STATE OF SOUTH CAROLINA	)	
	)	**BEFORE THE**
(Caption of Case)	)	**PUBLIC SERVICE COMMISSION**
In the Matter of:	)	**OF SOUTH CAROLINA**
	)	
Application of Duke Energy Carolinas, LLC for Approval of Energy Efficiency Plan Including an Energy Efficiency Rider and Portfolio of Energy Efficiency Programs	)	**COVER SHEET**
	)	**DOCKET NUMBER:** 2007 - 358 - E

(Please type or print)

Submitted by: J. Blanding Holman, IV
Address: Southern Environmental Law Center
200 W. Franklin Street, Suite 330
Chapel Hill, NC 27516

SC Bar Number: 72260
Telephone: (919)967-1450
Fax: (919)929-9421
Other:
Email: BHolman@SELCNC.org

NOTE: The cover sheet and information contained herein neither replaces nor supplements the filing and service of pleadings or other papers as required by law. This form is required for use by the Public Service Commission of South Carolina for the purpose of docketing and must be filled out completely.

DOCKETING INFORMATION (Check all that apply)

☐ **Emergency Relief demanded in petition** ☐ **Request for item to be placed on Commission's Agenda expeditiously**

☐ **Other:**

INDUSTRY (Check one)	NATURE OF ACTION (Check all that apply)		
☒ Electric	☐ Affidavit	☐ Letter	☐ Request
☐ Electric/Gas	☐ Agreement	☐ Memorandum	☐ Request for Certification
☐ Electric/Telecommunications	☐ Answer	☐ Motion	☐ Request for Investigation
☐ Electric/Water	☐ Appellate Review	☐ Objection	☐ Resale Agreement
☐ Electric/Water/Telecom.	☐ Application	☐ Petition	☐ Resale Amendment
☐ Electric/Water/Sewer	☐ Brief	☐ Petition for Reconsideration	☐ Reservation Letter
☐ Gas	☐ Certificate	☐ Petition for Rulemaking	☐ Response
☐ Railroad	☐ Comments	☐ Petition for Rule to Show Cause	☐ Response to Discovery
☐ Sewer	☐ Complaint	☐ Petition to Intervene	☐ Return to Petition
☐ Telecommunications	☐ Consent Order	☐ Petition to Intervene Out of Time	☐ Stipulation
☐ Transportation	☐ Discovery	☒ Prefiled Testimony	☐ Subpoena
☐ Water	☐ Exhibit	☐ Promotion	☐ Tariff
☐ Water/Sewer	☐ Expedited Consideration	☐ Proposed Order	☐ Other:
☐ Administrative Matter	☐ Interconnection Agreement	☐ Protest	
☐ Other:	☐ Interconnection Amendment	☐ Publisher's Affidavit	
	☐ Late-Filed Exhibit	☐ Report	

STATE OF SOUTH CAROLINA

BEFORE THE PUBLIC SERVICE COMMISSION

DOCKET NO. 2007-358-E

In the Matter of:	)	TESTIMONY OF DONALD GILLIGAN
	)	ON BEHALF OF ENVIRONMENTAL
Application of Duke Energy	)	DEFENSE, THE SOUTH CAROLINA
Carolinas, LLC for Approval of	)	COASTAL CONSERVATION
Energy Efficiency Plan Including an	)	LEAGUE, SOUTHERN ALLIANCE
Energy Efficiency Rider and Portfolio	)	FOR CLEAN ENERGY AND THE
of Energy Efficiency Programs	)	SOUTHERN ENVIRONMENTAL LAW
	)	CENTER

INTRODUCTION AND PURPOSE

Q. PLEASE STATE YOUR NAME, ADDRESS AND POSITION.

A. My name is Donald Gilligan. I am the President of the National Association of Energy Service Companies ("NAESCO"), which has its offices at 1615 M Street, NW Suite 800 in Washington, DC. As President of NAESCO, I am responsible for leading the Association's advocacy efforts nationwide with the focus on state legislative and regulatory initiatives.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS CASE?

A. I am testifying on behalf of Environmental Defense ("ED"), the South Carolina Coastal Conservation League ("CCL"), Southern Alliance for Clean Energy ("SACE") and the Southern Environmental Law Center ("SELC"). These nonprofit, nonpartisan organizations promote responsible energy choices that solve global warming problems and ensure clean, safe and healthy communities in South Carolina. I am not being paid by ED, CCL, SACE or SELC for my work in this matter, but rather am bringing the resources of NAESCO to assist these organizations in achieving their goal of promoting large-scale energy efficiency programs.

Q. PLEASE STATE BRIEFLY YOUR EDUCATIONAL BACKGROUND.

A. I received an A.B. degree from Harvard University in 1969.

Q. PLEASE DESCRIBE YOUR BUSINESS BACKGROUND AND EXPERIENCE.

A. I have been involved with the development and implementation of energy efficiency programs since 1975, as a state government official, entrepreneur and consultant.

I began my career as a Program Associate to Governor Hugh Carey of New York, serving as the liaison between the Governor and the state energy agencies. I was instrumental in establishing the Energy Office and Energy Research and Development Authority ("NYSERDA") and

organizing public/private consortia to provide energy conservation programs for schools, hospitals, colleges and large commercial buildings.

After leaving state government, in 1977, I co-founded DMC Energy, Inc., an energy services company that grew to a $70 million firm and was sold to Honeywell, Inc. Accomplishments at DMC included the following:

- Wrote the regional conservation program plan for the Coalition of Northeast Governors;
- Created the original program plans for RISE and Mass-Save, statewide utility consortia that delivered energy efficiency services in Rhode Island and Massachusetts;
- Developed and implemented the first utility-sponsored residential conservation program in New York State, at Orange and Rockland Utilities, with funding from Exxon Enterprises; and,
- Created a program plan for a committee of the Ohio legislature that gave rise to a very successful statewide schools performance-contracting program.

After leaving DMC, I worked as an independent consultant for several years and drafted a number of energy efficiency program plans, including:

- *The Army Facilities Energy Plan* for the U.S. Army Corps of Engineers
- The residential conservation program manual for the American Public Power Association
- Business plans and market studies for Volkswagen AG Wolfsburg, the Federal Emergency Management Agency, The Yankee Group, American Can Company, Solectria, YTL Engineering and others.

In 1991, I co-founded Coneco Corporation where I served as President and CEO. Coneco provided analysis, design, construction and financing services to some of the nation's leading energy service companies, including Honeywell, Johnson Controls, EUA Cogenex, HEC, SYCOM, FPL Services,

PEPCo Services, AEM, IEA and TCG. Coneco delivered more than $200 million of projects, and was sold to Boston Edison Company in 1994.

In early 1998, I left Coneco to form Predicate, LLC., a consulting firm which provided organization, analysis and marketing support services to clients including AES New Energy, Energy New England, Connecticut Light & Power, FirstEnergy, TeCom and Enviros, Ltd. In addition, I concurrently served as a consultant to NAESCO where I coordinated state advocacy efforts for the association and produced numerous research papers.

In 2005, I became the President of NAESCO, advocating nationwide for more effective energy efficiency programs and regulations at the state level. On behalf of NAESCO, I am currently a member of the System Benefits Charge Advisory Group in New York, which evaluates the New York energy efficiency programs on behalf of the New York Public Service Commission, as well as a member of the Program Advisory Groups for the utility-administered energy efficiency programs in California, which advise the utilities and the California Public Utilities Commission on the design and implementation of the California energy efficiency programs. I am a member of the National Action Plan for Energy Efficiency Leadership Group, and have served as a member of the New England Demand Response Initiative and the Energy Efficiency Task Force of the Western Governors Association Clean and Diversified Energy Committee.

I am currently involved in regulatory and/or legislative efforts to develop and implement large-scale energy efficiency programs in New York, New Jersey, Massachusetts, Connecticut, North Carolina, South Carolina, Ohio, Indiana, Illinois, Arizona, California and Texas.

Q. PLEASE DESCRIBE NAESCO, THE ORGANIZATION OF WHICH YOU ARE PRESIDENT.

A. NAESCO's current membership of about 75 organizations includes firms involved in the design, manufacture, financing and installation of energy efficiency and renewable energy equipment and the provision of energy

efficiency and renewable energy services in the private and public sectors. NAESCO members deliver about $4 billion of energy efficiency and renewable energy projects each year – about equal to all of the energy efficiency projects delivered by all US utilities combined, according to a recent report by the Lawrence Berkeley National Laboratory. NAESCO numbers among its members some of the most prominent companies in the world in the HVAC and energy control equipment business, including Honeywell, Johnson Controls, Siemens, Trane and TAC/Tour Andover. Our members also include many of the nation's largest utilities: Pacific Gas & Electric, Southern California Edison, New York Power Authority, and TU Electric & Gas. In addition, NAESCO members include affiliates of several utilities that have a strong presence in the New York market including ConEdison, Pepco Energy Services, Constellation, PP&L and Direct Energy. Prominent national and regional independent members include Custom Energy, DMJM Harris, NORESCO, Onsite Energy, EnergySolve, Ameresco, UCONS, Chevron Energy Solutions, Synergy Companies, Wendel Energy Services, WESCO and Energy Systems Group.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to support the efforts of Duke Energy Carolinas ("Duke") to establish a large-scale energy efficiency program for its customers in South Carolina, but to oppose its "save-a-watt" ("SAW") approach to energy efficiency in its present form, which is contained in the Application of Duke Energy Carolinas, LLC for Approval of Energy Efficiency Plan Including and Energy Efficiency Rider and Portfolio of Energy Efficiency Programs (Application). Based on my experience, it is my opinion that Duke's "save-a-watt" proposal would not be sustainable and would not provide good value to the ratepayers of South Carolina.

Q. WHY DOES A TRADE ASSOCITION LIKE NAESCO CARE IF A UTILITY ENERGY EFFICIENCY PROGRAM IS SUSTAINABLE?

A. NAESCO member companies make their living delivering energy efficiency improvements. Many of us in the industry have spent our entire careers promoting energy efficiency. It has not been an easy or quick effort. In fact, I first called on Duke in 1978, urging them to make energy efficiency a core part of their business. We are now seeing a lot of momentum behind energy efficiency across the country. Our experience is that well-designed and implemented utility programs can boost energy efficiency, but that poorly designed, unsustainable programs are worse than no programs, because they undermine consumer and regulator confidence in the whole field of energy efficiency.

Q. WHAT DO YOU MEAN BY A "SUSTAINABLE" ENERGY EFFICIENCY PROGRAM?

A. A sustainable energy efficiency program that is operated by a regulated utility using ratepayer funds is one that provides substantial value to ratepayers while affording the utility an opportunity to make a fair profit. A sustainable program is characterized by a regulatory process that provides financial transparency and has substantial input and explicit acceptance from all major groups of stakeholders, to ensure the success of the program.

Q. HOW DOES AN ENERGY EFFICIENCY PROGRAM PROVIDE VALUE TO RATEPAYERS?

A. An energy efficiency program provides value to ratepayers when it provides the services that ratepayers want, such as lighting, heating and air conditioning, at lower cost and with greater reliability than simply providing energy. Duke, like many utilities around the country, has recognized that many of the ways that customers use its product, electricity, are inefficient. It has decided to help customers increase their efficiency because greater efficiency decreases capacity constraints on the power infrastructure as a whole and will decrease overall customer costs by reducing the need for the construction of additional generating, transmission and distribution facilities.

Greater efficiency will also reduce environmental emissions, and increase system reliability.

Q. HOW DOES AN ENERGY EFFICIENCY PROGRAM ALLOW A UTILITY TO MAKE A PROFIT? DOESN'T ENERGY EFFICIENCY REDUCE UTILITY PROFITS?

A. An energy efficiency program allows a utility to make a profit on the management of the delivery of energy to its customers, which is one of the core elements of its business. When people think of a utility, they often think only about the manufacturing elements of the business: the generation of electricity and the delivery of that electricity to customers. But a successful utility--and Duke is one of the most successful utilities in the country-- also has substantial skills in managing risks (technical, financial, environmental and legal), in complex financing, and in delivering technology such as metering systems to millions of customers. The value of these diverse management skills is currently built into the rates that Duke charges for its electricity.

An energy efficiency program can thus be characterized as a shift in the business emphasis of a utility from manufacturing to management. Duke, again like many other utilities, understands that the manufacturing side of the utility business is becoming increasingly expensive and risky. The next generation of power plants, whether nuclear or coal, is still under development, with rapidly escalating costs, uncertain licensing processes and uncertain construction schedules. In contrast, energy efficiency technologies, which can deliver the equivalent of many large new power plants, involve minimal technical risk, are generally decreasing in cost, and can deliver kilowatt-hours ("kWh") at less cost than new power plants. Additionally, energy efficiency carries none of the environmental risk (which may be translated into financial risk by national emissions reduction policies) of new power plants.

So Duke, again like many other utilities, is taking the path of least resistance and is proposing to make more of its profit in the future from its management skills, by delivering to customers the products and services they need to use electricity more efficiently. In fact, Duke's CEO, Jim Rogers, has led a national effort, called the National Action Plan for Energy Efficiency ("NAPEE"), to get utilities to understand the value of energy efficiency, and to make energy efficiency programs a part of the core business of utilities.

