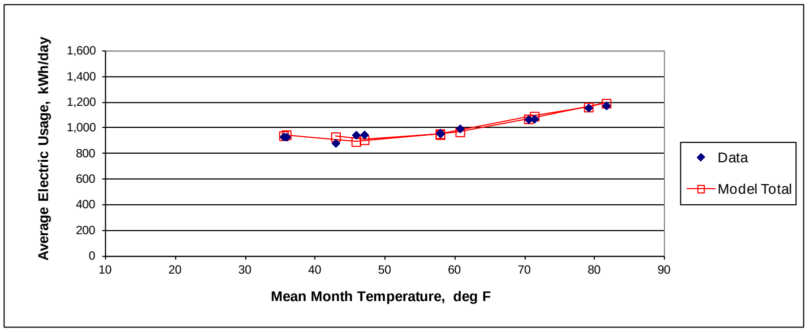


Figure 19. Average Monthly Electricity Usage 2012 – Grocery

Figure 18 was derived from a random sample of residential single family units older than four years. This model is intended to characterize the energy use in the largest portion of the residential sector. There are other similar models for the other segments of the residential sector. In general, these models of average performance fit quite closely with an R-square usually in excess of 95 percent. This figure shows clearly the increased energy use at higher temperatures for air conditioning. And it also shows increased average energy use at low temperatures for heating, mostly by customers with electric furnaces. Note that at average temperatures in the range of 55-65 deg F, there appears to be no heating or cooling. Energy use at these temperatures is mostly the residential base load: lights, plugs, hot water.

Figure 19 was derived from all the available billing histories of customers classified as Grocery. The model and the data fit quite closely here. The average grocery store shows an increased energy use with temperature associated with air conditioning and mostly with refrigeration. There appears to be little electric heating. In Figure 19 most of the energy use appears to be grocery base load, typically interior refrigeration, lights, and ventilation.

Energy Model Structure

For energy modeling purposes, customers were subdivided into segments as described in the Market Assessment section of this report. An engineering model was fitted to usage, appliance and end-use saturation levels, and temperature data. The models applied in each of the segments are all similar and represent six very fundamental end-uses:

- Space Heating
- Space Cooling
- Water Heating
- Lighting
- Internal Uses: Appliances, Electronics, Cooking, Dishwasher, Miscellaneous Plug Loads
- External Uses: Outdoor Lights, Washer, Dryer, Process Loads

Note that the fundamental end-uses distinguish between internal and external electric energy use. Internal uses contribute to internal heat gains while external uses do not contribute to internal gains. This distinction is for the purpose of estimating measure interactions between the heating and cooling end-uses and the electrical energy use within the conditioned space. Lighting and internal uses are assumed to occur within the conditioned envelope. Predominant internal and external uses differ by sector as shown below.

Predominant Internal and External End-Use by Sector		
Sector	**Internal**	**External**
Residential	Appliances and Misc Plug Load	Laundry
Commercial	Electronics and Misc Plug Load	Exterior Lighting
Industrial	Other Base Load	Process

Model Inputs

Some of these end-uses are dependent on weather variables. The heating and cooling end-uses depend on average monthly temperature; the hot water end-use depends on the average monthly inlet water temperature, and lighting depends slightly on calendar month and day length. The thermal and electrical solar energy benefits depend on the average monthly solar. The other end-uses are assumed constant from month to month. For weather dependent inputs the models use the inputs shown in Table 49.

Table 49. Weather Inputs to Modeling

End-Use	Inputs
Heating	Monthly average temperatures and long-term average month temperatures
Cooling	Monthly average temperatures and long-term average month temperatures
Hot Water	Monthly long-term average inlet water temperatures
Lighting	Seasonal lighting usage factors

Beyond the weather inputs are the inputs pertaining to the distribution and operation of the energy using systems, listed in Table 50 and Table 51 for residential and non-residential, respectively. These are the variables that are changed in the process of fitting a model to the data. It is noteworthy that relatively few model parameters are sufficient to specify a model that provides a good fit to the data. This is partly due to the fact that we are using usage and weather data aggregated from hundreds and, in some cases, thousands of sites.

The parameterization of this model is simple to provide transparency and for ease in review. It admittedly does not include many well-known second order effects, such as variation of heating COP with temperature. However, the simple treatment of energy use in terms of first order effects is sufficient to the principal purposes here, which are: 1) to be able to true-up the model to the current energy use, and 2) to be able to estimate a physically reasonable energy use assuming conditions of full technical potential.

Table 50. Residential Energy Model Parameters

	Existing Housing		New Construction	
Model Input	**Single Family**	**Multifamily**	**Single Family**	**Multifamily**
Water Heat Saturation	48%	57%	50%	25%
Hot Water Use Gallons per Day	55	45	55	55
Tank Loss btu/degree hour	3	3	3	3
Hot Water Tank Set Temperature	130	130	130	130
Hot Water Tank Efficiency	100%	100%	100%	100%
Space Heat Saturation	27%	52%	35%	23%
Space Heat Efficiency	1.21	1.83	1.55	1.30
Space Heat Set Temperature	60	59	60	60
Space Heat Use btu/degree hour	453	320	470	375
Lights kWh/day	7.90	4.81	7.50	5.41
Lights and Misc Saturation	100%	100%	100%	100%
Kitchen Use kWh/day	11.79	7.19	11.20	8.09
Kitchen Use Saturation	100%	100%	100%	100%
Washer, Dryer and External kWh/day	2.97	1.81	2.82	2.04
Washer, Dryer and External Saturation	100%	100%	100%	100%
Space Cooling Saturation	77%	74%	85%	40%
Space Cooling Set Temperature	65	68	65	67
Space Cooling Use btu/degree hour	453	320	470	375
Space Cooling Efficiency	2.45	2.80	3.50	3.00

Table 51. Non-Residential Energy Model Parameters

	Commercial												**Manufacturing**				
Model Input	**Grocery**	**Hospitals**	**Hotels**	**Office**	**Other**	**Health Srv**	**Eating/ Drinking**	**Retail**	**Schools**	**Warehouse**	**< 3000 kWh**	**AG Con**	**Stone/ Clay/ Glass**	**Food**	**Transportation**	**Other**	**Primary Metals**
Water Heat Saturation	40%	5%	10%	20%	20%	10%	10%	10%	15%	10%	0%	10%	1%	1%	1%	1%	5%
Hot Water Use (gallons/day)	230	9000	2550	80	100	375	430	500	675	75	60	500	5700	3300	3000	3500	260
Tank Loss (btu/degree hour)	15	40	4	4	4	4	4	4	40	4	4	4	150	4	150	4	4
Hot Water Tank Set Temperature	140	140	140	130	130	130	140	140	130	130	130	140	140	140	140	140	140
Water Heating Efficiency	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Space Heat Saturation	5%	1%	65%	12%	2%	30%	5%	10%	4%	15%	0%	10%	15%	0%	15%	10%	30%
Space Heat Efficiency	110%	110%	100%	75%	200%	130%	120%	200%	110%	150%	125%	150%	100%	100%	100%	100%	110%
Space Heat Set Temperature	62	60	62	55	56	69	65	66	62	45	60	60	63	63	63	63	50
Space Heat Use (btu/degree hour)	10000	16000	3600	1200	800	1500	1845	2302	18000	4000	10	2600	30000	6000	50000	2000	30000
Lights (kWh/day)	221.3	1254.3	266.0	85.8	24.0	133.0	78.7	210.1	862.1	302.4	2.9	217.9	747.1	614.5	1194.6	253.9	4207.3
Lights and Misc Saturation	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Process Use (kWh/day)	474.11	1602.24	127.27	66.52	37.89	169.89	215.23	70.04	1093.65	171.26	0.33	156.47	996.14	819.27	1592.77	338.54	5609.77
Process Use Saturation	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Washer, Dryer and External (kWh/day)	176.40	548.97	123.83	15.87	16.13	58.21	62.74	33.23	49.28	131.14	0.10	32.58	7346.53	6042.09	11746.65	2496.73	41372.06
Washer, Dryer and External Saturation	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Space Cooling Saturation	100%	100%	95%	75%	75%	80%	80%	80%	74%	80%	0%	60%	100%	50%	160%	60%	20%
Space Cooling Set Temperature	50	48	67	63	60	65	53	55	55	57	67	65	40	40	45	51	70
Space Cooling Use (btu/degree hour)	10000	16000	3600	1200	800	1500	1845	2302	18000	4000	10	2600	30000	6000	50000	2000	30000
Space Cooling Efficiency	2.20	3.50	2.50	3.50	1.73	3.25	2.70	3.00	3.00	2.80	2.70	1.80	1.00	1.50	2.60	1.50	2.00

Separation into End-Uses

The total energy use is partitioned into the six fundamental end-uses by a combination of empirical discovery and engineering calculation, however simple.

The heating and cooling end-uses are empirically derived through the fitting of the model to the energy versus temperature slope in the usage and temperature data. The hot water end-use is explicitly calculated from water usage, inlet water temperature, and storage loss assumptions.

During weather neutral months, such as April and May, these models empirically show the total building base load. But the models cannot go further and separate that total base load into its constituent end-uses: hot water, lighting, internal loads, and external loads.

The further separation of end-uses is done by removing the explicitly calculated hot water end-use and partitioning the remaining base load (lighting, internal loads, and external loads) on the basis of US national electric energy end-use splits. For the residential sector as a whole and for most of the commercial analysis categories there are published end-use splits on the average energy use for a full range of end-uses.

For this analysis appropriate items from the full range of end-uses are aggregated into the three fundamental end-uses used in this analysis: lighting, internal uses, and external uses. From these aggregated end-uses two ratios are developed, internal usage/lighting and external usage/lighting. These two ratios are then used in the models to maintain the appropriate relationships between lighting, internal uses, and external uses.

Usage Normalization

For planning purposes, usage data is normalized to the average 10-year temperatures for the service area. Figure 20 shows the actual temperatures in the test year and the long-term average temperatures.

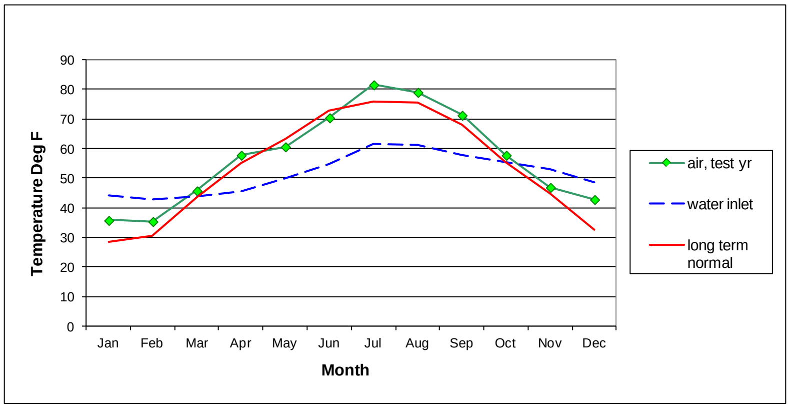


Figure 20. Air and Water Temperatures

In Figure 20, it is evident that the test year, green, will experience more heating and cooling, and will use more energy, than the 10-year average, red. The water temperature in Figure 20 refers to the ground water temperature which is used in the end-use models for water heating energy. In this case, the 30-year estimate of the groundwater temperature is assumed the same for the test year.

Perspectives on Energy

For perspective and review, the average daily energy use by end-use category and by month for each of the sixteen analysis categories is shown graphically at the end of this appendix.

Available Data

Duke made available hourly load data by rate class for 2012. This analysis proceeded from a load metered sample worked to an estimate of the total system demand, and to the demand of the principal customer sectors. Loads that we excluded from the analysis include the direct sales to municipalities and local CO-OPs and industrial transport.

This load analysis first derived the total residential and total non-residential coincident peak load for each hour of the peak day for each month for the analysis period, 2012. This analysis is the benchmark to which this demand model is trued up.