Q. WHAT MODIFICATIONS SHOULD BE MADE TO DUKE'S SAW PROPOSAL TO MAKE IT MORE SUSTAINABLE?

A. To date, Duke has not disclosed to the public many of the details of its proposed energy efficiency programs, particularly the financial details of program costs and savings. In my experience, this information is the foundation of any regulatory proceeding on large-scale energy efficiency programs. Without this information, it is not really possible for the stakeholders in the proceeding to determine if the proposed programs optimize available energy savings, appropriately reflect program-specific allocated costs, and maximize cost efficiencies and explicitly support the rate riders on which the program is based. Without this information, it is not possible for this Commission, which must rule on the Application, to determine whether the proposed programs deliver sufficient value to ratepayers and provide a fair rate of return to Duke. The need for the full disclosure of program information, often called transparency, was emphasized in a recent report by the National Action Plan for Energy Efficiency ("NAPEE"), which, as noted above, is co-chaired by Duke CEO Jim Rogers. The NAPEE report urges that "any/all [rate recovery] mechanisms be transparent with respect to both calculation of recoverable amounts and overall impact on utility earnings."

Q. WHY DO STAKEHOLDERS HAVE TO SUPPORT AN ENERGY EFFICIENCY PROGRAM? ISN'T REGULATORY APPROVAL SUFFICIENT?

A. Unlike other aspects of the utility business, energy efficiency programs require customers to respond proactively by accepting and purchasing energy efficiency equipment to be installed in their own facilities. As a result, it is important for customer representatives to have input into the details of program design, so that the specific program offerings are attractive to customers and motivate their participation. A customer does not have to make a proactive choice to accept the electric meter that Duke installs on the side of his/her house, but does have to choose the fluorescent bulb that will be used in his/her living room. Likewise, energy efficiency programs require that vendors, such as the energy service companies that are NAESCO members, provide services that are critical to the program success, such as actually selling efficiency projects to customers often employing multiple efficiency technologies. For such vendors, program details such as the level of rebates, or the application and payment processes, make the difference between an attractive program, on which they can make a profit, and an unattractive program that they will shun. Finally, ratepayers, whether represented by nonprofit organizations, or state government consumer advocates, must be convinced that the programs deliver fair value, or they will oppose the programs--and in our experience, ratepayer opposition eventually hamstrings or kills the program. Examples of programs that were discontinued due to ratepayer and/or regulatory opposition, include programs operated by Boston Edison Company (now called NStar) and Public Service Electric & Gas in New Jersey. Both of these programs had similarities to Duke's SAW proposal, in that they were based on paying a high percentage of system avoided costs, rather than actual program costs, for energy efficiency. In the NStar case, the problem was that the effective price of a compact fluorescent light ("CFL") bulb, based on long-term avoided costs, was more than ten times the retail price of the bulb. In New Jersey, the problem was that the five- to fifteen-year stream of payments due to the utility and its subsidiaries, totaling hundreds of millions of dollars, seemed much too expensive to new members of the regulatory board which had established the program.

It is important to note that the states with the most advanced energy efficiency programs, and the most experienced program administrators, (*e.g.*, California and New York) also have the highest level of stakeholder participation in program development, review and evaluation. This kind of participation has clearly been demonstrated to be a "best practice" for energy efficiency program administration. Why should South Carolina settle for less?

Q. WHAT KIND OF DETAIL HAS DUKE NOT PROVIDED?

A. In its Application and its pre-filed testimony in this proceeding, Duke has provided summary descriptions of its proposed programs. Examples of these descriptions can be found in Attachment A to the Duke Application and in the pre-filed testimony of Theodore E. Schultz. Missing from these descriptions is the kind of data that is normally the focus of proceedings like this one, such as the following:

- Detail of the cost/benefit analysis of potential program measures, including the avoided costs used in the analysis for each measure;
- Detailed costs by program and by major costs category, *e.g.*, marketing, incentives, administration, sub-contracts, evaluation and monitoring, etc.
- Detailed program benefits by program, including estimated kW and kWh savings by unit and in aggregate; and,
- Detailed compensation to the utility, by measure, program and in aggregate.

Q. WHY HAS DUKE NOT PROVIDED THIS DATA IF IT IS, AS YOU SAY, THE FOCUS OF MOST PROCEEDINGS ON UTILITY ENERGY EFFICIENCY PROGRAMS?

A. Duke apparently considers much of this information to be confidential, which is a position I have not encountered in similar proceedings in other states. I could understand Duke's emphasis on confidentiality if it were a competitive energy services company ("ESCO") operating in a competitive marketplace. In fact, Duke and its predecessor company Cinergy owned at

least two subsidiaries that were ESCOs and were NAESCO members. Duke divested itself of these subsidiaries because it did not want to be in the competitive ESCO business, but it has apparently not made the transition in its thinking from the competitive marketplace, in which most operating data is kept confidential, to the regulated monopoly environment, in which operating data is the proper subject of public regulatory proceedings.

Q. ARE YOU NOT PROPOSING TO MICRO-MANAGE THE DUKE PROGRAMS, RATHER THAN ALLOW DUKE THE MANAGEMENT FLEXIBILITY IT NEEDS TO MEET ITS ENERGY SAVING GOALS?

A. I am not suggesting that stakeholders should usurp Duke's management role. Rather, I am proposing that Duke fully expose its program plans so that NAESCO and other stakeholders can provide input that will improve the programs.

With all due respect, Duke as an organization has very modest track record of delivering cost-effective energy efficiency and demand response programs. According to a recent presentation by the consulting firm Summit Blue, LLC at the annual conference of the Midwest Energy Efficiency Alliance (MEEA) in Chicago, the programs operated by Duke Energy Indiana were among the least productive and most expensive of nineteen surveyed demand side management programs from around the country. Summit Blue used public data to determine that the median surveyed program produced about .7% energy savings at a first-year cost of about $.12/kWh, and .8% demand savings at a first-year cost of about $650/kW. Duke Energy Indiana appears from the graphic to have produced the lowest kW and kWh savings of the surveyed programs at first-year costs of about $.20/kWh and $1000/kW.[1]

Like the Duke Indiana program, the proposed South Carolina program appears to have modest aspirations for results and very high costs to

[1] See Gilligan Exhibit A, appended to this testimony.

consumers. Because I believe that new programs should aspire to be among the most productive and most cost-effective programs, I think that the costs and benefits of the programs that Duke is proposing for South Carolina should get rigorous public scrutiny.

NAESCO member companies, which each year deliver billions of dollars worth of energy efficiency projects in every state in the country, dwarf Duke in terms of recent energy efficiency program experience. It appears to us, based on the limited data that we have seen, that the program Duke has proposed has several major deficiencies.

First, Duke seems to have severely underestimated the amount of energy efficiency that is available at a cost lower than new supply options. It is realizing only a small fraction of the energy efficiency resource that is available in South Carolina. The Duke Energy Carolinas DSM Action Plan: South Carolina Draft Report ("Forefront study"), commissioned by Duke, estimates that there are about 3.6 million megawatt-hours ("MWH") in annual economic energy savings available in South Carolina.[2] Duke, in its Application, proposes as a target only 180,000 MWH annually, or about 5% of the Forefront estimate, for both North and South Carolina combined! It is hard to imagine Duke, one of the leading electric utilities in the country, settling for such a modest achievement in any other aspect of its business.

Second, Duke has omitted from its proposed program portfolio a number of programs that are the foundation of most large-scale energy efficiency programs across the country. The omissions include the following:

There is no new construction program, either for residential or commercial customers. I have never seen these omitted from a portfolio, especially in a high-growth area like South Carolina. For example, in New York, the commercial buildings new construction program is saving about 250,000 MWH and 53.5 peak megawatts ("MW") per year, while the

[2] Forefront Economics Inc., H. Gil Peach & Associates LLC and PA Consulting Group, "Duke Energy Carolinas DSM Action Plan: South Carolina Draft Report" (July 2007) at 30 (attached as Gilligan Exhibit B).

residential programs (single and multi-family) save about 32,000 MWH per year.[3] Duke should be emphasizing these programs, because new homes and buildings should use less than half the energy of existing buildings at essentially no additional first cost.

There appears to be only one mention of the US EPA ENERGY STAR program in the filing -- incentives for ENERGY STAR refrigerators for low-income customers. Most programs provide incentives for the purchase of the full range of ENERGY STAR appliances and leverage the ENERGY STAR brand name in their marketing, because it is recognized by a majority of residential customers. Every utility program portfolio I have seen in the last few years includes a major ENERGY STAR component. In New York, for example, the appliance Market Support programs, which are built around the ENERGY STAR brand, are saving about 304,000 MWH and about 73 peak MW per year.[4]

Residential energy audits, which seem to be a major part of Duke's program portfolio, are a minor part of most programs today. They have been supplanted by more sophisticated programs which, for example, train residential contractors to offer a turnkey service of energy audits and comprehensive installations. They are also usually linked to the Home Performance for ENERGY STAR program. The proposed residential air conditioner and heat pump program is considered obsolete in the leading programs. Duke should be providing incentives for the installation of high-efficiency systems (equipment + duct sealing + controls that include DR capabilities), not just isolated pieces of equipment. Studies have shown that equipment-only programs deliver a fraction of the potential savings of comprehensive system programs. A comprehensive residential retrofit program also involves training wholesalers and installers and interfacing Duke

---

[3] New York Energy $mart Program Evaluation and Status Report, , NYSERDA, March 2007, pages 3-29, 4-14, 4-18 (attached as Gilligan Exhibit C)..
[4] Id.

programs with local building inspectors to make sure that all new installations are up to standard.

For commercial and industrial customers, Duke again seems to put the emphasis on energy audits and not on comprehensive retrofit programs. Noteworthy for its omission is a standard offer program for large customers. This is the largest single program, and one of the most cost-effective, in the current New York and California portfolios. In New York, for example, the Enhanced Commercial Industrial Performance Program is savings about 836,000 MWH and about 142 peak MW per year.[5] Standard offer programs have also produced hundreds of megawatts of savings in states as diverse as Texas, Maine and New Jersey. A standard offer program enables customers to assemble a comprehensive package of measures that fits their needs and can be self-financed from energy savings. These programs are particularly effective for public sector buildings, because they deliver new equipment to facilities that are starved for capital improvement and maintenance dollars, while saving significant amounts of energy. They are thus the embodiment of "public/private partnerships" and bring into the Duke program the ESCOs, the most skilled and experienced energy efficiency vendors in the nation. Finally, standard offer programs are the ideal framework for introducing new technologies to customers, because the new technology can be part of a large project, rather than a standalone effort. Standard offer programs also lend themselves to the integration of demand response and energy efficiency technologies into self-financing package that deliver substantial benefits to both the customer and the utility.

Q. ISN'T DUKE OMITTING THESE PROGRAMS BECAUSE THEY ARE NOT COST-EFFECTIVE?

A. Duke has said that its proposed programs contain all measures that have proven cost-effective in its analyses, but it has not submitted its analyses

[5] Id.

into the public proceeding so that they can be reviewed by experts. I do not believe that it is possible to determine the validity of Duke's statement without that review. In my experience, this is an unusual way for a utility to proceed, and is not accepted by regulatory Commissions in other states that are considering large-scale, utility-administered energy efficiency programs. In my experience, a thorough public examination of the cost-effectiveness of proposed programs, focusing on the assumptions such as avoided costs that are used in cost-effectiveness analyses, is the centerpiece of the regulatory proceeding.

Q. WHY DO YOU THINK THAT THE SAW PROGRAM DOES NOT PROVIDE GOOD VALUE TO DUKE RATEPAYERS?

A. The Duke SAW proposal appears to guarantee that Duke ratepayers will be compensated for demand-side resources at 10% less than supply-side resources, because Duke proposes to be compensated for demand-side resources at 90% of avoided costs. However, Duke's proposed compensation scheme also caps the return to ratepayers at a value that is much lower than that realized in other energy efficiency programs.

If Duke is compensated at the 90% of avoided costs for all of its demand-side programs, and if base rates are reviewed to ensure that avoided cost savings are reflected in customer bills, ratepayers would receive a benefit of approximately $1.11 (the inverse of .9) for each dollar spent on demand-side resources. This proposed benefit to South Carolina ratepayers compares to the benefits cited in the July 2006 NAPEE report (pages 1-8 and 3-9) of about $1.98 for a proposed national program, $2.50 for historical programs in the Northwest, and about $3.00 for historical programs in Texas, two regions with relatively low costs for electricity. Duke thus seems to be proposing to capture virtually all of the value of demand-side programs that in other states, accrues to ratepayers for the same types of programs. That does not seem like good value for South Carolina ratepayers.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

Testimony of Donald Gilligan on Behalf of ED, CCL, SACE and SELC
Docket No. 2007-358-E