But first it is important to note that the energy model developed here estimates the average demand for a particular hour for each month. The average hourly demand from this model is quite different than the peak day hourly load for the same hour and month in the Duke Energy System Peak Day Load Analysis. They are almost as different as apples and oranges because the hourly demand is born of the monthly average and the peak hourly load comes from the monthly extreme and includes transmission and distribution losses. The initial analysis showed that the shape of the peak day load curves provided an opportunity to empirically modify and tune the timing of the predicted demand.

Demand Model

The demand model is driven by the energy model. For each end-use and for each month, the energy model estimates the average daily energy use, kWh/day. The demand model then takes the estimated daily energy use and distributes it among the twenty four hours of the day.

The objective of this demand model is to estimate the average distributed hourly demand for a large number of customers. The concept of distributed demand assumes that thousands of the same device, (stove, water heater, computer, etc) will be turning on and off according to use at random times within the hour of interest. The contribution of any one of these devices is the full load power multiplied by the duty cycle for the hour. For example, if a 1400 watt toaster is on for one-tenth of the hour, the distributed demand is 1400 watts times 0.1 hours, or 140 watts. In essence, the distributed demand is the energy used in the hour.

The distribution from daily energy use to hourly is done by means of "demand distribution functions". The demand distribution function consists of twenty-four hourly demand factors that specify the fraction of the daily energy use that occurs in each hour. Figure 21 and Figure 22 show the hourly demand factors empirically derived from this analysis and applicable to the residential customers.

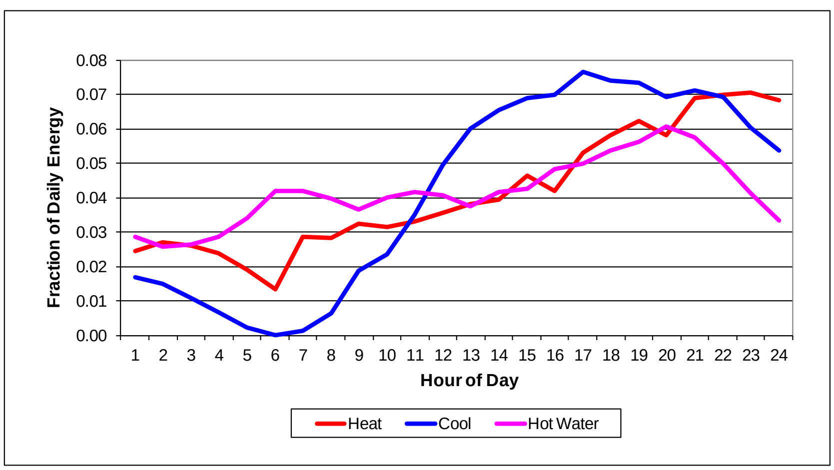


Figure 21. Residential Hourly Demand Factors for Heating, Cooling and Hot Water

Notice in Figure 21 that the cooling demand factor is greatest at about 4-5 PM when the cooling energy for each hour reaches about .073*daily average cooling energy. Similarly, the hourly demand factor for heating appear to be maximum at 1 AM when the hourly demand factor is .068 and the hourly heating energy is .068*daily average heating energy. Hot water demand is known to be bi-modal occurring in the morning and late evening.

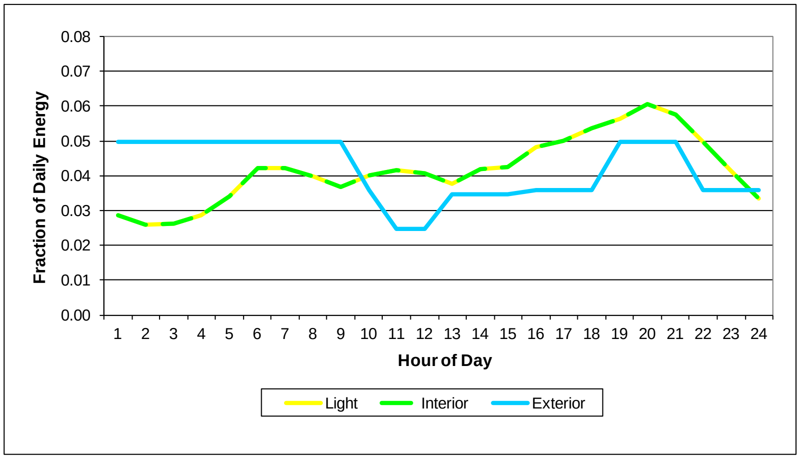


Figure 22. Residential Hourly Demand Factors for Lighting, Internal and External Loads

Notice in Figure 22 that the interior loads and lighting have the same hourly demand factor and work toward a daily peak at about 8PM. The exterior load here consists of washer and dryer activity and some exterior lighting. Washers and dryers are considered here to be external loads because most of the energy is discharged outside as in the case of dryers. Or because the load may occur in an attached space such as a basement or wash porch that is not directly part of the conditioned space, as in the case of washers.

In the model there is a set of hourly demand factors for each of the six end-uses for each of the 24 analysis categories. In principal quite a lot of unique demand specifics. But in practice the comparison of the modeled demand and the de-rated peak day load curves was done at a much aggregated level. For example the de-rated commercial peak day load was compared hour by hour to the sum of the demand estimated in the twelve commercial analysis categories. In this comparison, the data is not detailed enough to distinguish one commercial load from another. Therefore, there is a set of hourly demand factors for each of the six end-uses, and these are used in all twelve of the commercial analysis categories. The commercial hourly demand factors are shown in Figure 23 and Figure 24.

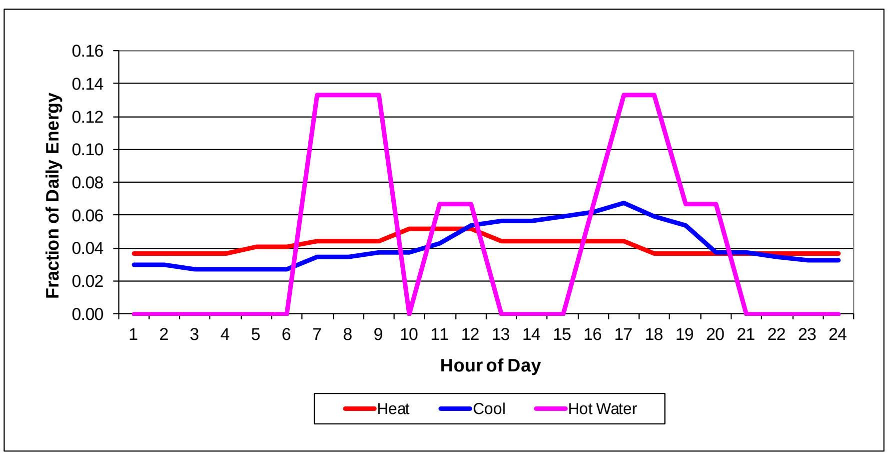


Figure 23. Commercial Hourly Demand Factors for Heating, Cooling and Hot Water

There is very little electric heating or water heating in the commercial sector, and the demand factors for these end-uses find minimal use. In Figure 23 the demand factors for cooling are the most important.

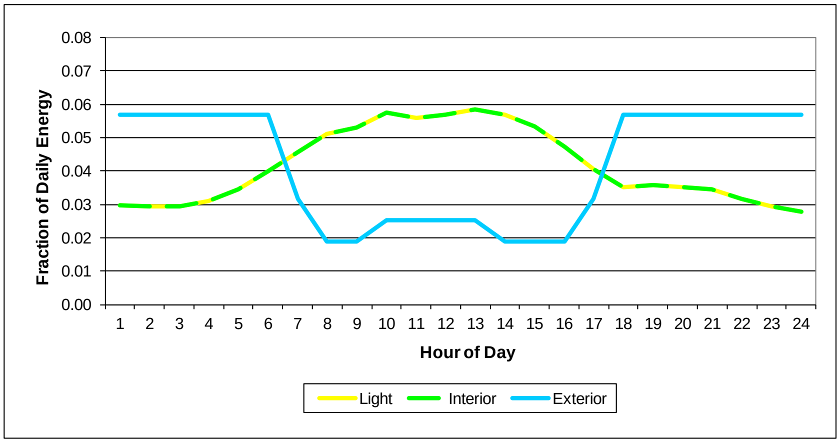


Figure 24. Commercial Hourly Demand Factors for Lighting, Internal and External Loads

In Figure 24, the hourly demand factors for the exterior loads express the fact that these loads are principally exterior lighting which is on at night. The hourly demand factors of principal importance are those for the lighting and interior loads which are assumed to be the same.

Truing the Demand Model

The demand model is ultimately trued against the coincident peak day. And ultimately, the truing process requires a temperature adjustment to simulate peak load instead of average demand conditions.

The first step in the demand true-up is to adjust the non-weather end-uses, lighting, internal loads, external loads, and hot water. The adjustment consists of modifying the hourly demand factors for these end-uses until the modeled sum of the non–weather end-uses is close to that observed from the load study. This comparison is best done when heating and cooling are at a minimum. Once the hourly demand factors are so adjusted they are then used to represent the non-weather load throughout the year and especially in the heating and cooling situations. Figure 25 shows a close comparison between the demand estimated by the model and the demand from the load study for the sum of the non-weather load.

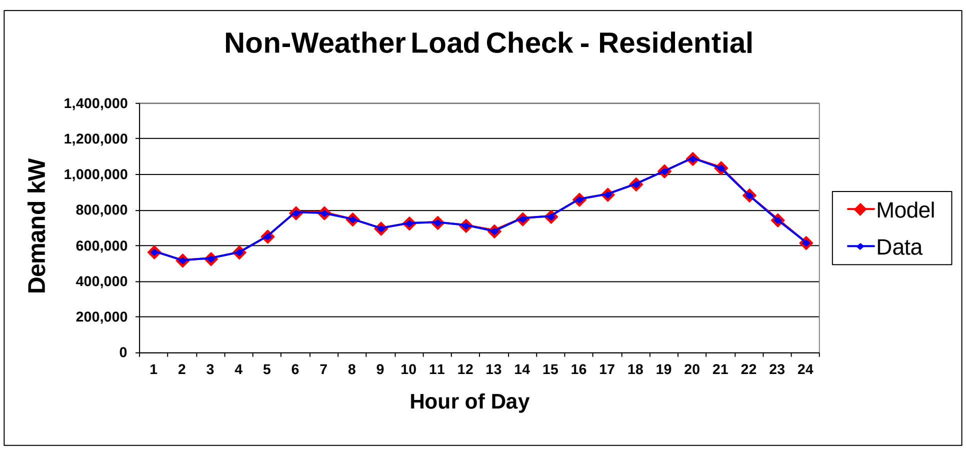


Figure 25. Base Load True-Up – Residential, October

The next step in the true-up is for cooling. In this case the model is compared to the load study for a maximum cooling month and the hourly load factors for each of the cooling months are adjusted for best fit between the model and load study. It has been found necessary to derive a different load factor curve for each cooling month because the actual dynamics of the cooling vary from month to month. For example cooling in May never carries over into the small hours of the morning as does cooling in August.

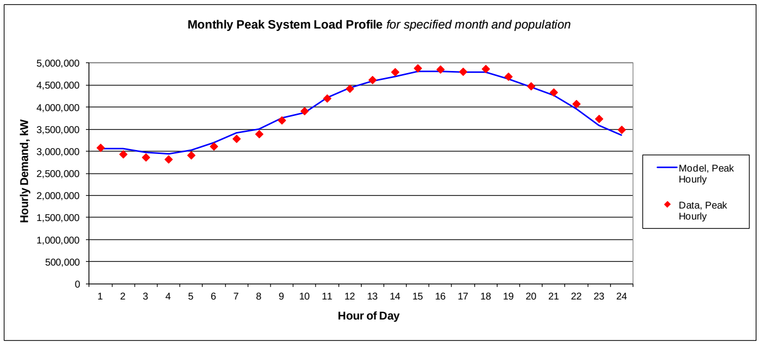


Figure 26. Cooling True-Up – All Customers, August

Figure 26 shows a close comparison between the demand estimated by the model and the demand from the load study after this cooling true-up step.