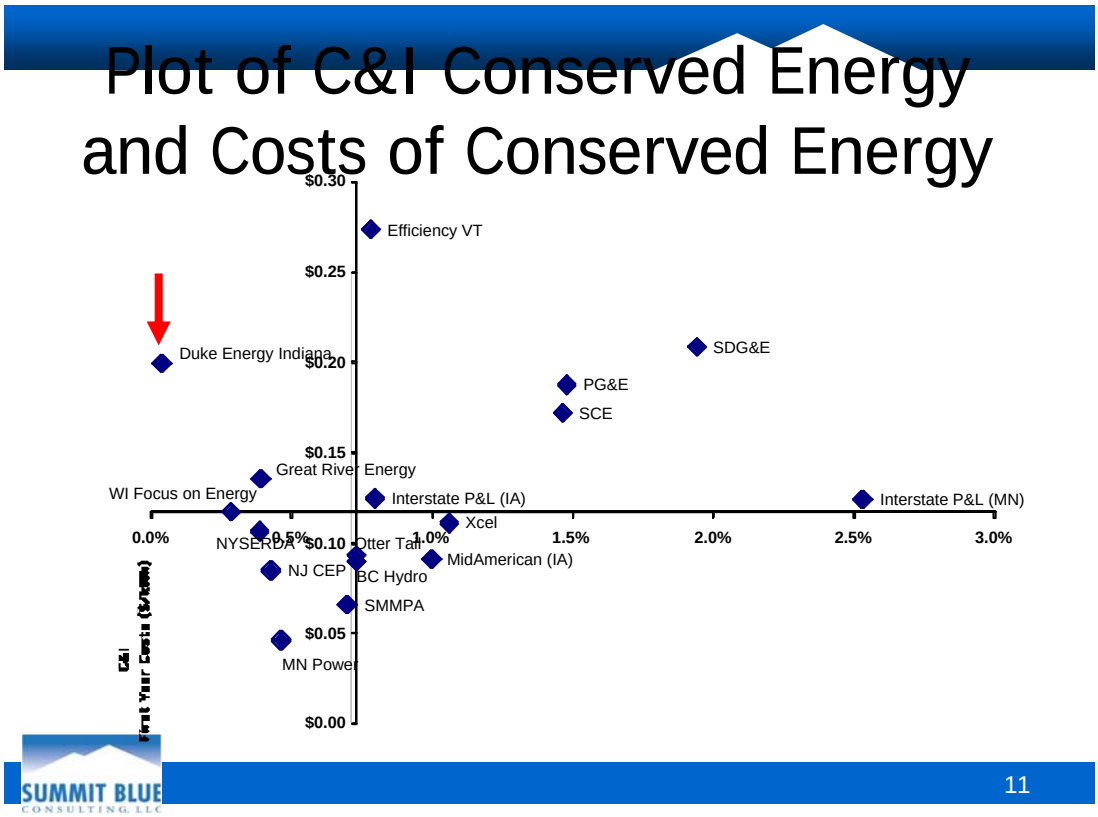
Exhibit A

Excerpt From A Presentation Entitled "Best Practices For Midwest Electric C&I DSM Programs" ~ Laura Agapay, Summit Blue Consulting, LLC; 01/11/08

Attachment A to Testimony of Donald Gilligan

Excerpt from a presentation entitled
"Best Practices for Midwest Electric C&I DSM Programs"
Laura Agapay, Summit Blue Consulting, LLC
Midwest Energy Efficiency Alliance
January 11, 2008

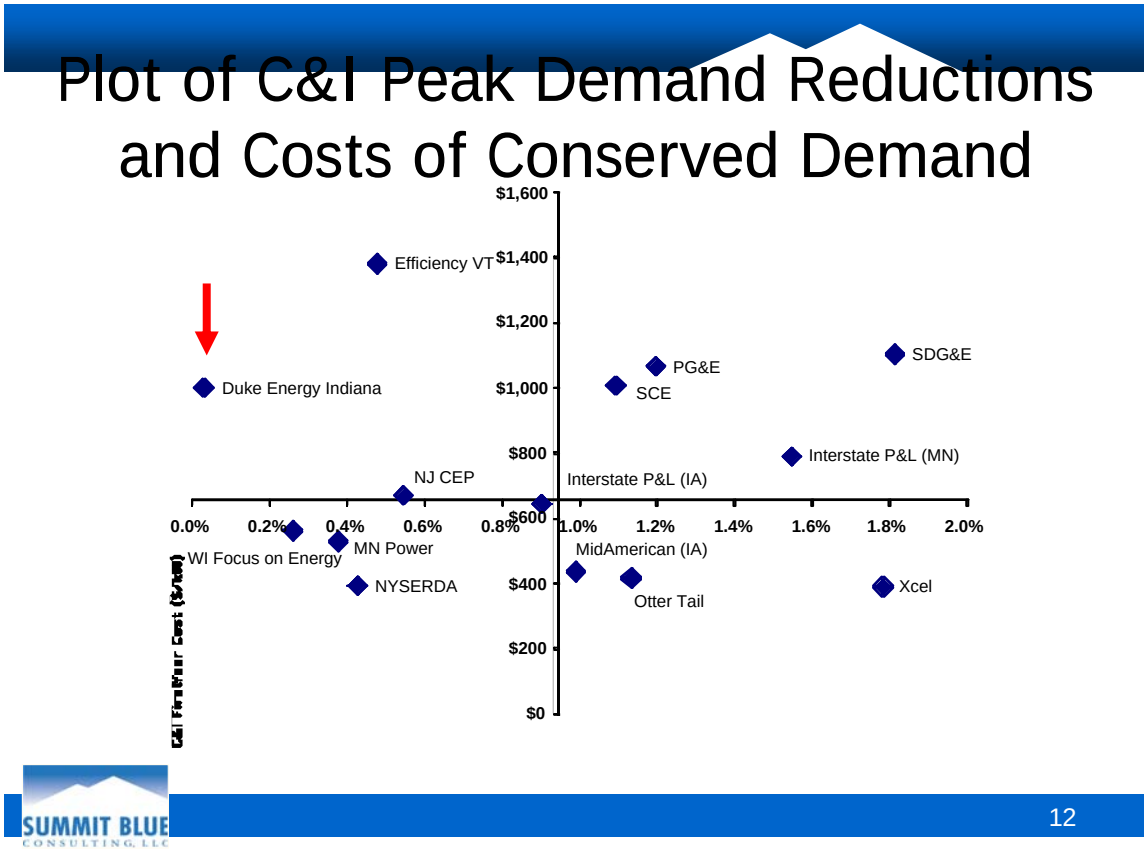
Slide 11 (arrow added for emphasis)



Attachment A to Testimony of Donald Gilligan

Excerpt from a presentation entitled
"Best Practices for Midwest Electric C&I DSM Programs"
Laura Agapay, Summit Blue Consulting, LLC
Midwest Energy Efficiency Alliance
January 11, 2008

Slide 12 (arrow added for emphasis)



Testimony of Donald Gilligan on Behalf of ED, CCL, SACE and SELC
Docket No. 2007-358-E

Exhibit B

"Duke Energy Carolinas DSM Action Plan: South Carolina Draft Report" ~ Forefront Economics Inc., H. Gil Peach & Associates LLC and PA Consulting Group; 07/2007

Duke Energy Carolinas DSM Action Plan: South Carolina Report

Prepared for:
Duke Energy Carolinas
Charlotte, North Carolina

Prepared by:
Forefront Economics Inc.
H. Gil Peach & Associates LLC
PA Consulting Group

with contributions from:
Mark E. Thompson
H. Gil Peach
Howard Reichmuth
Luisa Freeman
Carol Mulholland
Ulrike Mengelberg
John Mitchell
Ayala Cnaan

August 31, 2007

Forefront Economics Inc., H. Gil Peach & Associates LLC and PA Consulting Group. Duke Energy Carolinas DSM Action Plan: South Carolina Report. Report prepared for Duke Energy Carolinas, Charlotte, North Carolina, August 2007.

TABLE OF CONTENTS

Table of Contents i
List of Tables v
List of Figures vii
Executive Overview 1
Overview of Findings 1
Overview of Approach 3
Market Assessment 3
DSM Potential 3
DSM Programs 4
Organization of Report 4
Market Assessment 5
Overview of Market Sectors 5
Residential 8
New Construction Levels 9
Housing Stock Characteristics 9
Appliance Saturation Rates 11
Electricity Usage Analysis 11
Non-Residential 14
Customer Description 14
Energy Efficiency Measures and Potential Savings 19
Technical Potential 19
Residential Technical Potential 20
Non-Residential Technical Potential 20
Energy Efficiency Measure Assessment 23
Cost Effectiveness 27
Cost Effectiveness Rankings 28
Economic Potential 31
DSM Programs 34
Multi-Sector Programs 36
Program 1. Key Accounts Custom Program 36
Program 2. Load Control Program 39
Program 3. Prescriptive Program 43
Non-Residential Programs 51
Program 4. Commercial and Institutional Retro-Commissioning Lite Pilot 51
Program 5. New Commercial Construction Program 54
Residential Programs 56
Program 6. Residential Energy Assessment Program 56
Program 7. Energy Star Appliances and Lighting 58
Program 8. Residential HVAC Systems 65
Program 9. Solar Heated Domestic Hot Water 67
Program 10. Energy Star Plus Program 69
Program 11. Manufactured Homes Program 73
Program 12. On-Site Audit with Direct Install Program 77
Program 13. Old Refrigerator Pick-Up and Recycling Program 80
Program 14. Residential Weatherization Program 82
Program 15. Energy Star Cool Roofs Program 87
Program Cost Effectiveness 90
Expected Program Costs 90
Miscellaneous Program Assumptions 91
Avoided Costs 91
Cost Effectiveness Results 91

Other Assumptions....92
Currently Recommended Programs....92
Program Evaluation....96
Customer Satisfaction Metrics....98
Appendix A. Methodology....100
Energy Model....101
Nature of the Data....101
Energy Model Structure....102
Model Inputs....102
Separation into End-Uses....104
Usage Normalization....104
Perspectives on Energy....105
Demand Model....105
Available Data....105
Demand Model....105
Truing the Demand Model....107
Estimating the Coincident Peak Day Load....109
Estimating the Technical Potential for Demand Savings....109
Measure Savings....109
Customer and Load Forecast....110
Appendix B. Cost Effectiveness Methology....111
Technology Cost Effectiveness....111
Program Cost Effectiveness....112
Utility Cost Test (also known as Administrator Cost Test)....113
Participant Test....113
Ratepayer Impact Measure Test....113
Total Resource Cost Test....114
Societal Test....114
Appendix C. Residential EEM Documentation....115
Solar Photovoltaic (R-1)....116
Resistance Electric Furnace to SEER 13 Heat Pump (R-2, R-3)....116
SEER 8 to SEER 13 Central Air Conditioner (R-4, R-5)....117
Refrigeration Charge and Duct Tune Up (R-6, R-7)....118
Upgrade the Heat Pump Efficiency from a SEER 13 to a SEER 15 (R-8, R-9)....118
Upgrade the Central Air Conditioner from a SEER 13 to a SEER 15 (R-10, R-11)....119
Efficient Window AC (R-12)....119
Cool Roofs (R-13)....120
EE Windows (R-14)....121
Programmable Thermostats (R-15)....122
Ceiling Insulation R6-R30 (R-16, R-17)....123
House Sealing Using Blower Door (R-18, R-19)....123
Ground Source Heat Pump (R-20)....124
Wall Insulation (R-21, R-22)....125
Solar Siting Passive Design (R-23)....125
Energy Star Manufactured Home (R-24)....127
Energy Star Construction (R-25)....127
Eliminate Old Refrigerators (R-26)....128
HVAC Set Back (R-27)....129
Energy Star Clothes Washers (R-28)....129
Energy Star Dishwashers (R-29)....130
Energy Star Refrigerators (R-30)....131
Pool Pumps (R-31)....132
Compact Fluorescent (R-32)....132
Daylighting Design (R-33)....133

Occupancy Controlled Outdoor Lighting (R-34) 134
Tank Wrap, Pipe Wrap, and Water Temperature Setpoint (R-35) 134
Low Flow Fixtures (R-36) 135
Heat Pump Water Heaters (R-37) 136
Tankless Water Heaters (R-38) 137
Solar Water Heaters (R-39) 138
Efficient Plumbing (R-40) 138
Sources 139
Appendix D. Non-Residential EEM Documentation 140
Solar Photovoltaic (C-1) 141
Small HVAC Optimization and Repair (C-2) 141
Commissioning New and Re/Retro (C-3, C-4) 142
Low E Windows New and Replace (C-5, C-6) 143
Premium New HVAC Equipment (C-7) 143
Large HVAC Optimization and Repair (C-8) 144
Integrated Building Design (C-9) 145
Efficient Package Refrigeration (C-10) 145
Electrically Commutated Motors (C-11) 146
Premium Motors (C-12) 146
Variable Speed Drives, Controls and motor applications tune up (C-13) 148
Energy Star Transformers (C-14) 149
Efficient AC/DC Power (C-15) 150
Efficient Network Management (C-16) 151
New and Retrofit Efficient Lighting (C-17, C-18) 151
LED Exit Signs (C-19) 152
LED Traffic Lights (C-20) 152
Perimeter Daylighting (C-21) 153
Low Flow Fixtures (C-22) 154
Solar Water Heaters (C-23) 155
Heat Pump Water Heaters (C-24) 156
Energy Star Hot Food Holding Cabinet (C-25) 156
Energy Star Electric Steam Cooker (C-26) 157
Pre-Rinse Spray Wash (C-27) 157
Restaurant Commissioning Audit (C-28) 158
Grocery Refrigeration Tune-Up and Improvement(C-29) 158
Refrigeration Casework Improvements (C-30) 159
VendingMiser® (C-31) 160
Sources 160
Appendix E. Segmentation and CIS Sampling Plan 161
Sample Selection 162
Appendix F. Segment Load Charts 163
Residential 163
Non-Residential 164
Appendix G. Emerging Programs and Technologies 168
Technology 1. Programmable Thermostats 169
Technology 2. Solar Absorption Chillers 170
Technology 3. Drain Water Heat Recovery (DWHR) 170
Technology 4. Oil-Free Chiller Compressors 172
Technology 5. Evaporative Condenser Air Conditioner 172
Technology 6. "Smart" Walk-in Freezer Defrost Controllers 173
Technology 7. Reduced Wattage Fluorescent Lamps 173
Technology 8. High-Intensity Fluorescent (HIF) Lighting Systems 173
Technology 9. Intelligent Bathroom (Motion Sensor) Lighting 174
Technology 10. Power Reducers 175

Technology 11. Induction Cooking 175
Technology 12. Transient Voltage Surge Suppressors 175
Technology 13. Voltage Controllers 175
Technology 14. Turbochef® Rapid Cooker 175
Technology 15. Cool Roofs 176
Technology 16. Electric and Plug In Electric Hybrid Vehicles 176
Vehicle Availability 176
Vehicle Impacts 177
Vehicle Costs 178

List of Tables

Table 1. Annual Usage and DSM Potential 2026 Planning Year 1
Table 2. Energy Savings and Annual Budget for Recommended Programs 2
Table 3. DEC Customers and Weather Normalized Annual Usage by Sector 5
Table 4. DEC Total Annual Electric Use by End-Use 7
Table 5. Residential Customers by Segment 8
Table 6. Appliance and End-Use Installation Rates from Residential Survey 11
Table 7. Annual Usage by Residential Segment 12
Table 8. Residential Sector Monthly Usage by End-Use 13
Table 9. Business Counts and Estimated Square Footage by Segment 14
Table 10. Number of Premises and Annual Usage by Segment 15
Table 11. Manufacturing Customers and Unadjusted 2006 Loads 17
Table 12. Summary of Technical Potential Over 5 and 20 Year Planning Horizon 22
Table 13. DSM Technology Assessment, Residential 25
Table 14. DSM Technology Assessment, Non-Residential 26
Table 15. Ranked Measures, Residential 29
Table 16. Ranked Measures, Non-Residential 30
Table 17. Program Recommendations 35
Table 18. Measures and Incentives – Key Accounts Custom 36
Table 19. Estimated Participation and Savings – Key Accounts Custom 37
Table 20. Estimated Five-Year Program Budget – Key Accounts Custom 38
Table 21. Measures – Prescriptive Program 43
Table 22. Estimated Participation and Savings – Prescriptive Program 43
Table 23. Estimated Five-Year Program Budget – Prescriptive Program 50
Table 24. Measures and Incentives – Retro-Commissioning 51
Table 25. Estimated Participation and Savings – Retro-Commissioning 52
Table 26. Estimated Five-Year Program Budget – Retro-Commissioning 53
Table 27. Measures and Incentives – New Commercial Construction 54
Table 28. Estimated Participation and Savings – New Commercial Construction 55
Table 29. Estimated Five-Year Program Budget – New Commercial Construction 55
Table 30. Measures – Residential Energy Assessment 56
Table 31. Estimated Participation and Savings – Residential Energy Assessment 56
Table 32. Estimated Five-Year Program Budget – Residential Energy Assessment 57
Table 33. Estimated Participation and Savings – Energy Star Appliances and Lighting 58
Table 34. Measures and Incentives - Energy Star Appliances Promotion 59
Table 35. Measures and Incentives - Energy Star Lighting Promotion 62
Table 36. Estimated Five-Year Program Budget – Energy Star Appliances and Lighting 64
Table 37. Measures and Incentives – Residential HVAC Systems 65
Table 38. Estimated Participation and Savings – Residential HVAC Systems 66
Table 39. Estimated Five-Year Program Budget – Residential HVAC Systems 66
Table 40. Measure and Incentive – Solar Heated Domestic Hot Water 67
Table 41. Estimated Participation and Savings - Solar Heated Domestic Hot Water 68
Table 42. Estimated Five-Year Program Budget - Solar Heated Domestic Hot Water 68
Table 43. Measures and Incentives – Energy Star Plus 69
Table 44. Estimated Participation and Savings – Energy Star Plus 70
Table 45. Estimated Five-Year Program Budget – Energy Star Plus 72
Table 46. Measures and Incentives – Manufactured Homes 74
Table 47. Estimated Participation and Savings – Manufactured Homes 75
Table 48. Estimated Five-Year Program Budget – Manufactured Homes 76
Table 49. Measures – On-Site Audit with Direct Installed Measures 77
Table 50. Estimated Participation and Savings – On-Site Audit with Direct Installed Measures 78
Table 51. Estimated Five-Year Program Budget – On-Site Audit with Direct Installed Measures 79
Table 52. Measure and Incentive – Old Refrigerator Pick-Up and Recycling 80

Table 53. Estimated Participation and Savings – Old Refrigerator Pick Up and Recycling 80
Table 54. Estimated Five-Year Program Budget – Old Refrigerator Pick Up and Recycling 81
Table 55. Income Levels - GAP Delivery Channels 83
Table 56. Measures - Weatherization 85
Table 57. Estimated Participation and Savings - Weatherization 85
Table 58. Estimated Five-Year Program Budget - Weatherization 86
Table 59. Measure and Incentive – Energy Star Cool Roofs 87
Table 60. Estimated Participation and Savings – Energy Star Cool Roofs 88
Table 61. Estimated Five-Year Program Budget – Energy Star Cool Roofs 89
Table 62. DSM Staffing Cost Assumptions 90
Table 63. Energy Savings and Annual Budget for Recommended Programs 93
Table 64. Comparison of DSM Program Spending and Savings 94
Table 65. Program Assumptions 95
Table 66. Benefit-Cost Ratios 95
Table 67. Recommended Measurement and Verification Approaches 96
Table 68. Weather Inputs to Modeling 102
Table 69. Residential Energy Model Inputs 103
Table 70. Energy Systems Performance Inputs 103
Table 71. Customer and Load Forecast 110
Table 72. Benefits and Costs by Cost Effectiveness Test 112
Table 73. Mapping of EEM to Residential DSM Programs 115
Table 74. Mapping of EEM to Non-Residential DSM Programs 140
Table 75. Technology Table 168
Table 76. Vehicle Specifications 177
Table 77. Annual Electricity Sales by Vehicle Type 178

List of Figures

Figure 2. Total DEC Electric Sales by Rate Class....6
Figure 3. Total DEC Electric Sales by End-Use....6
Figure 4. DEC Hourly Average Demand Map....7
Figure 5. Residential Housing Units Permitted for Construction, DEC-SC Service Area....9
Figure 6. Percent of Single Family Dwellings by Year Built....10
Figure 7. Percent of Single Family Dwellings by Square Feet....10
Figure 8. Single Family Mean Square Feet by Year Built....10
Figure 9. Residential Electric Usage by Existing Housing Type....12
Figure 10. Residential Electric Usage by New Housing Type....12
Figure 12. Commercial EUI Distribution....16
Figure 13. Commercial Square Footage Distribution....16
Figure 14. Monthly Commercial Usage by End-Use....17
Figure 15. Monthly Manufacturing Usage by End-Use....18
Figure 16. Residential Technical Potential Models....19
Figure 17. Technical Potential by Month....21
Figure 18. Technical Potential for Demand Reduction – August....22
Figure 19. Technical Potential for Demand Reduction – December....22
Figure 20. Technical Potential over Planning Horizon....23
Figure 21. Residential DSM Supply Curve....31
Figure 22. Non-Residential DSM Supply Curve....32
Figure 23. Residential Savings by Type and Cost....33
Figure 24. Non-Residential Savings by Type and Cost....33
Figure 25. Existing Single Family....101
Figure 26. Grocery....101
Figure 27. Air and Water Temperatures....104
Figure 28. Residential Hourly Demand Factors for Heat Cool, Hot Water....106
Figure 29. Residential Hourly Demand Factors for Lighting, Interior, and Exterior Loads....106
Figure 30. Commercial Hourly Demand Factors for Heating, Cooling, and Hot Water....107
Figure 31. Commercial Hourly Demand Factors for Lighting, Internal and External Loads....107
Figure 32. Base Load True-Up – Residential, September....108
Figure 33. Cooling True-Up – All Customers, August....108
Figure 34. Heating True-Up – All Customers, January....109
Figure 35. Motor Efficiency specification NEMA premium....147
Figure 36. Typical Motor Operating Efficiencies versus Load....147
Figure 37. Transformer Efficiency specification NEMA TP-1....149
Figure 38. Typical Drain Water Heat Recovery System (Source: U.S. Dept. of Energy)....171
Figure 39. Comparison CO2 Values for Each Vehicle Type....178
Figure 40. Six-Year Projected Costs of Purchase and Operation....179

EXECUTIVE OVERVIEW

This document presents a long-term Demand Side Management (DSM) Action Plan for residential and non-residential electric customers in the Duke Energy Carolinas – South Carolina (DEC-SC) service area.[1] The DSM Action Plan was prepared by Forefront Economics Inc., H. Gil Peach and Associates and PA Consulting Group with consultation and review by the Residential and Non-Residential Collaboratives. The design, implementation, oversight and cost effectiveness of electric DSM programs are addressed in this DSM Action Plan.

Overview of Findings

Key findings from the DSM Action Plan are summarized in Table 1.

Table 1. Annual Usage and DSM Potential 2026 Planning Year

	kWh (millions)	Percent of Total
Total Usage	24,184	100%
Technical Potential Savings	6,948	29%
Economic Potential (@ $0.06/kWh)*	4,116	17%
Recommended DSM Programs (after 5 years) **	300	1.5%

* Based on incremental cost of measures without administration or overhead costs.
** DSM savings shown as percent of 2011 usage.

The technical potential shows that if the electric saving technologies identified in this report were applied across all applicable customers, without regard to market or economic constraints, weather normalized annual kWh usage could be reduced by 29 percent. Economic potential considers the cost of these technologies compared to the marginal cost of energy supply and shows that more than half of the technical potential is cost effective at $0.06 per kWh (17% of total usage). These findings compare favorably to similar studies from across the U.S. A study of statewide potential in North Carolina by GDS Associates found technical potential of 33 percent and economic potential of 14 percent at $0.05 per kWh. A review of eleven studies of potential found median technical potential of 33 percent and median economic potential of 20 percent.[2]

Estimated savings from the DSM programs recommended for implementation provides an estimate of realistically achievable energy savings. These programs ramp up over a five-year implementation schedule reaching 300 million kWh of annual savings after the fifth year, a 1.5 percent reduction from projected usage. This level of savings represents 4.3 percent of projected technical potential and 7.3 percent of economic potential.

[1] This project also includes a similar analysis and DSM Action Plan for DEC North Carolina, the results of which are presented in a separate report. Both reports are structured the same to allow for ease of comparison between the two reports. All of the data presented in this report pertain to DEC-SC unless otherwise stated.
[2] Nadel, Steven, Anna Shipley and R. Neal Elliott. *The Technical, Economic and Achievable Potential for Energy-Efficiency in the U.S. – A Meta-Analysis of Recent Studies.* 2004 ACEEE Summer Study in Energy Efficiency in Buildings.

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 a comprehensive list of DSM technologies for saving energy,
(3) consider the appropriateness of selected technologies for Duke's Couth Carolina 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, and
(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 following DSM programs are recommended for implementation:

- Key Accounts Custom
- Load Control – pending internal study[3]
- Prescriptive
- Commercial and Industrial Retro-Commissioning Lite Pilot
- New Commercial Construction
- Residential Energy Assessment
- Energy Star Appliances and Lighting
- Energy Star Plus
- Manufactured Homes
- On-Site Audit with Direct Install
- Old Refrigerator Pick-Up and Recycling
- Residential Weatherization
- Energy Star Cool Roofs

All of the recommended programs were found to be cost effective from a total resource cost (TRC) perspective with the exception of the Retro-Commissioning (pilot) and Residential Weatherization programs (directed toward low income families).

Table 2. Energy Savings and Annual Budget for Recommended Programs

Year	Cumulative kWh Savings (millions)	Program Budget (millions $)	Cost per Customer	Percent of Revenue
1	26	7.2	13.67	0.6%
2	71	13.0	24.50	1.1%
3	132	16.4	30.85	1.3%
4	212	20.1	37.96	1.6%
5	300	21.5	40.56	1.7%

Note: Although demand response programs are recommended, program budgets and savings are not included in this table and were not developed as part of this report.

Annual program budgets are estimated at $21.5 million for all recommended programs by Year 5. This amounts to 1.7 percent of the approximately $1.23 billion in retail revenues and equates to spending of $41 per customer for program delivery cost and incentives. Based on recent data from the US Department of Energy on DSM program spending at 25 utilities, spending at $41 per customer is well within the range of spending but higher than average.

[3] The Load Control program is recommended but requires internal study before proceeding. Consequently, we have not developed program cost and savings for this program.

Spending per customer by the comparable utilities ranged from less than one dollar to nearly $90, averaging $26.50.[4] Spending as a percent of revenue averaged 1.3 percent with a wide range.

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 is perhaps best described as 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 from the use of secondary information documenting the industry's experience with the technology adjusted for the market assessment and load modeling results specific to DEC-SC. 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.

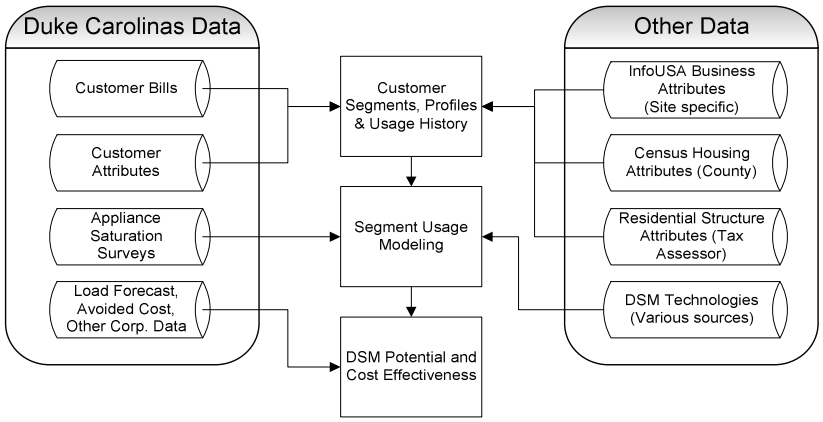


Figure 1. Overview of Market Assessment and DSM Potential Estimates

[4] See Table 64.