The final demand true-up step is for heating. In this case the model is compared to the load study for the heating months and a separate heating load factor curve is derived for each month from the best fit between the model and load study.

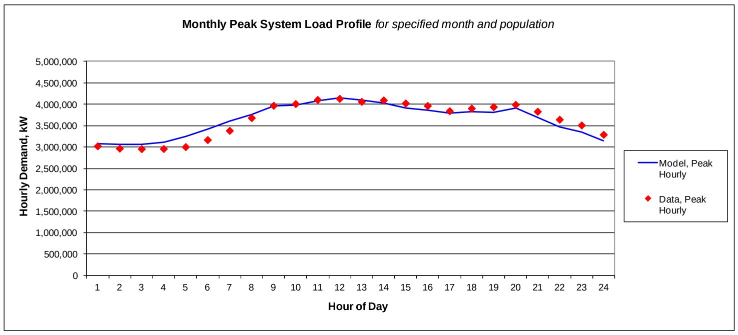


Figure 27. Heating True-Up – All Customers, December

Figure 27 shows a close comparison between the demand estimated by the model and the demand from the load study after this heating true up step. Through these true-up steps, the most significant hourly demand factors are derived and the demand model can now estimate the average daily demand versus hour for each month.

Estimating the Coincident Peak Day Load

There is a relationship between the coincident peak day load versus hour and the average day demand versus hour produced by this model. To estimate the coincident peak load, the energy model is driven by peak monthly temperatures instead of average monthly temperatures.

This model will estimate the change in average hourly demand for each month simulating any group of efficiency measures or all the measures used to express full technical potential. This month by month change in hourly average demand, at the hour of maximum system demand, will be reported as the demand impact. As such, this demand impact does not include effects of transmission and distribution losses that will often be in the financial analysis for both energy and demand. This analysis is carried out in terms of demand, and the final technical potential will be reported as an offset to the forecast energy at the meter.

Estimating the Technical Potential for Demand Savings

This model will also estimate the change in hourly demand for each month for peak, not average, conditions corresponding to any group of efficiency measures or all the measures used to express full technical potential. This month by month change in peak hourly demand, at the hour of maximum system demand, will be reported as the technical potential demand impact for each month. As such, this demand impact does not include effects of transmission and distribution losses.

Measure Savings

The screening relies on measure savings that are observable in real world billing histories. Thus the measure savings used in this screening are the net observable savings after and including the effects of take back, measure interactions, and background energy usage changes. Competent impact evaluations often report savings at the measure level.

Measure specific estimates are typically derived by regression from a billing analysis normalized for weather. This type of analysis often does not show "crossover savings," that is, gas savings resulting from measures intended to produce electric savings. These crossover savings result from measures such as duct sealing, attic insulation, wall insulation, or house sealing which produce both gas heat and electric cooling savings. This highlights a cost-effectiveness issue for this analysis: the true cost effectiveness of some measures will need to include the value of both the electric and gas savings.

Customer and Load Forecast

In order to better express the savings potential attributable to new construction, and to understand the magnitude of the technical potential relative to overall energy sales, we put the technical potential in the perspective of the current 20-year planning horizon. The technical potential model has been aligned to the base case utility forecast which does not include any energy efficiency efforts except those that would occur naturally such as the effects of product improvements or the effects of current building codes and standards, including the effects of the mandated retirement of incandescent lighting. The model is aligned to the utility forecast at four intervals in the 20-year planning horizon. This alignment is achieved by the use of scaling factors which drive the technical potential model to match the utility forecast at the desired years.

It should be noted that this technical potential is a strictly physical calculation based on the empirically derived energy usage of the average customers in 24 different categories. In estimating future energy use or savings it is assumed that these average energy uses do not change with time, commonly referred to as a "frozen efficiency" estimate. We recognize that in the real world energy decisions will often be based on more complex effects such as the response to energy costs, and the emergence and demise of various energy saving options with time. Therefore in the interest of simplicity and transparency our estimates do not include customer price elasticity, fuel switching, efficiency changes, or demographic trends. The estimates presented here over the 20 year planning horizon are essentially physical offsets to the official utility forecast which generally does include the more complex effects. The intention here is to present a reasonable physical estimate of technical potential accounting for redundancies, measure interactions, and time of season and day, and that is well bounded by the empirical evidence found in survey information and in the utility's aggregate energy usage records. The energy use and demand estimated for 2014 will be used as a benchmark for evaluating DSM program objectives and performance.

The utility forecast for this analysis is the Duke Energy forecast for Indiana that was used in the most recent Integrated Resources Plan. Derived in this manner, it should be clear that our 20 year estimate of technical potential relative to the utility forecast serves the purpose of providing a broad perspective of the technical potential vis-à-vis the utility planning horizon.

APPENDIX B. COST EFFECTIVENESS METHOLOGY

Cost-effectiveness analysis refers to the systematic comparison of program benefits and costs using standardized measures of economic performance. In this report, cost effectiveness is discussed at both the technology level and the program level. The assumptions and approach used to calculate technology and program cost effectiveness are presented in this appendix. Much of the material in this section is taken from the *California Standard Practice Manual: Economic Analysis of Demand Side Management Programs and Projects, October 2001* (SPM 2001),[51] which has broad industry acceptance.

Technology Cost Effectiveness

It is desirable to consider some measure of a technology's cost effectiveness in the preliminary stages of program design. This allows program planners to subjectively tradeoff cost and other attributes of energy efficiency measures (EEM) when considering possible program designs. Cost-effectiveness analysis is less precise at the technology screening stage because estimates of energy savings and costs at the measure level are subject to a great deal of variance due to interaction with other measures and actual program implementation. Still, measure cost effectiveness provides a useful metric for consideration along with the many other factors outlined in the Program Plans section of this report.

What is needed at the technology or measure level is a simple measure of cost effectiveness that does not require assumptions of avoided resource cost, rebates, program delivery cost and other program level details. Levelized Cost (LC) provides such a measure by expressing the cost of a measure in annual terms per unit of energy saved. This allows an easy way to compare and rank order the cost effectiveness of measures. The formula used for the LC calculations in this report is presented below:

LC=DCosts / DSavings

$$DCost = \sum_{t=1}^{N} \frac{IC_t + OM_t}{(1+d)^{t-1}} \qquad\qquad DSavings = \sum_{t=1}^{n} [(\Delta EN_t) \div (1+d)^{t-1}]$$

where:

LC	=	Levelized cost per unit of the total cost of the resource (dollars per kWh)
IC	=	Incremental cost of the measure or technology
OM	=	Annual operation and maintenance cost
DCost	=	Total discounted costs
DSavings	=	Total discounted load impacts
ΔENit	=	Reduction in net energy use in year t
N	=	Life of measure
d	=	Discount rate

Although not suited for fuel substitution and load building programs, LC provides an easily calculated way of comparing measures. Measure cost, savings, useful life, and discount rate are the only assumptions required for calculating LC. Real levelized cost refers to LC expressed in constant dollars (i.e., without inflation).

The formula used in Microsoft Excel to approximate LC is as follows:

LC = (OM-PMT(d,N,IC))/EN

where PMT is the payment function in Excel and the other terms are defined as above.

[51] Prepared by the California Public Utilities Commission (CPUC) and the California Energy Commission (CEC). All formulas and discussion are based on the SPM 2001. Formulas have been modified to remove peak savings, multiple costing periods, and otherwise adapted to be relevant for use with this project.

For example, using a real discount rate of 6.6%, a measure life of 18, an incremental cost of $200, and annual savings of 100 kWh with no annual O&M, results in real levelized costs of $0.1931.[52]

Program Cost Effectiveness

The discussion of program cost effectiveness is meant to provide a general overview of the standard tests consistent with the calculations in the SPM (2001). Actual cost-effectiveness analysis was run using DSMore software from Integral Analytics. DSMore returns benefit-cost ratios and other results for the perspectives represented in the standard tests. Contact Integral Analytics (http://www.integralanalytics.com/) for information and documentation regarding DSMore software.

Many additional assumptions over and above those required for calculating EEM cost effectiveness must be made when calculating program cost effectiveness. Cost effectiveness of energy efficiency programs involves describing the economic impact of the program from the perspective of various groups. This analysis required detailed program budgets and design elements, such as rebate levels and other program features. Perspectives, also called tests, presented in this report are listed in the table below along with the primary benefits and costs used to compute cost effectiveness.

Table 52. Benefits and Costs by Cost Effectiveness Test

Cost Effectiveness Test	Benefits	Costs
Utility Cost (also known as Administrator Cost)	Avoided energy costs (net)	Program expenses paid by utility including incentives
Participant	Reduced energy bill Incentive payments Tax credits Decreased O&M costs	EEM installation Increased O&M costs
Ratepayer Impact	Avoided energy costs (net)	Lost revenue (net) Program expenses
Total Resource Cost (TRC)	Avoided energy costs (net) Tax credits Decreased O&M costs	EEM installation Program expenses Increased O&M costs
Societal (variant of TRC)	TRC benefits plus non-energy benefits less tax credits	TRC costs plus non-energy costs

Reference to "net" indicates that the load used to measure the benefit or cost is net of free-riders. EEM installation includes all incremental costs to acquire and install an EEM. Program expenses include all costs related to delivery of the program and include staffing and overhead, advertising, incentive payments, administration fees, and monitoring and evaluation expenses.

Various measures of the economic impact are available for each perspective. The two primary measures we will use in this report are listed below:

- Net Present Value
- Benefit-Cost Ratio

In addition to the economic criteria listed above, other criteria may be unique to a given perspective. For example, simple payback of investment is often cited as an important criterion from the participant perspective. Each of the perspectives is discussed in detail below including the assumptions and formulas required to calculate the measures of economic impact. Each of the cost-effectiveness tests are discussed below.

[52] The values used in the example are not meant to represent actual assumptions. See the Energy Efficiency Measure Assessment section for specific assumptions, including the discount rate.

Utility Cost Test (also known as Administrator Cost Test)

The Utility Cost Test measures the cost of acquired energy savings considering only the costs paid by the utility. Benefits are similar to the TRC Test but costs are more narrowly defined. Its primary purpose is for assessing resource acquisition from the perspective of the utility. In this sense, it is similar to the Participant Test in that the test provides a measure of cost effectiveness from a single perspective that does not include all costs.

Benefits included in the calculation are the avoided cost of energy supply. Net loads are used for the purpose of calculating avoided cost of energy benefits. The costs include all program expenses including incentive payments for EEM installation.

Participant Test

This test compares the reduction in energy bills resulting from the program with any costs that might have been incurred by participants. Other benefits included in this test include incentive payments and tax credits. When calculating benefits, gross energy savings are used rather than reducing savings for free-riders.

The main value of the Participant Test is that it provides insight into how the program might be received by energy consumers. The incentive level required to achieve some minimum level of cost effectiveness, for example, can be useful in program design efforts. It should be noted, however, that consumer decision making is far more complex than reflected by the Participant Test. For this reason, the test should be used as one consideration of likely program acceptance and not an absolute indicator.

Ratepayer Impact Measure Test

The Ratepayer Impact Measure (RIM) Test measures the impacts to customer bills and rates due to changes in utility revenues and operating costs caused by the program. Rates will go down if the change in revenues from the program is greater than the change in utility costs. Conversely, rates will go up if revenues collected after program implementation is less than the total costs incurred by the utility for implementing the program. This test indicates the direction and relative magnitude of the expected change in customer rate levels.

The benefits calculated in the RIM Test are the savings from avoided supply costs. These avoided costs include the reduction in commodity and distribution costs over the life of the program.

The costs for this test are the lost revenues from reduced sales and all program costs incurred by the utility, including incentives paid to the participant. The program costs include initial and annual costs, such as the cost of equipment (either total cost for a new installation or net cost if done as a replacement), operation and maintenance, installation, program administration, and customer dropout and removal of equipment (less salvage value). The decreases in supply costs and lost revenues should be calculated using net savings.

Total Resource Cost Test

The Total Resource Cost Test measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs. Of all the tests, the TRC is the broadest measure of program cost effectiveness from the standpoint of energy acquisition. This makes the TRC Test useful for comparing supply and demand side resources.

The primary benefit in the TRC Test is the avoided cost of energy. Loads used in the avoided cost calculation are net of free-riders. Tax credits and reductions in annual O&M costs, if applicable, are also treated as a program benefit (or a reduction in costs). Costs used in the TRC calculations include all EEM installation costs, program related costs and any increased O&M costs no matter who pays them. Incentive payments are viewed as transfers between participants and ratepayers and are excluded from the TRC Test.

Societal Test

The Societal Test is the broadest of all of the perspectives and is considered a variant of the TRC. The primary difference between the two tests is that the Societal includes non-energy benefits and costs that are not part of the TRC. Another difference is the treatment of tax credits. While tax credits are counted as a benefit in the TRC test, they are considered a transfer payment between members of society and, hence, excluded from the Societal test.

APPENDIX C. RESIDENTIAL EEM DOCUMENTATION

The purpose of this appendix is to provide documentation of the assumptions used to screen the residential Energy Efficiency Measures (EEM) identified for consideration in this report. As such, this appendix supports, but does not list, the specific values for savings, measure life and incremental costs for measures used in this study. These specific values for residential measures are listed in Table 15 on page 28. In this particular analysis all of the electric EEM in the Indiana Technical Resource Manual, TRM Jan 2013, are included using the costs, measure life, and energy savings value or algorithm deemed in the TRM. It should be noted that the TRM supports calculation of site specific savings for various cities in Indiana; we used Indianapolis as a representative location for all measures.

There are several EEMs that are not part of the TRM, but are necessary for the comprehensive EEM list used in a technical potential estimate. The table below provides a cross reference between EEMs listed in this study and the TRM, and it also identifies EEMs not found in the TRM. For EEMs not found in the TRM, EE program experience is used to establish a reasonable range of assumptions; the point estimate used within that range is based on our professional opinion. In cases where the TRM is used the reader is directed to the associated TRM documentation. EEMs not found in the TRM are described below after the following table.

Table 53. Residential Measure List Cross-Reference to Indiana TRM

Ref #	Measure Name	TRM Database Reference
R-1	Combined Heat Power, Micro CHP	
R-2	Elec Furnace to SEER 15 H Pump SF	Res-HVAC-ASHP-1
R-3	Resist to SEER 15 Heat Pump SF	Res-HVAC-ASHP-1
R-4	Elec Furnace to SEER 15 H Pump MF	Res-HVAC-ASHP-1
R-5	Resist to SEER 15 Heat Pump MF	Res-HVAC-ASHP-1
R-6	Refrig Charge/Duct Tune-Up Electric	Res-AC-tune up-1 & Res-HVAC-DTS-1
R-7	Refrig Charge/Duct Tune-Up Gas	Res-AC-tune up-1 & Res-HVAC-DTS-1
R-8	SEER 13 to SEER 15 Heat Pump SF	Res-HVAC-ASHP-1
R-9	SEER 13 to SEER 15 Heat Pump MF	Res-HVAC-ASHP-1
R-10	SEER 13 to SEER 15 CAC New	Res-HVAC-AC-1
R-11	SEER 9 to SEER 15 CAC Replace	Res-HVAC-AC ER-1
R-12	Efficient Window AC	Res-Appl-ES-RAC-TOS-1
R-13	Cool Roofs	
R-14	EE Windows	Res-Shell-ESWind-1
R-15	Programmable Thermostats	Res-HVAC-Tstat-1
R-16	Ceiling Insulation (R6-R30) Electric	Res-Shell-RoofInsul-1
R-17	Ceiling Insulation (R6-R30) Gas	Res-Shell-RoofInsul-1
R-18	House Sealing using Blower Door Electric	Res-Shell-AirSeal-1
R-19	House Sealing using Blower Door Gas	Res-Shell-AirSeal-1
R-20	Ground Source Heat Pump	Res-HVAC-GSHP-1
R-21	Wall Insulation (R3-R11) Electric	Res-Shell-WallIns-1
R-22	Wall Insulation (R3-R11) Gas	Res-Shell-WallIns-1
R-23	Solar Siting/Passive Design	Res-WB-RNC-1
R-24	Energy Star Manufactured Home	Res-WB-RNC-1
R-25	Energy Star Construction	Res-WB-RNC-1
R-26	Major Remodel	Res-WB-WWRetro-1
R-27	Window Film	
R-28	Dehumidifier	Res-Appl-ES Dehumid-1
R-29	Eliminate Old Refrigerators	Res-Appl-Refrig-LI-1
R-30	Set Back HVAC with Ceiling Fan	
R-31	Energy Star Clothes Washers	Res-Appl-CloWash-1
R-32	Energy Star Dish Washers	Res-Appl-DishWash-1
R-33	Energy Star Refrigerators	Res-Appl-Refrig/Freeze-TOS-1
R-34	Pool Pumps	Res-Pool-Motor-1
R-35	Efficient TV	Res-Appl-TV-1
R-36	Efficient Residential Lighting Makeover	Res-Ltg-CFL-1 & Res-Ltg-LED-1
R-37	Occupancy Controlled Outdoor	
R-38	LED Residential Outdoor Yard Light	
R-39	Single CFL	Res-Ltg-CFL-TOS-1
R-40	Single LED	Res-Ltg-LED-1
R-41	Tank Wrap, Pipe Wrap and Water Temp Setpoint	Res-DHW-PipeIns-1 & Res-DHW-TankWrap-1
R-42	Low Flow Fixtures	Res-DHW-SH-1 & Res-DHW-Aerator-1
R-43	Heat Pump Water Heaters	Res-DHW-HPWH-1
R-44	Solar Water Heaters	Res-DHW-SWH-1
R-45	Efficient Plumbing	
R-46	Ductless Heat Pump	Res-HVAC-ASHP-1
R-47	Drain HX	
R-48	Smart Plug	Res-Appl-Strip-1
R-49	Heat Pump Pool Heater	
R-50	Customer Report	
R-51	Solar PV	
R-52	In Home Display	

Combined Heat/Power, Micro CHP (R-1)

This measure is a form of site generation. There are two general classes of combined heat and power. The first class is applied to large steady thermal loads, usually at an industrial scale. This first class has a high load factor and is very rare in a residential context. The second class of combined heat and power has a low load factor, typical of the highly seasonal heating load in the residential sector. This second class, referred to here as "micro CHP", is considered here as a residential measure. In this context it is intended to apply to existing residential space heat and water heat loads. 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, and it also has significant benefit as summer capacity, and as local backup power. Notably, this resource is based on ultra clean and quiet combustion in sterling cycle engines or fuel cells, and it can potentially be readily sited anywhere in the service territory and used to balance distribution. System sizes range from about 1 kW to 8kW electrical output. For this estimate of technical potential an electrical output of 4 kW is assumed.

Measure Applicability

This measure is applicable to residences with gas space and water heat.

Incremental Cost

This measure is not currently a mature market item and costs reflect the demonstration nature of the resource.

Average Annual Expected Savings

The savings from this measure have not been widely measured but based on the available space and water heating load an electrical output of 5,000 kWh/yr is assumed. A greater annual output could easily be achieved, but only by generation with no useful thermal load which would be much less fuel efficient.

Expected Useful Life

This measure has an expected useful life typical of appliances, of 15 to 20 years.

Cool Roofs (R-13)

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 roofing materials. Recent improvements in roofing have led to roofing material 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.

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 $0.20/square foot, but which is expected eventually to be zero. All other roofing costs are required and ventilation is assumed to be unchanged by this measure.

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. Larger savings will be found in the extreme cases with poorly insulated air conditioning distribution located in the attic spaces. Generally, savings depend significantly on the size of the residence, temperature set points, and the thermal integrity of the shell.

Expected Useful Life

This measure consists of reasonably durable material installed in an attic where degradation potential is reduced.

Window Film (R-27)

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 and provides a limited IR barrier to heat loss through the window. It is a highly cost-effective measure with wide application.

Measure Applicability

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 a significant portion building's heat load can be generated by solar heating though un-shaded windows. During the heating season, some 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 per square foot of window film installed.

Expected Useful Life

This measure is assumed to have a relatively short measure life of around 3 to 6 years.

Setback HVAC with Ceiling Fan (R-30)

This measure is a voluntary set back of both the heating and cooling set points by 3 deg F. This is the average setback for the whole day not just the night set back. This type of setback could lead to slight behavior changes, such as different clothing when lounging around or sedentary. The heating and cooling savings from such a simple change can be large, of the order of 2000 kWh/yr. The savings will be greatest in houses heated by resistance heat, but they will be significant in heat pump houses as well. It also includes installing Energy Star ceiling fans instead of non-Energy Star ceiling fans. Ceiling fans circulate conditioned air throughout the room. This makes the room temperature more uniform and can reduce the tendency to change thermostat settings. The Energy Star ceiling fan has a more efficient motor and compact fluorescent light bulbs making it more efficient than its counterpart.

Measure Applicability

This measure is applicable throughout the residential sector. But the greatest savings will be where the measure is applied to electric-heated homes.

Incremental Cost

This measure has essentially no cost. Energy Star ceiling fan costs vary but are typically in the $75 to $100 range.

Average Annual Expected Savings

The savings for this measure depend strongly on the amount of set back and the heating type. Based on DEI specific weather, low savings would be about 500 kWh/yr for a mild set back to a good heat pump, and high savings would be about 2,000 kWh/yr for a five degree set back to an electric furnace.

Expected Useful Life

This is a temporary measure; the set back strategy may only work for one or two seasons and ceiling fans typically last about 10 years.

Occupancy Controlled Outdoor Lighting (R-37)

This measure is designed to save lighting energy by turning on selected outdoor lighting only when occupancy or movement is detected. This measure has a strong security context, but it also is very convenient at entrances, garages, etc., where light switches can only be accessed from inside and lighting is left on for long periods of time in order to provide light for the short time it is actually needed.

Measure Applicability

This measure is applicable throughout the existing residential stock.

Incremental Cost

This measure physically involves replacing two frequently used outdoor lights by occupancy controlled lights. Costs depend on the number of lights installed and is estimated at about $50 per light, with 2 lights being typical.

Average Annual Expected Savings

The average annual expected savings from this measure depends on the type of light that is being controlled. The preferred type of light to control is a compact fluorescent spot light because of its lower power use and long life. But in colder outdoor applications these lights can take from 30 seconds to a minute to come to full brightness which may be unacceptable in some cases. For this analysis, we will assume that 150 watts is being controlled, and that a savings of 5 hours/day is achieved.

Expected Useful Life

The useful life is typically 10 to 15 years for this measure.

LED Residential Outdoor Yard Light (R-38)

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 specialty applications such as back lighting of flat panel displays, and outdoor applications. It is probable that LED lighting will find its place ultimately in many 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 residential sector.

Incremental Cost

The incremental cost for an outdoor LED light of this type is expected to decrease as the market matures. 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.

Average Annual Expected Savings

Measure savings proceed from the replacement of a 250 watt light by a 19 watt LED assembly.

Expected Useful Life

LED lighting is known for its exceptionally long life, some estimates say 50,000 hours.

Efficient Plumbing (R-45)

This measure saves water heating energy by leaving less hot water in the pipes to cool during periods of non-use. Conspicuously, the primary motive for this measure is the amenity benefit of limiting the waiting time for usable hot water at the tap or showerhead; waiting times can be reduced from a significant fraction of a minute to only a few seconds. Physically this measure involves the use of smaller diameter continuous PEX water pipes with no elbows or Tees and the use of carefully sized pipe manifolds. While this measure is tested and viable it involves the use of small diameter piping in a context that is not familiar to the plumbing trade or to building officials. It is therefore considered an emerging technology and will not be included in program recommendations.