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 DEC-SC. DEC-SC service territory specific data used to construct the analysis include:

- Monthly energy bills for over 19,000 customer sites sampled from 16 market segments.[5]
- 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 2007 providing recent information on equipment and end-uses. DEC-SC respondents were selected and analyzed separately from the broader survey.
- Hourly (8,760) load data for 21 residential and 20 non-residential DEC-SC rate classes. Hourly load data are not typically available for these types of projects and proved extremely valuable in our modeling efforts.
- Size of home (square feet) and vintage of construction (year built) were obtained from a sample of tax-assessor records for 5,000 residential properties within the DEC-SC service territory.
- Site-specific business attributes for a sample of 1,000 business locations within the DEC-SC service territory. These records provided the information necessary to estimate non-residential floor space and energy utilization per square foot by non-residential segment.
- Long-term load forecast for Duke Energy Carolinas, prorated to DEC-SC.

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 the 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 corporate 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 a seasoned 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 fit DEC-SC.

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 two sections of the main report present program cost effectiveness results and evaluation plans. 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 2006 weather normalized unless otherwise stated.

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

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 DEC-SC service territory in terms of households, businesses and customer data.[6] 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 heat, water heat, lighting, cooking, dryers, process energy, 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 use estimates presented in this report are normalized to long-term weather conditions by using the energy usage models applied to a typical or normal year. All energy use and end-use estimates in the report have been normalized to 10-year monthly temperature normals. Though the energy use estimates are for a normal year, the models were developed using actual usage and weather data from January 2006 through December 2006.

Overview of Market Sectors

The focus of this study is the over one-half million residential and non-residential retail customers in the DEC-SC service territory.[7] These customers account for 18.3 billion kWh annually, as shown in Table 3.

Table 3. DEC Customers and Weather Normalized Annual Usage by Sector

Sector	Customers	Annual Usage (million kWh)	Percent of Total	Use per Customer (kWh/year)
Residential	447,324	6,418	35.0%	14,348
Non-Residential	81,267	11,913	65.0%	146,596
All	528,591	18,332	100.0%	34,680

Source: Unique premise counts and billing data from CIS extract (Jan 2006 – Dec 2006).

With nearly 450 thousand 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 average non-residential customer uses 10 times more electricity than the average residential customer. The non-residential sector accounts for 65 percent of the energy consumption considered in this study.

Monthly electric loads for both sectors are shown in Figure 2 with non-residential broken down between commercial and manufacturing loads. Monthly residential loads are by far the most seasonal with a slightly higher summer peak than winter. Although not as seasonal as residential, monthly commercial loads also peak in the summer but have a much less pronounced winter peak. By contrast, manufacturing loads are nearly constant across

[6] When using secondary data sources to describe the DEC service area, we have included the following 14 counties to describe the DEC-SC service area: Abbeville, Anderson, Cherokee, Chester, Greenville, Greenwood, Lancaster, Laurens, Newberry, Oconee, Pickens, Spartanburg, Union, and York.

[7] Wholesale and transportation customers and loads are not considered in this analysis.

the months except for a small summer peak in July and August, coincident with the residential and commercial peak.

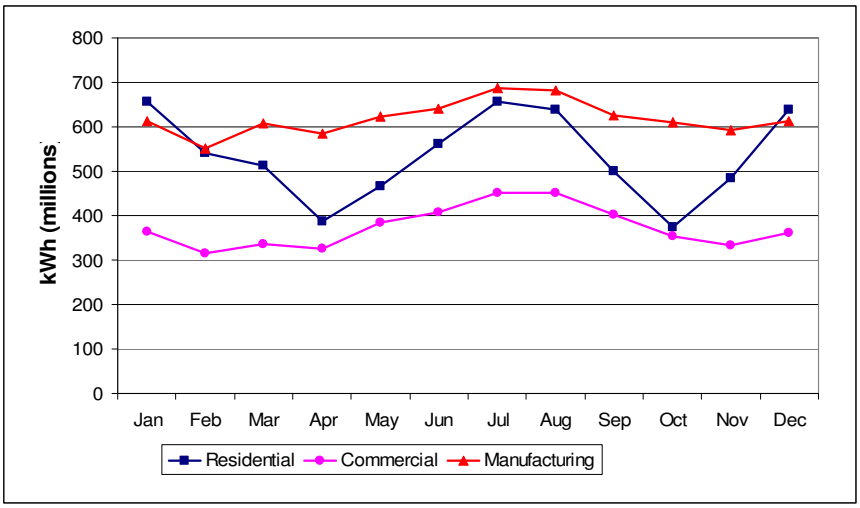


Figure 2. Total DEC Electric Sales by Rate Class

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.

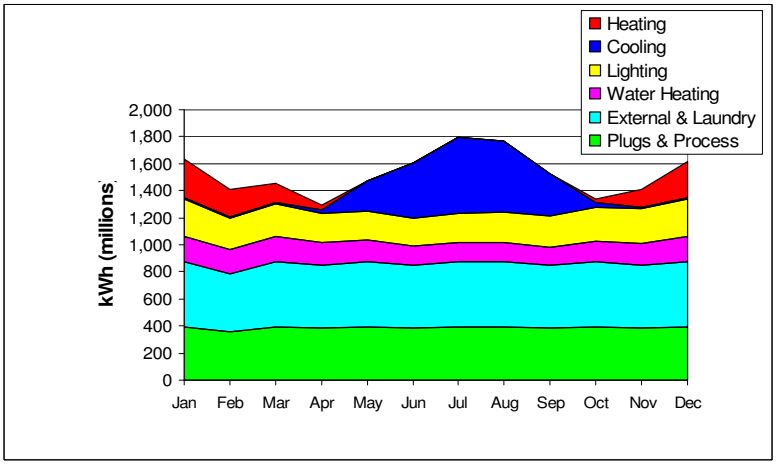


Figure 3. Total DEC Electric Sales by End-Use

Monthly shapes are characterized by a large base load with a prominent summer peak for cooling. Although 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, and miscellaneous plug loads. Annual data are shown for these same end-uses in Table 4. Base loads comprise over 80 percent of total annual usage.

Table 4. DEC Total Annual Electric Use by End-Use

End-Use	Millions kWh	Percent
Plugs and Process	4,660	25%
External and Laundry	5,630	31%
Lighting	2,811	15%
Cooling	2,174	12%
Water Heating	1,962	11%
Heating	1,093	6%
Total	18,332	100%

Source: Analysis of monthly usage

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

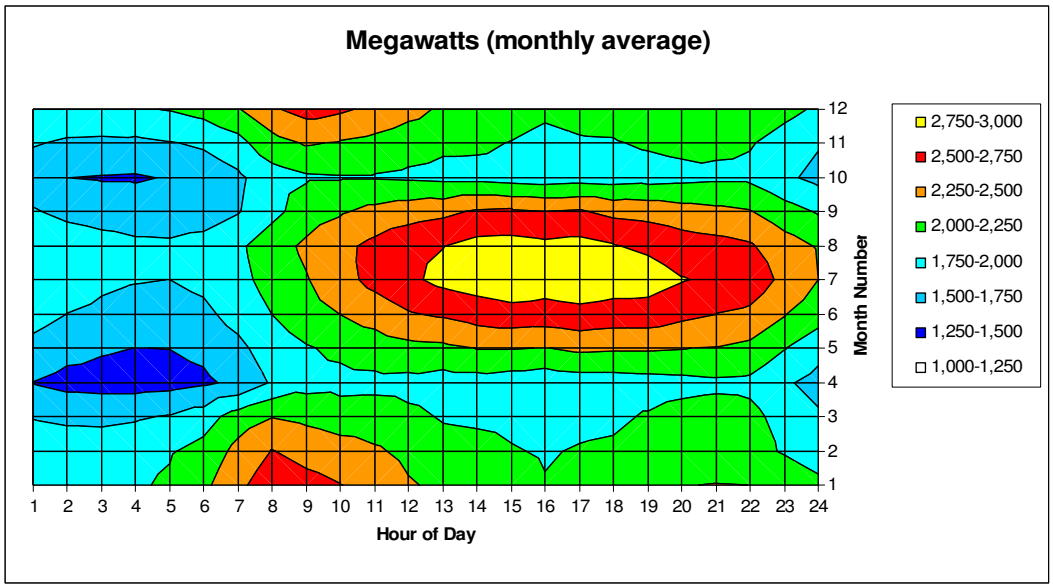


Figure 4. DEC Hourly Average Demand Map

Demand was modeled using several sources of information, including hourly load data provided from DEC's Retail Demand Analysis for 2006. A detailed discussion of the methodology is presented in Appendix A. Demand is at its highest in July between 4 PM and 6 PM with high loads throughout the afternoon and early evening of the summer months. DSM technologies and programs with impact loads during these periods will save peak and energy.

Residential

The market assessment presented in this section begins with a high-level view of residential housing in the DEC 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 DEC, including monthly billing data.
2. The Duke Residential Appliance Saturation Survey (RASS), completed in early 2007.
3. A sample of 5,000 residential assessor records purchased from Data Quick.
4. Hourly load data for 21 DEC-SC rate classes.

Duke serves nearly 450 thousand residential customers in South Carolina. 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 and vintage of construction, based on meter set date, were available from the DEC customer information system (CIS). This segmentation approach captures the major differences in residential housing stock 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 four segments are shown in the table below.

Table 5. Residential Customers by Segment

	Single Family	Multifamily	Total
Existing Construction	354,967	61,670	416,637
New Construction	25,338	5,349	30,687
Total	380,305	67,019	447,324
Percent	85%	15%	100%

Source: DEC CIS Data

Single family construction accounts for nearly 85 percent of all residential customers. The remainder is multifamily housing units including duplexes, condominiums and apartment buildings. Single family and multifamily units 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 2004. Current building practices are reflected in the new construction segment, defined as all customers connected in 2004, 2005 and 2006. Using 2004 as a cutoff is somewhat arbitrary and less important than having a group of homes to model and contrast the differences between existing and new housing stock.

New Construction Levels

Residential construction estimated from housing permit data for the DEC-SC 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. Single family and multifamily residential construction adds around 12 thousand dwellings annually in the DEC-SC service area. Although the mix of construction varies from year-to-year, about 90 percent of new housing stock is single family units.

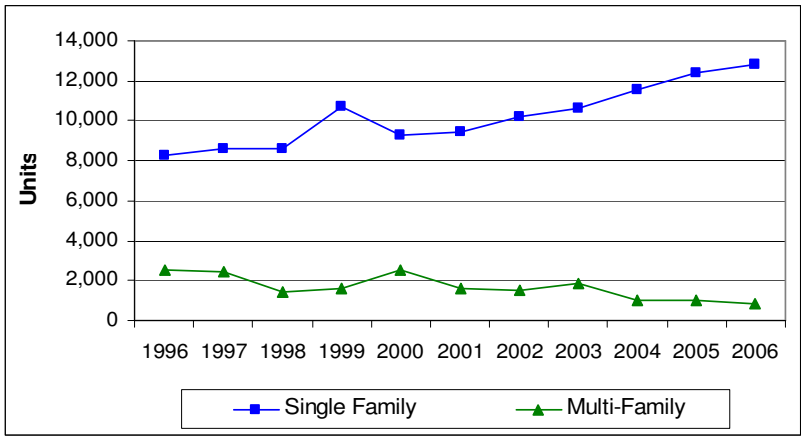


Figure 5. Residential Housing Units Permitted for Construction, DEC-SC Service Area

In addition to the "site-built" construction reflected in the permit data, an average of 1,100 manufactured homes are placed in the DEC-SC service territory annually.[8] Site built homes are constructed on-site without the use of pre-built walls and other major structural components. Manufactured homes are homes built or primarily built off-site and then installed on the building site.

Housing Stock Characteristics

Figure 6 through Figure 8 was derived from a random sample of 5,000 assessor-based records on developed residential properties.[9] Assessor records provide valuable housing attribute details useful for understanding the nature of the housing stock and, therefore, the DSM opportunities. Since these data pertain to a tax parcel, their greatest value comes from the information on single family housing.

[8] Based on US Census data for statewide placements of manufactured homes (2004-2006) and the percentage of statewide population living within the service territory.

[9] Sample data were purchased from Data Quick. Data Quick is estimated to provide coverage for approximately 90 percent of the DEC-SC service area.

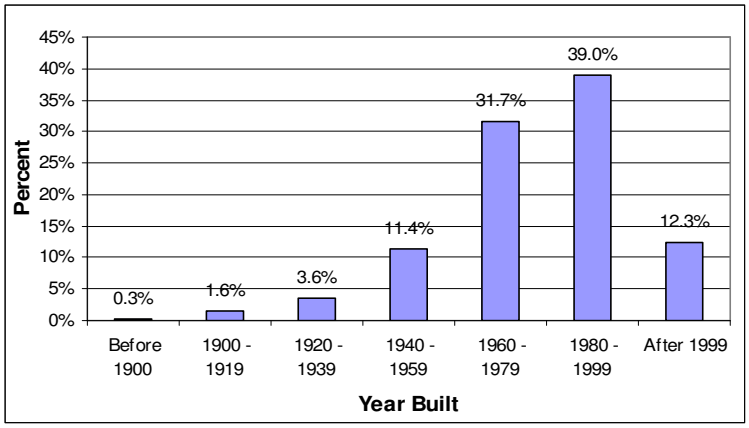


Figure 6. Percent of Single Family Dwellings by Year Built

Nearly half of the single family housing stock was constructed prior to 1980.

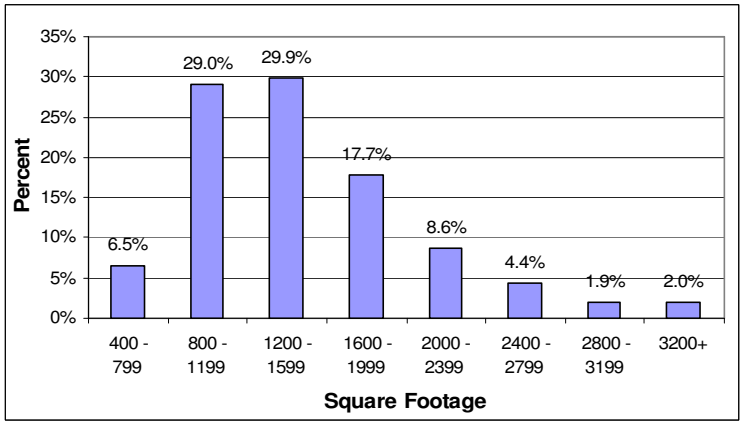


Figure 7. Percent of Single Family Dwellings by Square Feet

Nearly two-thirds of the single family housing stock is smaller than 1,600 square feet.