Measure Applicability

This measure is applicable to 100 percent of the residential new construction.

Incremental Cost

In large scale use, this measure offers the possibility of actually lowering the cost of hot water plumbing because smaller diameter less expensive pipe is used. But specialized manifolds and system planning are required.

Average Annual Expected Savings

The savings from this measure have not been widely measured but savings of 10 percent of the hot water end-use are reasonable.

Expected Useful Life

This tends to be a very long-lived measure.

Drain HX (R-47)

Drain water heat recovery consists of the installation of a single-pass heat exchanger on the down-spout of a residential shower drain. As warm shower grey water flows down the drain and into the heat exchanger, feed water to the resident's water heater is pre-warmed.

Measure Applicability

This measure is applicable for 10% of the residential new construction and retrofit housing stock. Limitations due to space concerns are the primary determinant for the implementation of this measure. High efficiency exchangers require 69 inches of vertical pipe clearance for installation.

Incremental Cost

The installed cost of this measure varies based on the size of the heat exchanger installed and the amount of plumbing required for installation.

Average Annual Expected Savings

For a typical residential household using a single shower for bathing, the annual electrical savings from pre-heating hot water heater feed water is typically 15% to 35% of annual water heating load, with variations based on family size and bathing routines.

Expected Useful Life

This measure is assumed to have a long useful life.

Heat Pump Pool Heater (R-49)

This measure consists of the installation of a heat pump unit for the application of below-ground pool heating. This heat pump unit replaces a typical electric resistance pool heater and produces significant savings for applicable locations.

Measure Applicability

This measure is applicable in homes with below-ground pools. Indications are that it is more effective when used to heat indoor pools.

Incremental Cost

The incremental cost for this measure is based on pool size and heating requirements. There is a large variation in costs based on unit size and the necessary installation costs that may be incurred if pre-existing electrical supply gear is not adequate for the new loading requirements.

Average Annual Expected Savings

The U.S. Department of Energy estimates that savings associated with this measure are roughly 80% of the annual pool-heat loading required by resistance heater pool heat. This is based on national survey data and averaged for each region based on seasonal pool usage.

Expected Useful Life

This measure is a self-contained unit with high reliability and therefore has a long expected useful life.

Customer Report (R-50)

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.

Solar PV (R-51)

This technology consists of a roof or ground mounted solar electric array with a full sun output of 3 kW. Such an array has an area of 200-300 square feet. Electricity from the array is converted to AC by an inverter and the power is immediately used on site with excess fed into the grid. This technology needs full solar exposure and shadows can significantly restrict output. This technology is fully mature, but local builders and building officials are still unfamiliar with it.

Measure Applicability

No local studies have estimated the percentage of housing stock with suitable exposure; for this analysis it is assumed that 26 percent of residential buildings are suitable sites.

Incremental Cost

A system installation usually requires an electrical inspection to verify appropriate wire sizing and insulation type, disconnects, and grounding. Costs are quite site specific, with most of the costs associated with solar electric panels, which have come down dramatically in the last few years.

Average Annual Expected Savings

The electrical output for this technology is directly related to the solar intensity. Monitoring studies in this region of the US have shown that 1 kW of installed capacity can yield in excess of 1,000 kWh/yr on a long term basis. For the 3. kW array considered here, the annual savings for the DEI service territories is estimated to be 3,000 kWh/yr.

Expected Useful Life

This equipment demonstrated long trouble free service in severe applications such as remote communications, navigation lighting, and road signage. The long-term output of the cells is assumed to decrease with time, but the rate of decrease for current technology is not known. The crystalline and semi-crystalline forms of the technology have already demonstrated degradation of less than 20 percent in 20 years. But earlier thin film forms of the technology have showed shorter lifetimes. The lifetime of new thin film technologies is expected to be of the order of 25 years but it is not known.

In-Home Display (R-52)

In-Home Displays is a behavioral measure. It saves energy by focusing customer attention on household energy use by providing a display in the home.

Measure Applicability

All residential customers are technically eligible. However this measure might be seen more generally as “timely feedback on energy use”. As a feedback loop this measure may become part of the other behavioral measures, R-47 customer reports, or R-48 prepay.

Incremental Cost

The incremental cost is high if the standard in-home hardware display approach is used; if, instead, messages are sent by e-mail and text messaging the incremental cost is very low (this is an in-home display without utility furnished equipment).

Average Annual Expected Savings

A small average behavioral savings response is expected at first with rapid decay in a few months to a weak but stable average annual savings.

Expected Useful Life

Until there is at least a decade of experience with scaled up in-home display including studies of decay, the measure life will not be well understood.

APPENDIX D. NON-RESIDENTIAL EEM DOCUMENTATION

The purpose of this appendix is to provide documentation of the assumptions used to screen the non-residential Energy Efficiency Measures (EEM) identified for consideration in this report. As such, this appendix supports, but does not list, the specific values for savings, measure life and incremental costs for measures used in this study. These specific values for non-residential measures are listed in Table 16 on page 29. In this particular analysis all of the electric EEM in the Indiana Technical Resource Manual, TRM Jan 2013, are included using the costs, measure life, and energy savings value or algorithm deemed in the TRM. It should be noted that the TRM supports calculation of site specific savings for various cities in Indiana; we used Indianapolis as a representative location for all measures.

There are several EEMs that are not part of the TRM, but are necessary for the comprehensive EEM list used in a technical potential estimate. The table below provides a cross reference between EEMs listed in this study and the TRM, and it also identifies EEMs not found in the TRM. For EEMs not found in the TRM, EE program experience is used to establish a reasonable range of assumptions; the point estimate used within that range is based on our professional opinion. In cases where the TRM is used the reader is directed to the associated TRM documentation. EEMs not found in the TRM are described below after the following table.

Table 54. Non-Residential Measure List Cross-Reference to Indiana TRM

Ref #	Measure Name	TRM Database Reference
C-1	Combined Heat and Power, CHP	
C-2	Solar Electric	
C-3	Small HVAC Optimization and Repair	
C-4	Commissioning - New	
C-5	Re/Retro-Commissioning Lite	
C-6	Low-e Windows 1500 ft2 New	CI-Shell-Hpglass-1
C-7	Low-e Windows 1500 ft2 Replace	CI-Shell-Hpglass-1
C-8	Premium New HVAC Equipment	
C-9	Chiller Tune-Up	CI-HVAC-chiller tune-1
C-10	Window Film	CI-Shell_Windfilm-1
C-11	Room Air Conditioner	CI-HVAC-RAC-1
C-12	Split System AC	CI-HVAC-AC-1
C-13	Heat Pump System	CI-HVAC-ASHP-1
C-14	Outside Air Economizer	CI-HVAC-Econ-1
C-15	Demand Controlled Ventilation	CI-HVAC-DCV-1
C-16	Chilled Water Reset	CI-HVAC-CHWReset-1
C-17	VFD HVAC	CI-HVAC-VFD-1
C-18	Cool Roof	CI-Shell-Cool Roof-1
C-19	Roof Insulation	CI-Shell-Roofinsul-1
C-20	Integrated Building Design	
C-21	Electronically Commutated Motors	
C-22	Premium Motors	
C-23	VSD, Controls and Motor Applications Integrated	
C-24	Single Application VSD	CI-HVAC-VFD-1
C-25	Energy Star Transformers	
C-26	Efficient AC/DC Power	
C-27	LED/Efficient Outdoor Lighting	
C-28	New Efficient Non-Controls Lighting Equipment	CI-ltg-fixedrep-NC-1
C-29	Retrofit Efficient Non-Controls Lighting Equipment	CI-Ltg_fixtrep-ER-1
C-30	LED Exit Signs	CI-Ltg-LEDexit-1
C-31	LED Traffic Lights (10)	CI-Ltg-LEDtraffic-1
C-32	Perimeter Daylighting	
C-33	C&I Lighting Controls	CI-Ltg-control-1
C-34	Commercial Skylight	CI-Ltg-liteTube-1
C-35	Low Flow Fixtures	
C-36	Solar Water Heaters	
C-37	Heat Pump Water Heaters	CI-SHW-HPWH-1
C-38	HE Food Prep and Holding	CI-food-Holdcab-1
C-39	Energy Star Commercial Clothes Washer	CI-Proc-CloWash-1
C-40	Restaurant Commissioning Audit	
C-41	Steam Cooker	CI-Food_StmCook-1
C-42	Energy Star Fryers	CI-Food-Fryer-1
C-43	Energy Star Combination Oven	CI-Food-CombiOven-1
C-44	Energy Star Convection Oven	CI-Food-ConvectOven-1
C-45	Energy Star Griddle	CI-Food-Griddle-1
C-46	Spray Nozzles for Food Service	CI_SHW-PRSV-1
C-47	Efficient Package Refrigeration	
C-48	Grocery Refrigeration Tune-Up and Improvements	
C-49	Refrigeration Casework Improvements	
C-50	VendingMiser®	CI-Plug-Vending-1
C-51	Refrigerated Case Covers	CI-Refrig-CaseCover-1
C-52	Door Heater Controls For Cooler - Freezer	CI-Refrig-ASHCntrl-1
C-53	Door Heater Controls For Cooler - Refrigerator	CI-Refrig-ASHCntrl-1
C-54	New Energy Star Ice Machine	CI-Refrig-IceMach-1
C-55	Solid or Glass Door Refrigerators, New	CI-Refrig-RefFreeze-1
C-56	Strip Curtins for Coolers	CI-Refrig-StripCurt-1
C-57	Door Gaskets for Refrigerated Cases	CI-Refrig-Gasket-1
C-58	Network Computer Power Management	
C-59	High Efficiency Pumps	CI-Proc-Pum[-1
C-60	Engineered Nozzles	CI-Proc-CANozzle-1
C-61	Insulated Pellet Driers	CI-Proc-INSULpellet-1
C-62	Injection Molding Barrel Wrap	CI-Proc_IMMWrap-1
C-63	Efficient Air Compressors	CI-Proc-AirComp-1

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.

Solar Electric (C-2)

This technology consists of a roof or ground mounted solar electric array with a full sun output of 50 kW. Such an array has an area of 4,000-6,000 square feet. Electricity from the array is converted to AC by an inverter and the power is immediately used on site with excess fed into the grid. This technology needs full solar exposure and shadows can significantly restrict output. In the commercial context, this technology can be an architectural enhancement.

Measure Applicability

This measure is applicable wherever there is sufficient space and solar exposure. For this study we assume applicability to 15 percent of all commercial buildings.

Incremental Cost

A system installation usually requires an electrical inspection to verify appropriate wire sizing, disconnects, and grounding. Costs are quite site-specific, with most of the costs associated with the solar electric panels. In the current 2011 market, costs are $2.50-$3.50/watt peak for the solar cells alone. Installation and balance of system can be expected to add $4.00/watt.

Average Annual Expected Savings

The electrical output for this technology is directly related to the solar intensity. Monitoring studies in this region of the US have shown that 1 kW of installed capacity can yield in excess of 1,300 kWh/yr.

Expected Useful Life

This equipment demonstrated long trouble free service in severe applications such as remote communications, navigation lighting, and road signage. The long-term output of the cells is assumed to decrease with time, but the rate of decrease for current technology is not known. The crystalline and semi-crystalline forms of the technology have already demonstrated degradation of less than 20 percent in 20 years. But earlier thin film forms of the technology have shown shorter lifetimes. The lifetime of new thin film technologies is expected to be of the order of 25 years but it is not known.

Small HVAC Optimization and Repair (C-3)

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 (eg, 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.

Commissioning New and Retro (C-4, C-5)

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.

Premium New HVAC Equipment (C-8)

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.

Integrated Building Design (C-20)

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, 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. (cf 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.

Electronically Commutated Motors (C-21)

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-22)

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.