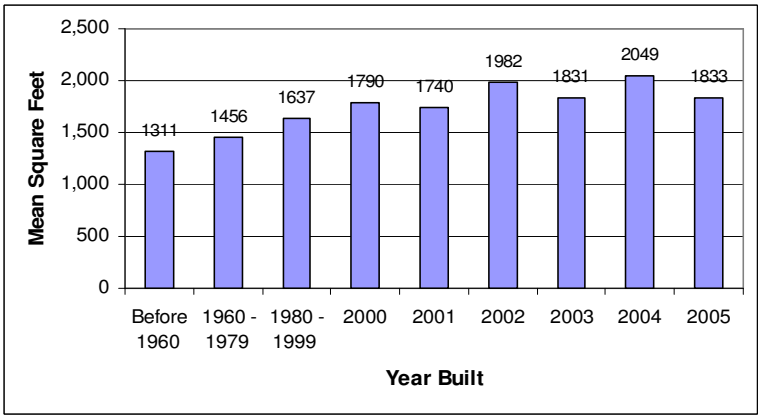


Figure 8. Single Family Mean Square Feet by Year Built

New homes have been averaging around 1,900 square feet since 2002.

Appliance Saturation Rates

Our analysis of customer usage took advantage of the Residential Appliance Saturation Survey (RASS) conducted by Duke in early 2007. 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 6. Survey results are reported for segments with at least 30 respondents.

Table 6. Appliance and End-Use Installation Rates from Residential Survey

	Single Family		Multifamily	
	Existing	New	Existing	New
	n=150	n=24	n=14	n=1
Main Heat Fuel - Electric:	55%	NA	NA	NA
Standalone Forced Air Furnace	4%	NA	NA	NA
Heat Pump with Forced Air Furnace	21%	NA	NA	NA
Standalone Heat Pump	24%	NA	NA	NA
Other	6%	NA	NA	NA
Main Heat Fuel - Gas/Other:	45%	NA	NA	NA
Standalone Forced Air Furnace	28%	NA	NA	NA
Heat Pump with Forced Air Furnace	6%	NA	NA	NA
Standalone heat Pump	1%	NA	NA	NA
Other	10%	NA	NA	NA
Used for Cooling:				
Central Air Conditioner	41%	NA	NA	NA
Heat Pump	52%	NA	NA	NA
Window Unit	11%	NA	NA	NA
None	2%	NA	NA	NA
Electric Water Heat	82%	NA	NA	NA
Electric Oven	89%	NA	NA	NA
Electric Range	82%	NA	NA	NA
Electric Clothes Dryer	93%	NA	NA	NA
Dishwasher	68%	NA	NA	NA
Clothes Washer	97%	NA	NA	NA

Source: Residential Appliance Saturation Survey (2007)

The RASS survey was not stratified by vintage of construction or housing type. Consequently, only existing single family has sufficient number of respondents to rely on the RASS results.

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 7 below shows annual usage for each residential segment.

Table 7. Annual Usage by Residential Segment

Segment	Premises	Average Annual kWh per Premise	Total Usage (millions of kWh)
Single Family Existing	354,967	15,359	5,452
Multifamily Existing	61,670	9,999	617
Single Family New	25,338	12,259	311
Multifamily New	5,349	7,253	39
Total Residential	447,324		6,418

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

The monthly load profiles resulting from the energy models are shown by segment in Figure 9 and Figure 10.

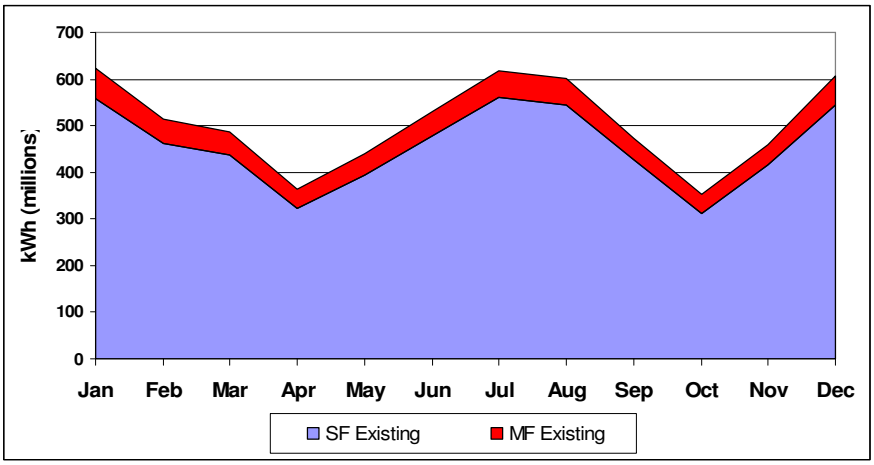


Figure 9. Residential Electric Usage by Existing Housing Type

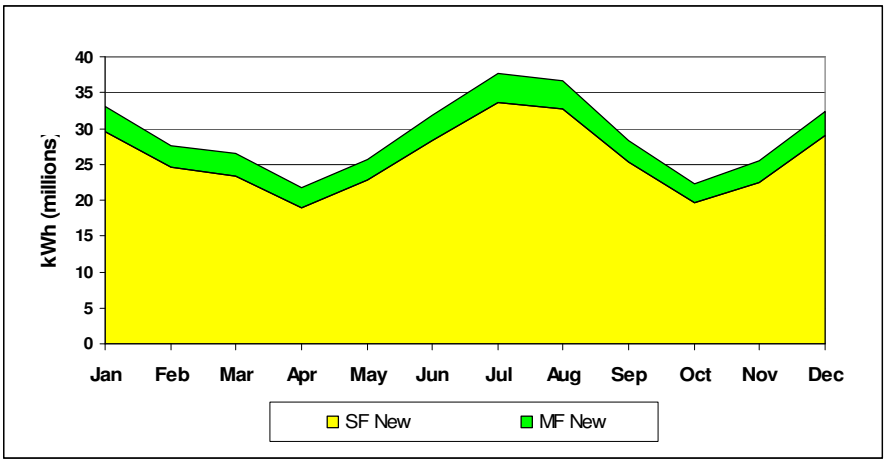


Figure 10. Residential Electric Usage by New Housing Type

Because of the large number of homes, the existing stock of single family homes is by far the largest segment, accounting for over 80 percent of the residential sector's energy usage. All segments follow a similar monthly load pattern, as expected. Monthly residential loads by major end-use are shown in Figure 11 and Table 8.

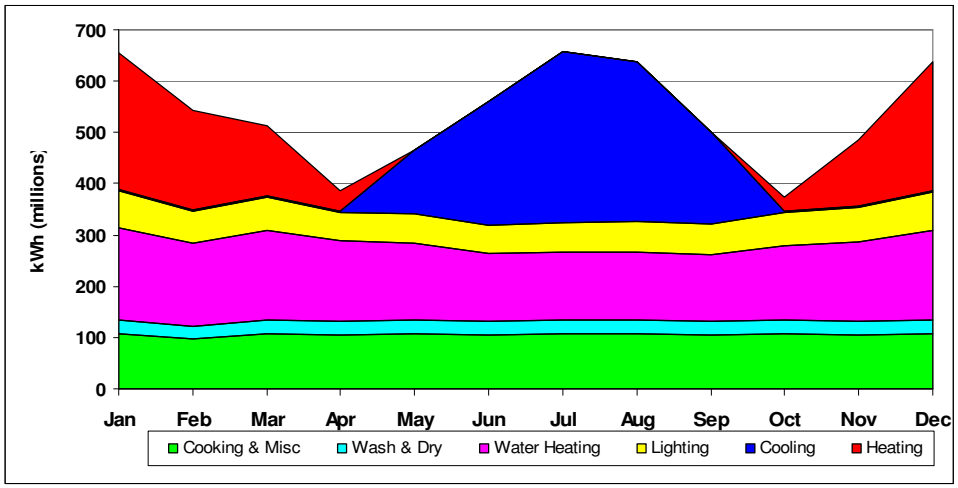


Figure 11. Monthly Residential Loads by End-Use

Table 8. Residential Sector Monthly Usage by End-Use

(millions of kWh)

Month	Cooking & Misc	Wash & Dry	Water Heating	Lighting	Cooling	Heating	Total
Jan	108	27	178	72	3	267	655
Feb	98	25	161	62	2	194	542
Mar	108	27	173	65	3	136	512
Apr	105	26	157	57	2	39	386
May	108	27	149	58	124	0	466
Jun	105	26	134	54	242	0	561
Jul	108	27	132	57	332	0	657
Aug	108	27	130	60	312	0	638
Sep	105	26	130	61	179	0	501
Oct	108	27	144	65	3	27	374
Nov	105	26	154	68	3	130	486
Dec	108	27	174	73	3	253	639
Annual	**1,274**	**321**	**1,817**	**753**	**1,208**	**1,045**	**6,418**
Percent	20%	5%	28%	12%	19%	16%	100%

Water heating is the largest single end-use, accounting for over a quarter of all annual residential usage. Taken together with the other base load end-uses, cooking, washing and drying and lighting base loads, account for nearly two-thirds of all residential usage. Space cooling and heating account for just over a third of annual energy usage but contribute significantly to the seasonal peak. Cooling, for example, is responsible for over half of all July kWh consumption. Four charts that show 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 building is much larger in commercial. For these reasons it is useful to describe the non-residential sector not only in terms of number of businesses but also in terms of square footage. Analysis of DSM opportunities in the non-residential segment also benefits from an understanding of the square footage of commercial and industrial space in the service territory.

Square footage estimates were developed using a random sample of site-specific data for 1,000 businesses in the service territory obtained from InfoUSA. Business attributes included SIC code and estimated employment. These two pieces of information were used along with estimates of employment density (employees per square foot) by type of business to estimate the square footage of each business record in the secondary data. The results of this analysis, summarized by segment, are shown in Table 9.

Table 9. Business Counts and Estimated Square Footage by Segment

Segment	Businesses in Sample	Percent	Total SqFootage	SqFootage Distribution	SqFt per Business
Grocery	25	2.5%	180,010	2.0%	7,200
Hospitals	0	0.0%	0	0.0%	NA
Lodging	9	0.9%	103,950	1.1%	11,550
Office	213	21.3%	885,810	9.7%	4,159
Other	236	23.6%	1,278,470	14.0%	5,417
Other Health	70	7.0%	539,820	5.9%	7,712
Restaurants	67	6.7%	730,650	8.0%	10,905
Retail	125	12.5%	1,124,410	12.3%	8,995
Schools	15	1.5%	524,930	5.8%	34,995
Wholesale & Warehouse	77	7.7%	1,612,070	17.7%	20,936
Total Commercial	**837**	**83.7%**	**6,980,120**	**76.6%**	
Ag, Mining, Util., & Const	107	10.7%	509,820	5.6%	4,765
Manufacturing	56	5.6%	1,619,780	17.8%	28,925
Total Other Non-Residential	**163**	**16.3%**	**2,129,600**	**23.4%**	
Total Non-Residential	**1,000**	**100.0%**	**9,109,720**	**100.0%**	

Source: InfoUSA data for DEC-SC territory. Forefront Economics estimate of square footage based on employment and employment density by NAICS

The last column in the table above shows the average square footage per business. This result will be combined with the number of business sites from Duke's customer records to estimate the non-residential floor space by segment. Notice that for some of the segments the number of businesses in the sample is insufficient for meaningful analysis. As explained in the next section, in some of these cases other data are used to obtain better estimates of sector square footage.

Customer Description

Non-residential customer data were segmented using the same SIC code classification scheme used to describe the business data acquired for the service territory. Number of premises and annual usage is shown by segment in Table 10 along with other descriptive information about the commercial sector. The number of premises was found

to include many non-building types of electrical services (e.g. billboards and railroad controls). An alternative measure was developed to better approximate the number of actual buildings. The data in Table 10 only include premises with at least 3,000 kWh of annual usage.[10]

Applicable square feet shown in Table 10 is the total square footage found for that segment in the service area. The energy utilization index (EUI) is calculated using the estimate of applicable square footage. Energy utilization index results from the 2003 Commercial Building Energy Consumption Survey (CBECS) published by the US DOE are also shown for comparison purposes. Although they follow the same general pattern, there are a few notable differences in EUI estimates.