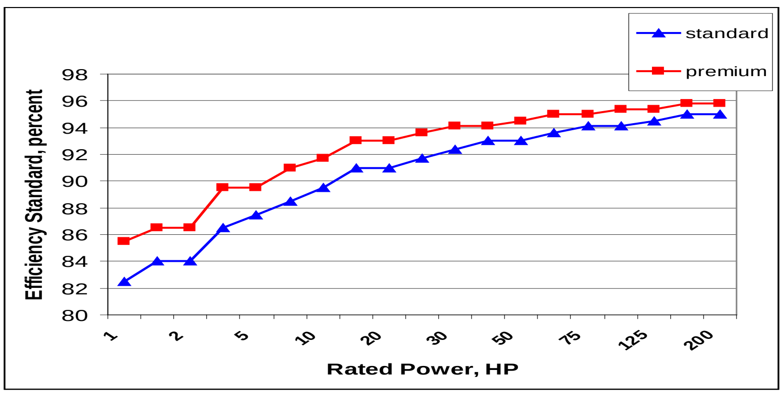


Figure 28. Motor Efficiency Specification NEMA Premium

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 29. 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.

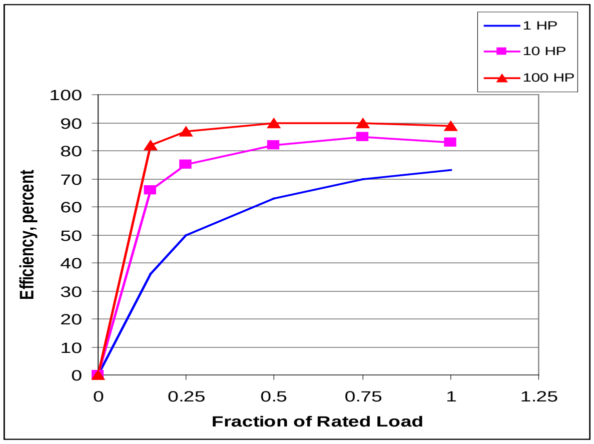


Figure 29. Typical Motor Operating Efficiencies versus Load

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 Integrated (C-23)

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-25)

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.

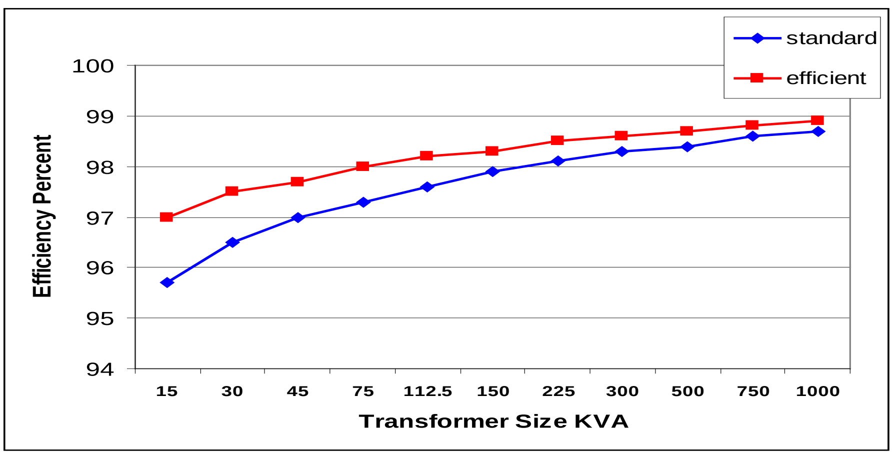


Figure 30. Transformer Efficiency Specification NEMA TP-1

Figure 30 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-26)

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/Efficient Outdoor Lighting (C-27)

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.

Perimeter Daylighting (C-32)

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-35)

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 DEI 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-36)

The water heating end-use in commercial buildings is a smaller end-use than in residences. In the DEI 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 DEI 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.

Restaurant Commissioning Audit (C-40)

This measure consists of an audit conducted by a restaurant energy professional to identify the potential for efficiency in a commercial kitchen. 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 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.

Efficient Package Refrigeration (C-47)

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.

Grocery Refrigeration Tune-Up and Improvements (C-48)

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-49)

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.

Network Computer Power Management (C-58)

This measure involves powering down unused network functions during unoccupied hours.

Measure Applicability

This measure is technically applicable in 100 percent of the commercial sector, but it is assumed that only 10 percent of the commercial sector will have the networks large enough and staff conversant enough to execute the measure.

Incremental Cost

The incremental cost for this technology will be very diverse. Based on NWPCC estimates, the premium upgrade costs about $0.115/kWh/yr.

Average Annual Expected Savings

Approximately 12 percent of commercial energy is for electronics and computers. It is assumed here that, at an applicable site, 2 percent of energy can be saved by efficient network power management.

Expected Useful Life

This is a transient measure dependent on the current system configuration. It is assumed to have a very limited useful life.

APPENDIX E. SEGMENTATION AND CIS SAMPLING PLAN

In order to accurately understand the nature of loads and DSM opportunities, we start by disaggregating the Duke Energy customer base into smaller groups of customers. These customer segments are chosen so that customers with similar energy attributes can be grouped for modeling purposes.

Duke Energy provided an extract from their customer information system (CIS) that included the information we requested for all customers in the Duke Energy service areas. Using the CIS extract, segments were developed using the following rules-based approach:

1. Aggregate customer loads (kWh) to the premise level.
2. Group customers into Residential based on the rate schedule.
3. Residential customers were then grouped into housing type and vintage.
    a. Housing type based on facility type field.
        i. Single Family
        ii. Multifamily including apartments and condominiums
    b. Vintage based on initial service date. (Note: The importance of delineating between new and existing stock is to describe and contrast current construction practices.)
        i. New construction (2011 and after)
        ii. Existing stock (prior to 2011)
4. Non-Residential customers were then grouped by load and SIC
    a. Customers with exceptionally small loads were assigned the small loads segment (less than 3,000 kWh over a recent 12-month period unadjusted for weather).
    b. Customers not classified in the small load were assigned segments based on their SIC code.

The segmentation strategy is shown in the table below.

Residential (based on rate code)			**Non-Residential (based on rate code)**
Single Family New Construction	Single Family Existing		Manufacturing and Non-Manufacturing Segments Based on SIC
Multifamily New Construction	Multifamily Existing		Small Loads (< 3,000 kWh/year)

Customer counts and usage by segment are shown in the attached PDF file. Non-residential segment assignments based on SIC code are shown in the table below.

SIC Code	Business Type Assignment
01 – 17	Agriculture, Mining and Construction
20 – 39	Manufacturing (further segmented as follows: Primary Metals Chemicals Transportation Equipment Food Products Other Manufacturing
42, 50 and 51	Warehouse
54	Grocery
58	Eating/Drinking
70	Hotels
80 (except 806)	Health Services (excludes hospitals)
806	Hospitals
82	Schools
52 – 59 nec	Retail
40 – 98 nec	Office
All other SIC nec	Other
nec = not elsewhere classified	

There were nearly 30,000 non-residential customers with small loads (< 3,000 kWh). This is fairly typical in that electric utility services include facilities that are not typical commercial establishments. Examples include billboards and railroad signals and switching equipment. The 3,000 kWh cutoff was determined after a review of the distribution of kWh usage and considering what a reasonable lower limit might be for a small commercial establishment.

Sample Selection

A random sample of customers served before October 2011 (to allow sufficient 2012 billing history) was drawn by segment for modeling purposes as follows:

1. Randomly select 1,200 customer sites for each segment.
2. All manufacturing customers are included in the sample to allow for various groupings to be explored without having to request another round of data.
3. Any customer with exceptionally large usage (over one million kWh) that was not included in the random sample was manually selected.

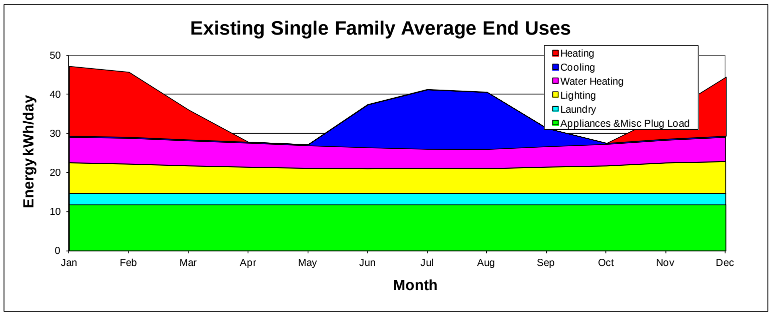
Monthly 2012 billing data for sample premises served as the basis for our energy modeling and analysis by market segment.

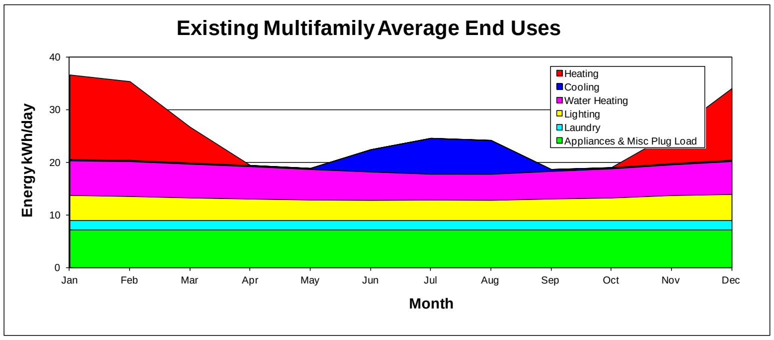
APPENDIX F. SEGMENT LOAD CHARTS

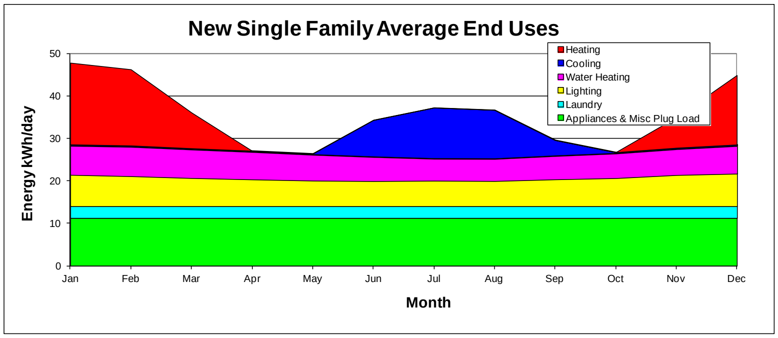
In this appendix, end-use charts are provided for each segment beginning with the residential sector. See Appendix A for additional information on typical end-uses by sector.

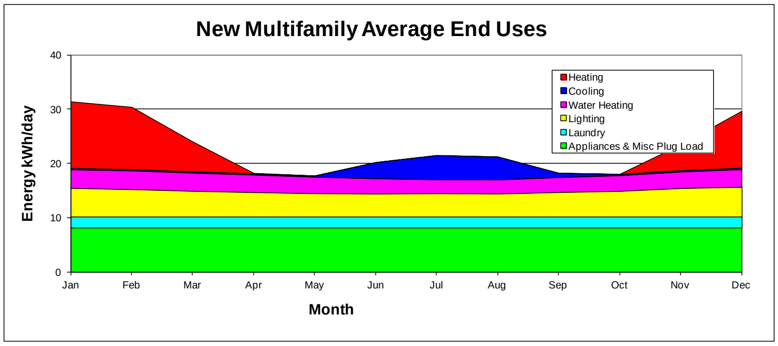
Residential

The following four charts show monthly usage by end-use for each of the residential segments.