Table 10. Number of Premises and Annual Usage by Segment

Segment	CIS Premises	Average Annual kWh per Premise	Total Usage (millions of kWh)	Percent of C&I Loads	Square Feet per Business (a)	Estimated Total Square Feet (millions)	Square Feet Distribution	EUI (kWh per Sq Ft)	EUI from CBECS
Grocery	1,004	28,209	283	2.4%	7,200	7.2	1.7%	39.2	49.4
Hospitals	61	379,676	232	1.9%	50,000	3.1	0.7%	75.9	27.5
Hotels	460	25,419	117	1.0%	11,550	5.3	1.3%	22.0	13.5
Office	25,470	5,956	1,517	12.8%	4,159	105.9	25.4%	14.3	17.3
Other	5,002	2,894	145	1.2%	5,417	27.1	6.5%	5.3	22.5
Health	1,592	14,173	226	1.9%	7,712	12.3	2.9%	18.4	16.1
Restaurants	2,313	16,910	391	3.3%	10,905	25.2	6.0%	15.5	38.4
Retail	7,797	10,143	791	6.7%	8,995	70.1	16.8%	11.3	14.3
Schools	1,188	25,379	301	2.5%	34,995	41.6	10.0%	7.3	11.0
Warehouse	2,562	14,876	381	3.2%	20,936	53.6	12.8%	7.1	7.6
Total Commercial	**47,449**	**9,239**	**4,384**	**37%**	**7,407**	**351.5**	**84%**	**12.5**	**NA**
Ag, Mining, Util. & Constr	1,668	3,938	66	0.6%	4,765	7.9	1.9%	8.3	NA
Manufacturing	2,019	367,973	7,429	62.5%	28,925	58.4	14.0%	127.2	NA
Total Other Non-Residential	**3,687**	**203,284**	**7,495**	**63%**	**17,995**	**66.3**	**16%**	**113.0**	**NA**
Total Non-Residential	**51,136**	**23,230**	**11,879**	**100%**	**8,171**	**417.8**	**100%**	**28.4**	**NA**

Source: Energy model results using monthly billing data from CIS. CBECS is the Commercial Building Energy Consumption Survey (2003, US DOE)
(a) Square feet per business calculated from InfoUSA sample and employment density. Hospitals square footage of 50,000 is from other Forefront-Peach studies due to insufficient sample size.
Duke loads and customer counts exclude "small load" premises (less than 3,000 kWh per year).

Energy utilization indices, plotted in Figure 12, serve a descriptive purpose in this report and are not used for the energy savings estimates. Hospitals and grocery stores are the most energy intensive of commercial buildings but only account for a small amount of the applicable floor space. Offices have a large amount of square footage along with a moderately high EUI.

[10] Although arbitrary, this level of usage was thought to effectively screen non-building premises such as billboards and switching equipment.

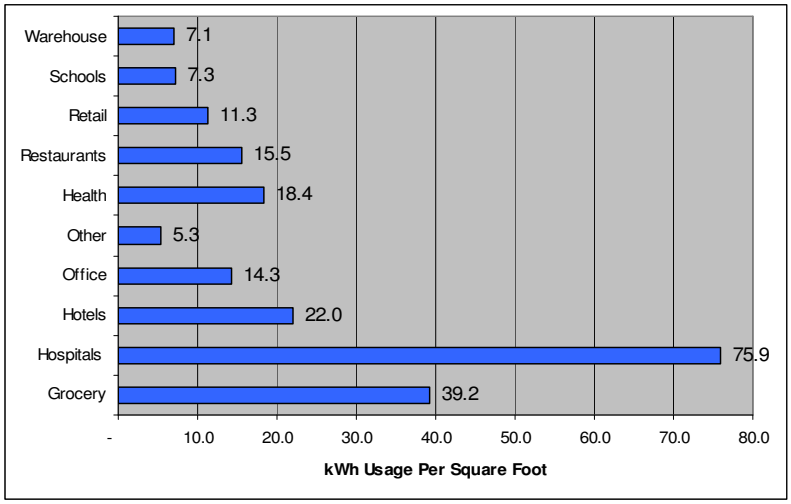


Figure 12. Commercial EUI Distribution

The estimated distribution of commercial square footage is shown in Figure 12. Together the square footage and EUI information are useful for understanding the nature of energy consumption in the commercial segment. Offices and retail account for approximately half of all commercial floor space and have similar energy requirements per square foot. Warehouse and schools are the next largest segments in terms of floor space but have relatively low energy requirements per square foot.

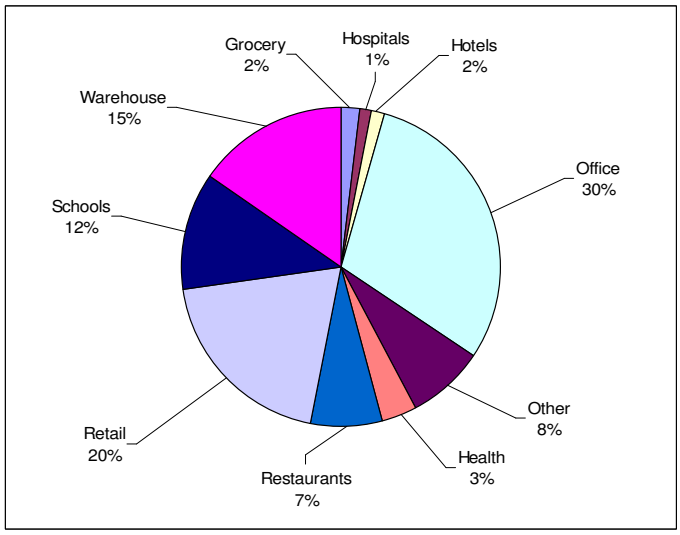


Figure 13. Commercial Square Footage Distribution

Commercial Load Analysis

Annual energy usage by segment has already been presented in Table 10. Commercial energy usage by end-use is shown in Figure 14. Commercial load is characterized by a large percentage of base load with a prominent summer cooling peak. Monthly load charts by end-use for each commercial segment are shown in Appendix F.

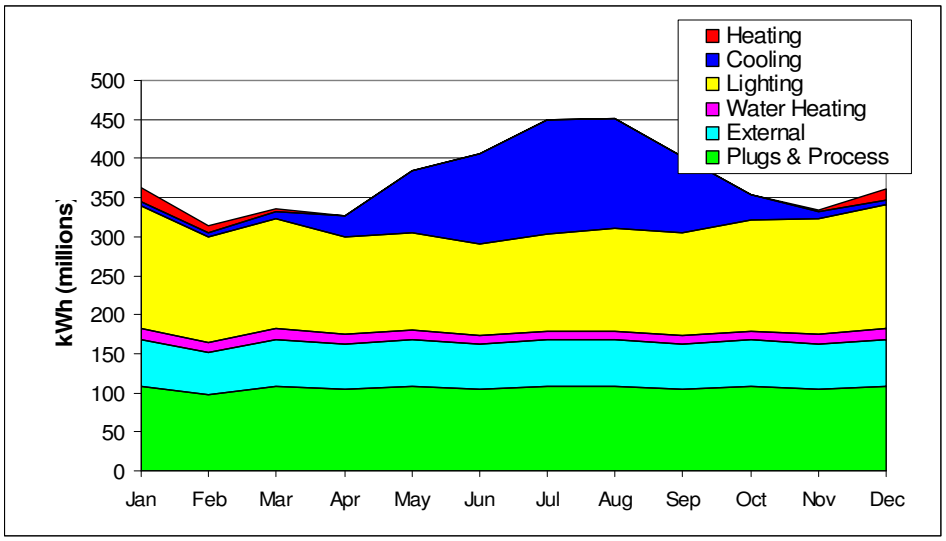


Figure 14. Monthly Commercial Usage by End-Use

Manufacturing Load Analysis

Energy sales to manufacturing customers came to 7.2 billion kWh in 2006, about 40 percent of total retail sales. As shown in Table 11, manufacturing customers cover a wide range of industries.

Table 11. Manufacturing Customers and Unadjusted 2006 Loads

SIC - Industry Name	Customers	Use Per Customer (MWh)	Total Usage (MWh)	Percent	Average Peak (kW)
20 - Food and kindred products	70	3,654	255,759	4%	672
21 - Tobacco manufactures	1	127	127	0%	104
22 - Textile mill products	165	8,668	1,430,159	20%	1,674
23 - Apparel and other textile products	94	455	42,810	1%	161
24 - Lumber and wood products	141	1,173	165,463	2%	239
25 - Furniture and fixtures	44	197	8,679	0%	61
26 - Paper and allied products	49	3,232	158,360	2%	690
27 - Printing and publishing	110	1,006	110,615	2%	191
28 - Chemicals and allied products	158	7,101	1,121,884	16%	1,164
29 - Petroleum and coal products	16	1,431	22,895	0%	360
30 - Rubber and miscellaneous plastics products	130	11,987	1,558,343	22%	1,949
31 - Leather and leather products	9	167	1,502	0%	72
32 - Stone, clay, glass, and concrete products	96	3,794	364,215	5%	592
33 - Primary metal industries	68	2,155	146,541	2%	414
34 - Fabricated metal products	193	1,220	235,540	3%	283
35 - Industrial machinery and equipment	349	1,422	496,158	7%	290
36 - Electrical and electronic equipment	106	3,431	363,663	5%	572
37 - Transportation equipment	66	5,592	369,069	5%	1,006
38 - Instruments and related products	29	10,084	292,437	4%	1,759
39 - Miscellaneous manufacturing industries	125	210	26,276	0%	81
Total Manufacturing	2,019	3,552	7,170,496	100%	645

The top three industries (textiles, rubber and plastics, and chemicals) account for nearly 60 percent of 2006 energy sales to manufacturing customers.

Total manufacturing loads are shown by month in Figure 15. 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 July peak.

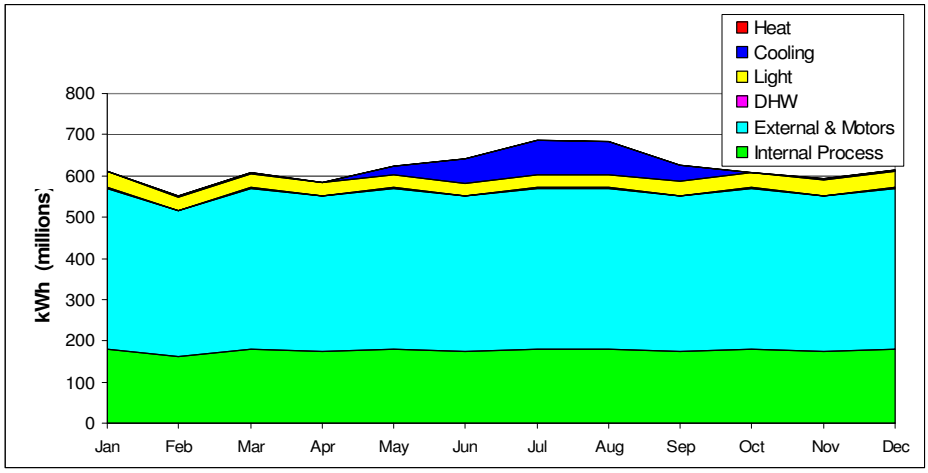


Figure 15. Monthly Manufacturing Usage by End-Use

ENERGY EFFICIENCY MEASURES AND POTENTIAL SAVINGS

In this section we present our estimates of the energy savings potential in the DEC-SC service area. This work builds off of the energy modeling results presented in Appendix A by applying energy efficiency technologies to the model parameters. 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.

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. In estimating the technical potential, the gas effects resulting from electric efficiency are not quantified. However, the relevant and significant natural gas effects have been used to allocate installed cost between fuels, thereby reducing the cost of electric DSM when gas savings are involved. Thirty-five percent of the DEC-SC residential customers heat with natural gas.

The technical potential was 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 EEMs, such as, the replacement of electric furnaces by heat pumps shown in Figure 16. This figure is used to illustrate the derivation of technical potential and shows the energy use pattern for customers with electric furnaces.

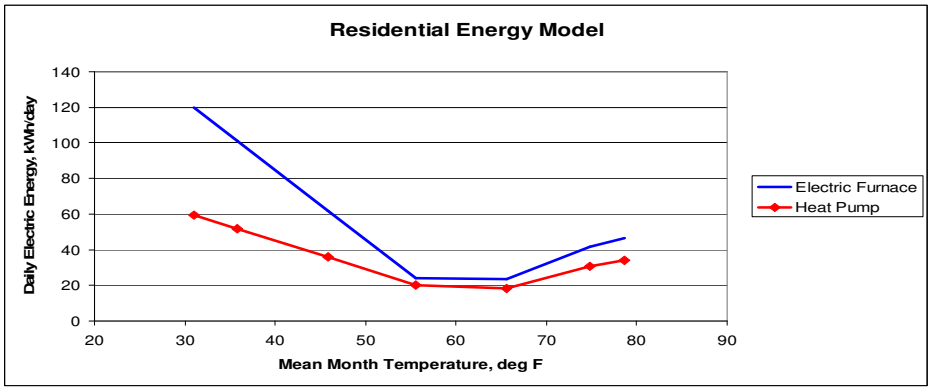


Figure 16. Residential Technical Potential Models

Figure 16 shows the building energy use model for a single average building in the residential sector. In an energy use model of this sort, the line designated as the model specifies 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. 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 16, most of the savings are associated with the improved heating efficiency.

Residential Technical Potential

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 and lower tank standby losses.

One of the largest components of the 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 Technical Potential

These 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 objective 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 17 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 12 below. The technical potential line shows base case energy usage after applying energy efficiency measures. It includes application of solar technologies with solar water heat on half the buildings and a 2 kW solar electric array on one-third of the buildings.