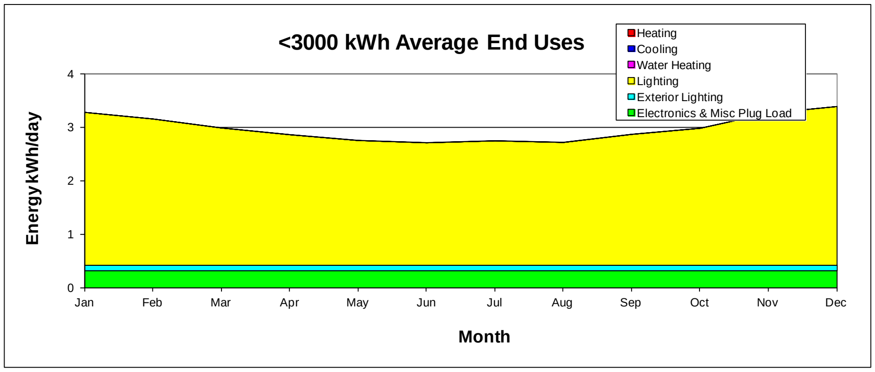


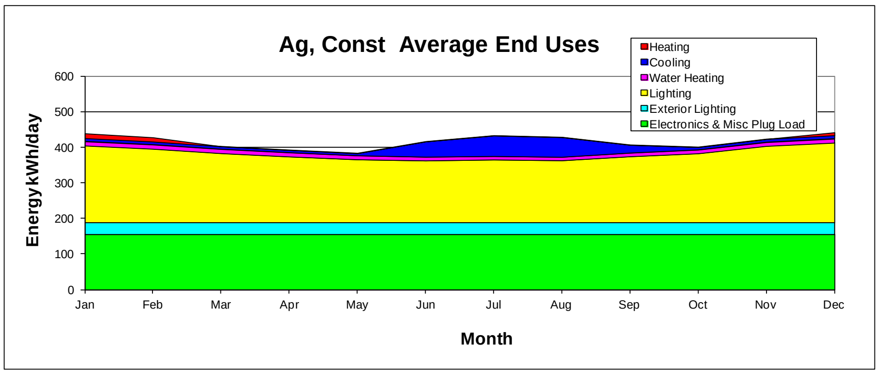


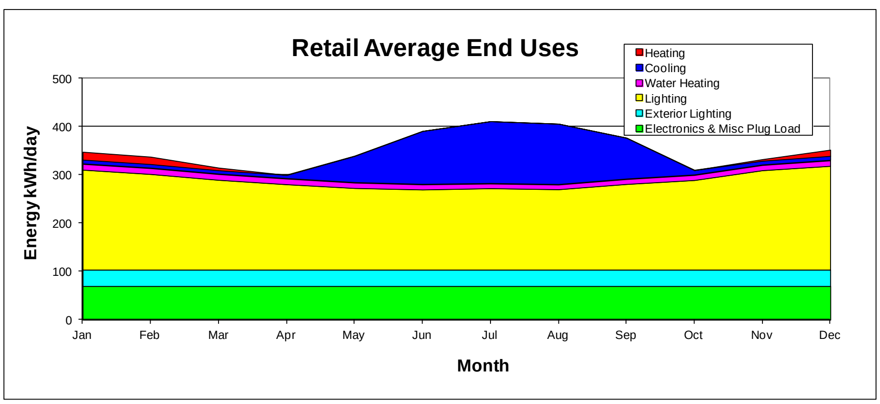


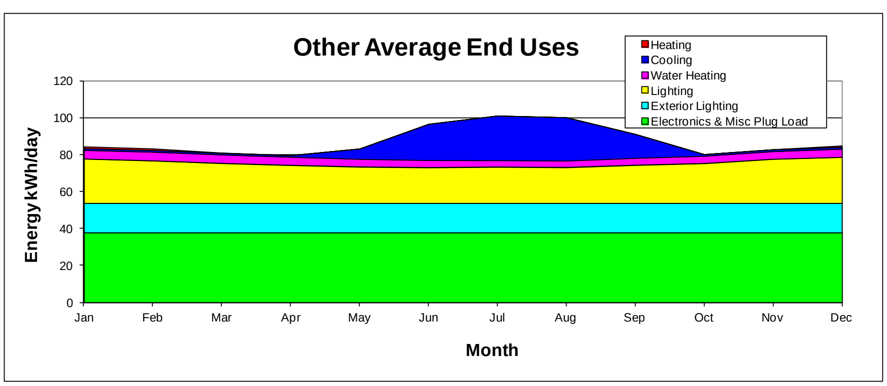
Non-Residential

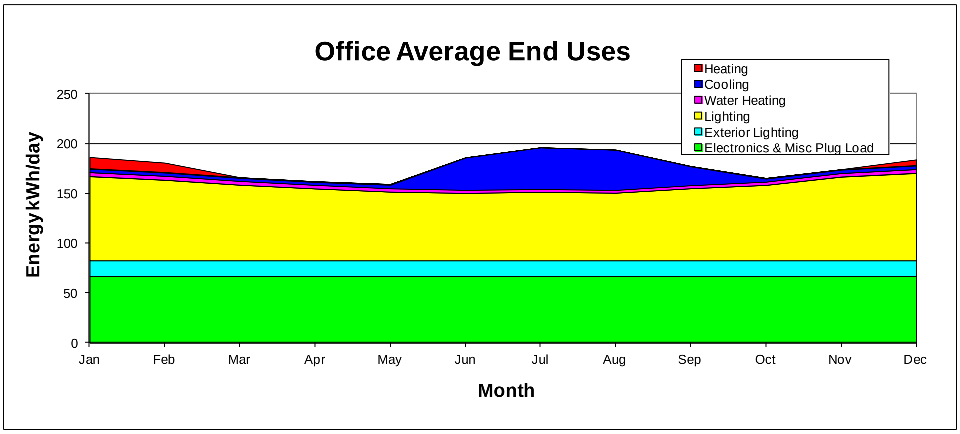
The following seventeen charts show monthly usage by end-use for each of the non-residential segments.

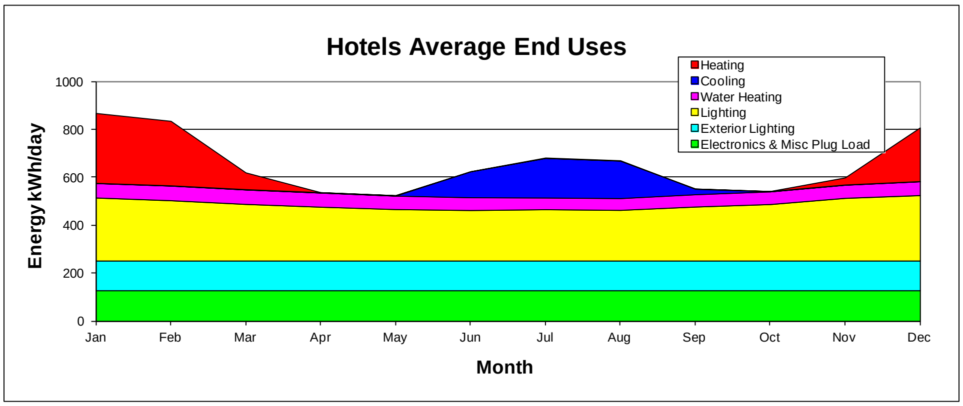


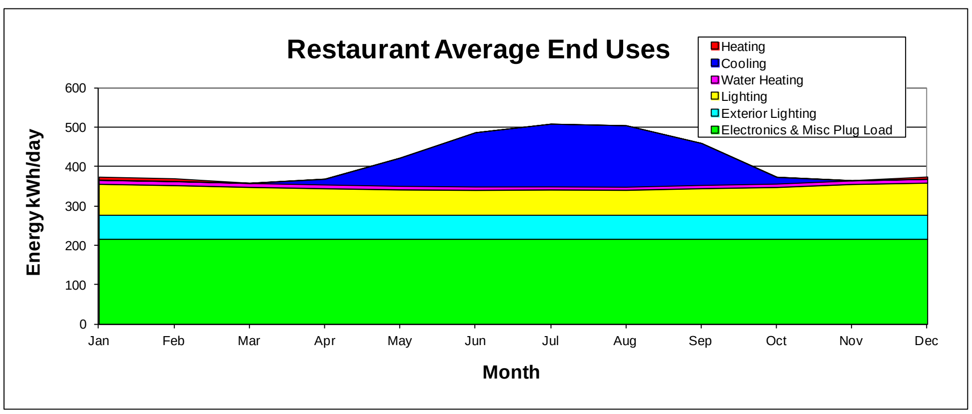


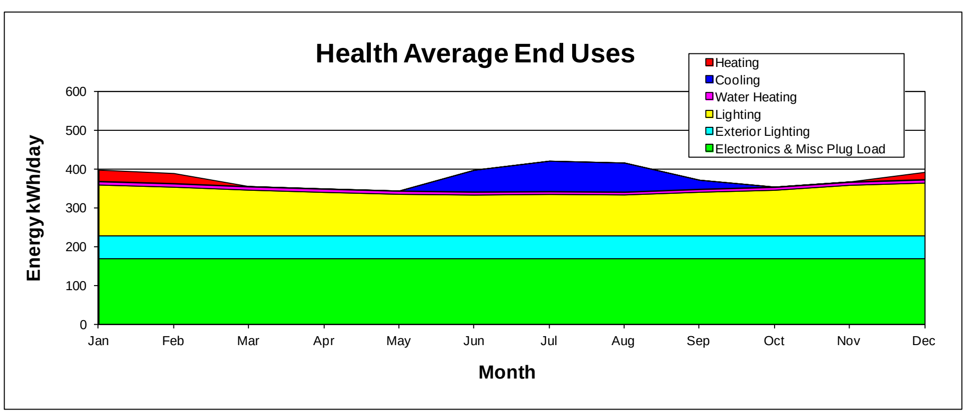


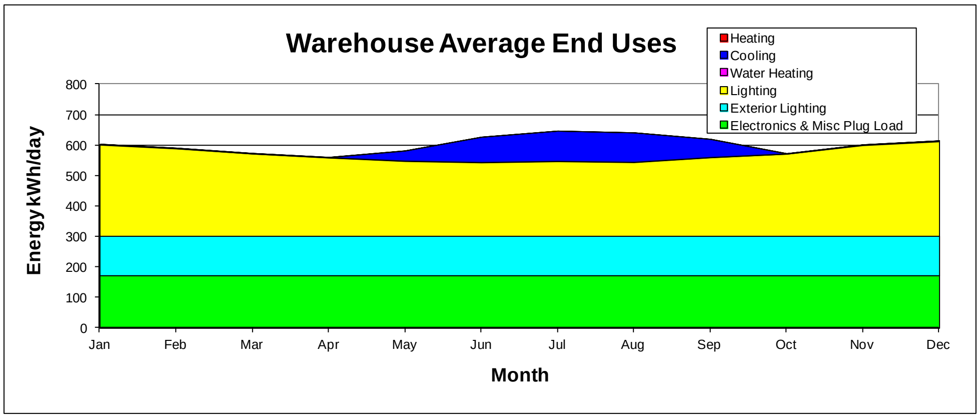


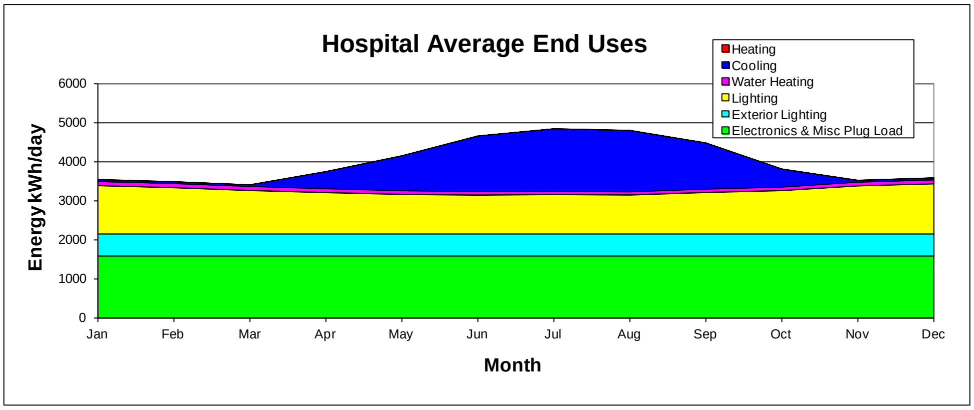

Office Average End Uses
Heating
Cooling
Water Heating
Lighting
Exterior Lighting
Electronics & Misc Plug Load
Energy kWh/day
0
50
100
150
200
250
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

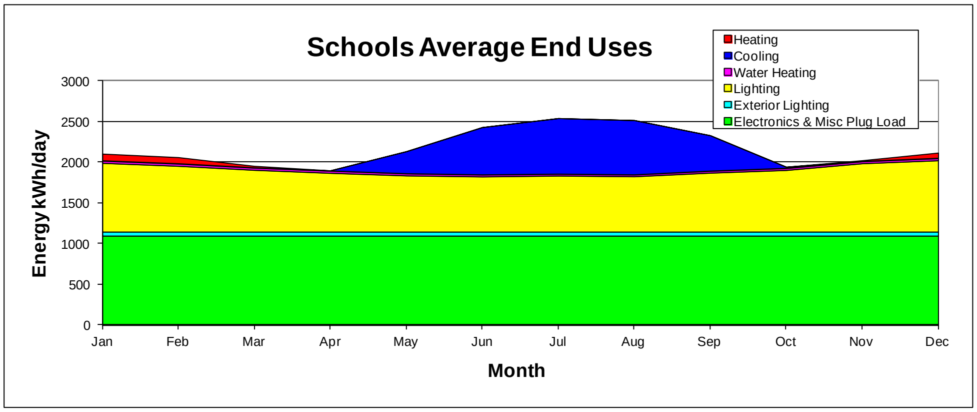

Hotels Average End Uses
Heating
Cooling
Water Heating
Lighting
Exterior Lighting
Electronics & Misc Plug Load
Energy kWh/day
0
200
400
600
800
1000
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

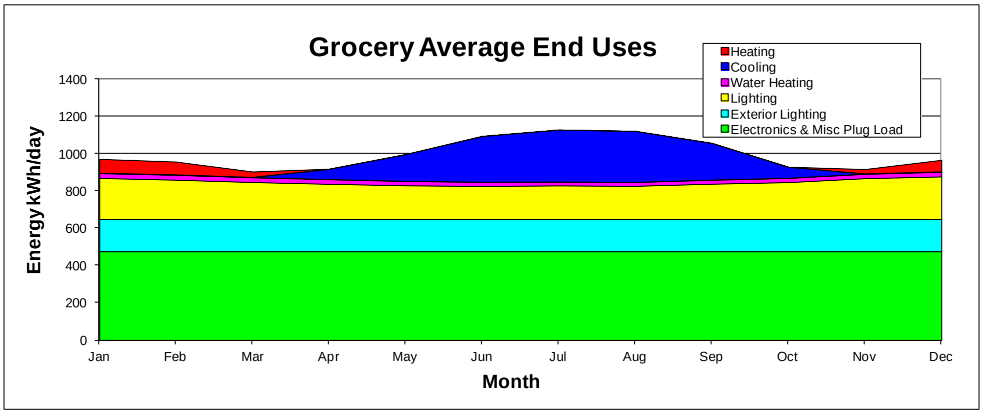

Restaurant Average End Uses
Heating
Cooling
Water Heating
Lighting
Exterior Lighting
Electronics & Misc Plug Load
Energy kWh/day
0
100
200
300
400
500
600
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

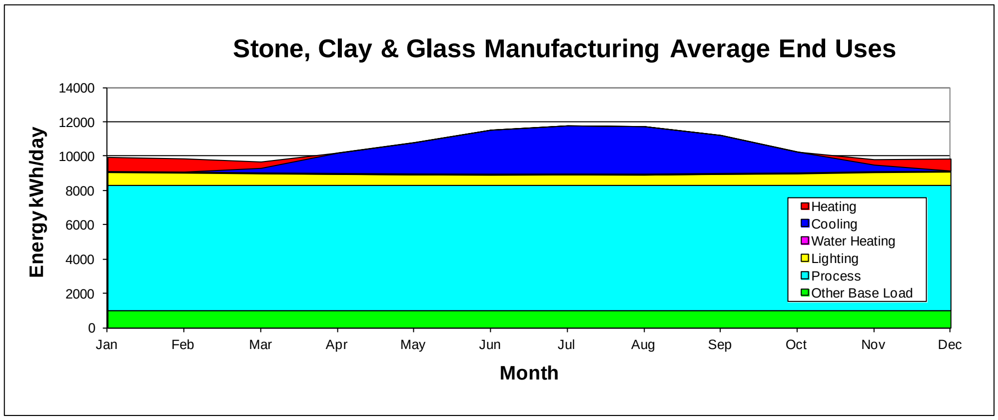

Health Average End Uses
Heating
Cooling
Water Heating
Lighting
Exterior Lighting
Electronics & Misc Plug Load
Energy kWh/day
0
100
200
300
400
500
600
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

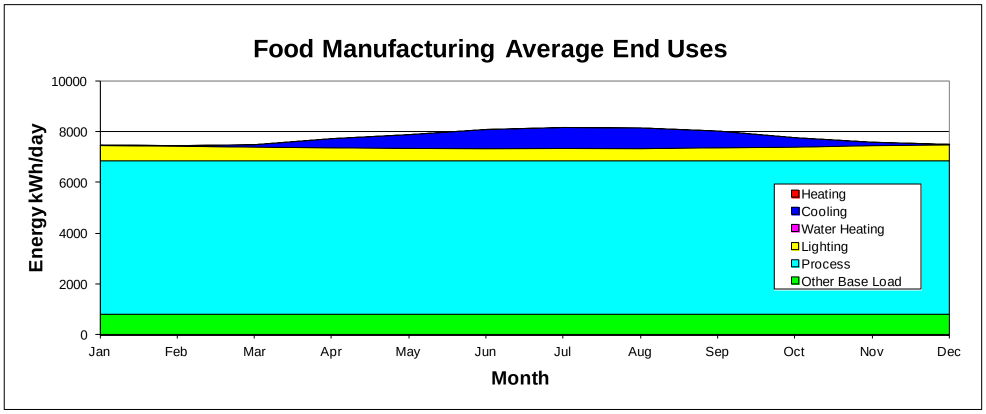

Warehouse Average End Uses
Heating
Cooling
Water Heating
Lighting
Exterior Lighting
Electronics & Misc Plug Load
Energy kWh/day
0
100
200
300
400
500
600
700
800
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

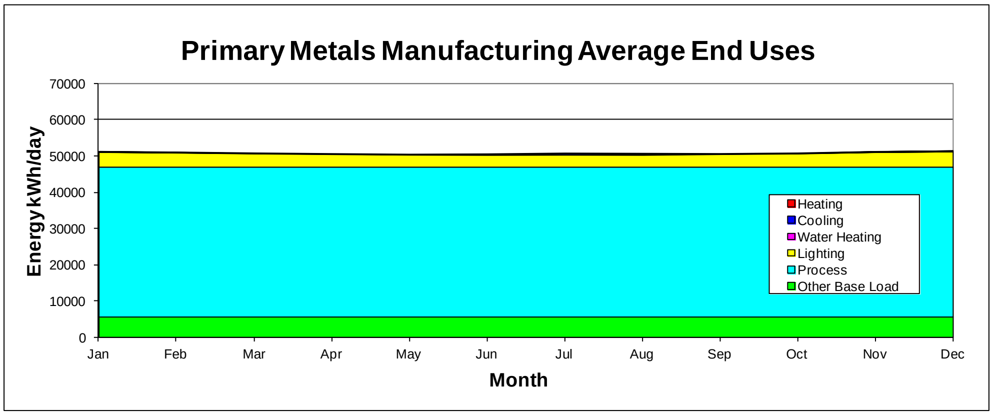

Hospital Average End Uses
Heating
Cooling
Water Heating
Lighting
Exterior Lighting
Electronics & Misc Plug Load
Energy kWh/day
0
1000
2000
3000
4000
5000
6000
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

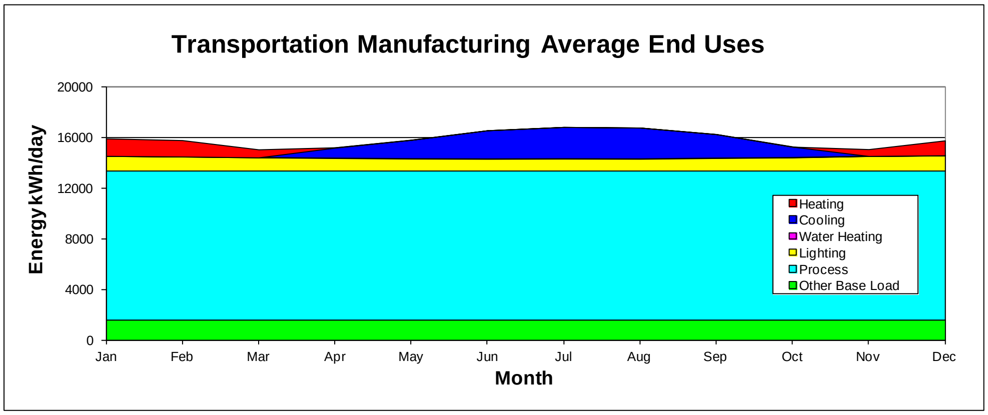

Schools Average End Uses
Heating
Cooling
Water Heating
Lighting
Exterior Lighting
Electronics & Misc Plug Load
Energy kWh/day
0
500
1000
1500
2000
2500
3000
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

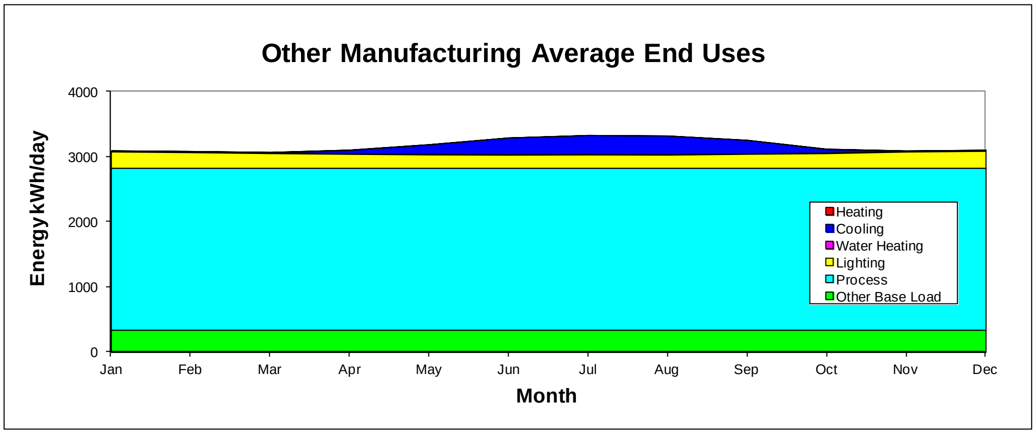

Grocery Average End Uses
Heating
Cooling
Water Heating
Lighting
Exterior Lighting
Electronics & Misc Plug Load
Energy kWh/day
0
200
400
600
800
1000
1200
1400
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


Stone, Clay & Glass Manufacturing Average End Uses
Energy kWh/day
14000
12000
10000
8000
6000
4000
2000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Heating
Cooling
Water Heating
Lighting
Process
Other Base Load


Food Manufacturing Average End Uses
Energy kWh/day
10000
8000
6000
4000
2000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Heating
Cooling
Water Heating
Lighting
Process
Other Base Load


Primary Metals Manufacturing Average End Uses
Energy kWh/day
70000
60000
50000
40000
30000
20000
10000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Heating
Cooling
Water Heating
Lighting
Process
Other Base Load


Transportation Manufacturing Average End Uses
Energy kWh/day
20000
16000
12000
8000
4000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Heating
Cooling
Water Heating
Lighting
Process
Other Base Load


Other Manufacturing Average End Uses
Energy kWh/day
4000
3000
2000
1000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Heating
Cooling
Water Heating
Lighting
Process
Other Base Load