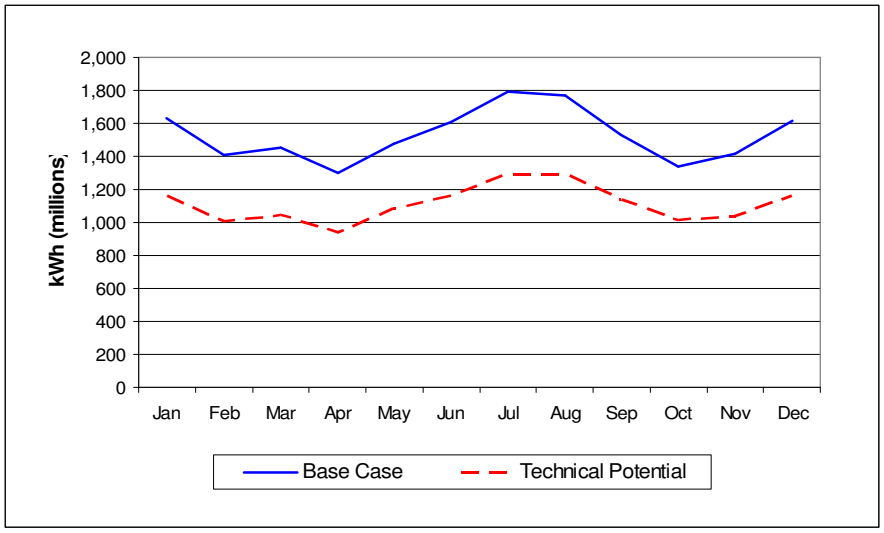


Figure 17. Technical Potential by Month

It should be noted that solar electric technology is technically fully mature. In principle, it could be maximally applied without regard for cost to create a technical potential savings of 100 percent. While this argument is technically accurate, we have resisted carrying the argument this far. Nevertheless, the solar potential noted here reflects an aggressive solar deployment.

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 each month for the base case and for the technical potential case. Figure 18 shows the hourly demand curves for August and Figure 19 shows December to illustrate cooling and heating demand, respectively.

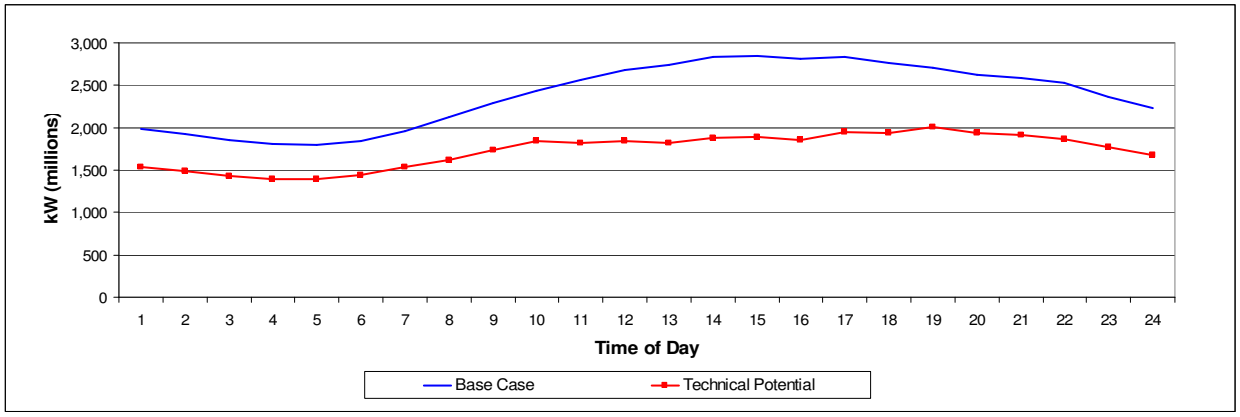


Figure 18. Technical Potential for Demand Reduction – August

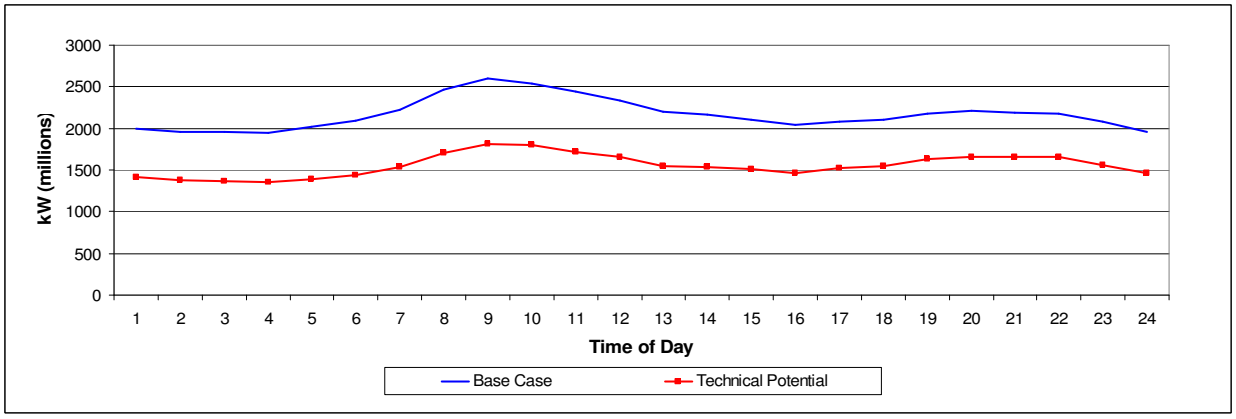


Figure 19. Technical Potential for Demand Reduction – December

It is noteworthy that the demand savings for winter are slightly more than the demand savings for summer. This is because winter heating savings are quite strong. A summary of the technical potential is presented in Table 12 below. 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 12. Summary of Technical Potential Over 5 and 20 Year Planning Horizon

	2006	2011	2026
Base Case Energy Usage (millions kWh)	18,332	19,551	24,184
Technical Potential Energy Savings (millions kWh)	5,005	5,426	6,948
Percent	27%	28%	29%
Base Case Peak Demand (MW)	3,551	3,788	4,686
Technical Potential Peak Savings (MW)	955	1,056	1,405
Percent	27%	28%	30%

It is important to understand the variation of technical potential with time. Figure 20 shows this relationship. In this figure the retrofit potential, red, remains constant over time. The new construction potential, the green wedge, increases in proportion to the amount of new construction. The solar potential is large and 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.

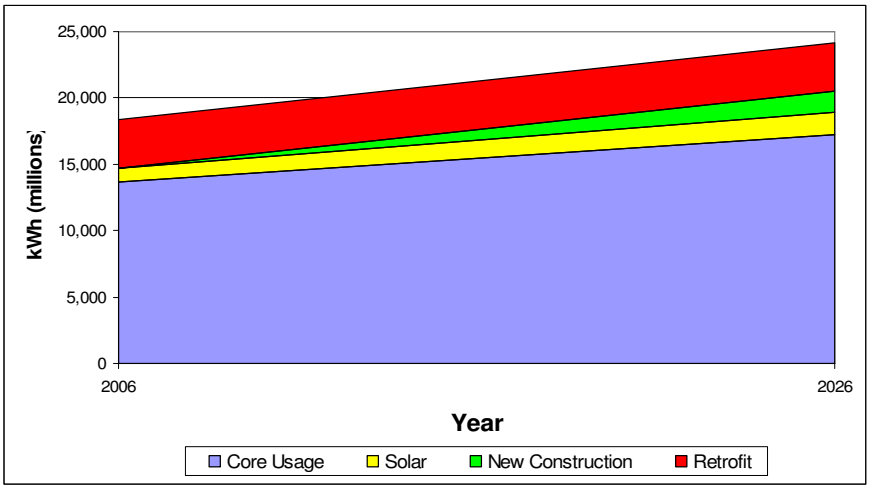


Figure 20. Technical Potential over Planning Horizon

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.

Our list of EEMs and assumptions was developed through an integrated approach that combined an extensive review of industry literature, the detailed analysis of DEC-SC loads described earlier, and our own expert opinion. These assumptions and sources are documented in the appendixes. The assumptions required to calculate EEM cost effectiveness are shown in Table 13 for residential and Table 14 for non-residential. 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 presented in Table 13 and Table 14 are presented below.

End Uses	EEMs are grouped by the end-use they address.
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 per customer site.
Annual Therm Savings (Table 13 only)	Annual therm savings per customer site when EEM involves a technology with dual fuel impacts. Not applicable to non-residential.
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. All costs are in 2006 dollars.
Annual O&M	Annual operation and maintenance 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.

Table 13. DSM Technology Assessment, Residential

End Uses	EEM Description	EEM Reference	Application	Annual kWh Savings	Annual Therm Savings	Incremental Cost (dollars)	Annual O&M (dollars)	Measure Life (years)	Real Levelized Cost ($/kWh)
1. Customer-Sited Generation	Solar Photovoltaic	R-1	All	3,300	0	20,000	10	25	0.4668
2. Residential Space Conditioning	Resist to Seer 13 Heat Pump	R-2	Elec SF	6,000	0	10,000	20	10	0.2273
	Resist to Seer 13 Heat Pump	R-3	Elec MF	4,800	0	10,000	20	10	0.2841
	SEER 8 to Seer 13 CAC	R-4	Gas SF	1,400	0	3,500	20	10	0.3503
	SEER 8 to Seer 13 CAC	R-5	Gas MF	1,200	0	3,500	20	10	0.4086
	Refrig Charge/Duct Tune-Up	R-6	Elec	1,200	0	300	0	5	0.0590
	Refrig Charge/Duct Tune-Up	R-7	Gas	300	47	300	0	5	0.0944
	SEER 13 to Seer 15 Heat Pump	R-8	SF Elec New	800	0	1,000	20	20	0.1320
	SEER 13 to Seer 15 Heat Pump	R-9	MF Elec New	700	0	1,000	20	20	0.1508
	SEER 13 to Seer 15 CAC	R-10	SF Gas New	400	0	800	20	20	0.2211
	SEER 13-Seer 15 CAC	R-11	MFGas New	350	0	800	20	20	0.2527
	Efficient Window AC	R-12	All	200	0	150	10	13	0.1336
	Cool Roofs	R-13	Elec	596	0	158	0	12	0.0312
	EE Windows	R-14	Elec	1,334	0	2,500	0	25	0.1434
	Programmable Thermostats	R-15	Elec	500	0	120	0	10	0.0323
	Ceiling Insulation (R6-R30)	R-16	Elec	1,800	0	750	0	25	0.0319
	Ceiling Insulation (R6-R30)	R-17	Gas	300	100	750	0	25	0.0765
	House Sealing using Blower Door	R-18	Elec	1,000	0	300	0	10	0.0403
	House Sealing using Blower Door	R-19	Gas	200	42	300	0	10	0.0806
	Ground Source Heat Pump	R-20	Elec	3,300	0	7,000	20	25	0.1684
	Wall Insulation (R3-R11)	R-21	Elec	2,100	0	1,400	0	25	0.0510
	Wall Insulation (R3-R11)	R-22	Gas	400	100	1,400	0	25	0.1071
	Solar Siting/Passive Design	R-23	New Elec	1,500	0	500	0	25	0.0255
	Energy Star Manufactured Home	R-24	New	4,632	0	2,600	0	25	0.0430
	Energy Star Construction	R-25	New Elec	3,788	0	2,100	0	25	0.0424
3. Load Management	Eliminate Old Refrigerators	R-26	All	1,150	0	100	0	5	0.0205
	Set Back HVAC	R-27	All	1,000	0	5	0	2	0.0027
4. Residential Appliances	Energy Star Clothes Washers	R-28	All	400	0	400	0	18	0.0908
	Energy Star Dish Washers	R-29	All	75	0	50	0	10	0.0896
	Energy Star Refrigerators	R-30	All	100	0	200	0	18	0.1815
	Pool Pumps	R-31	All	648	0	180	0	10	0.0373
5. Residential Lighting	Compact Fluorescent	R-32	All	800	0	150	0	5	0.0442
	Daylighting Design	R-33	New Elec	750	0	500	0	25	0.0510
	Occupancy Controlled Outdoor	R-34	All	250	0	100	0	10	0.0538
6. Water Heating	Tank Wrap, Pipe Wrap and Water Temp Setpoint	R-35	All	200	0	50	0	10	0.0336
	Low Flow Fixtures	R-36	All	500	0	25	0	10	0.0067
	Heat Pump Water Heaters	R-37	All	2,000	0	2,500	0	18	0.1135
	Tankless Water Heaters	R-38	All	400	0	1,500	0	18	0.3404
	Solar Water Heaters	R-39	All	2,594	0	6,000	20	25	0.1847
	Efficient Plumbing	R-40	New Elec	500	0	500	0	25	0.0765

Note: Dollar amounts are expressed in 2006 dollars.

Table 14. 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)
1. Customer-Sited Generation	Solar Photovoltaic	C-1	44,000	230,000	25	25	0.4006
2. C&I Space Conditioning	Small HVAC Optimization and Repair	C-2	7,000	1,417	50	5	0.0549
	Commissioning - New	C-3	18,535	6,873	0	10	0.0498
	Re/Retro-Commissioning Lite	C-4	18,535	2,000	0	10	0.0145
	Low-e Windows 1500 ft2 New	C-5	14,828	4,500	0	25	0.0232
	Low-e Windows 1500 ft2 Replace	C-6	14,828	30,000	0	25	0.1548
	Premium New HVAC Equipment	C-7	5,561	2,577	250	15	0.0920
	Large HVAC Optimization and Repair	C-8	5,561	1,901	0	5	0.0807
5. Design (new)	Integrated Building Design (new)	C-9	55,606	18,839	0	25	0.0259
	Efficient Package Refrigeration (new)	C-10	18,535	2,748	0	15	0.0150
6. Motors & Drives	Electrically Commutated Motors	C-11	3,707	1,238	0	15	0.0339
	Premium Motors	C-12	3,707	408	0	15	0.0112
	Variable Speed Drives, Controls and Motor Applications Tune-Up	C-13	18,535	15,964	0	15	0.0874
7. Power Distribution	Energy Star Transformers (new)	C-14	927	75	0	18	0.0074
	Efficient AC/DC Power	C-15	2,780	207	0	5	0.0175
8. Data Processing	Network Computer Power Management	C-16	3,707	426	0	2	0.0625
9. Lighting	New Efficient Lighting Equipment	C-17	18,535	4,875	0	18	0.0239
	Retrofit Efficient Lighting Equipment	C-18	18,535	6,094	0	18	0.0298
	LED Exit Signs	C-19	1,470	270	0	10	0.0247
	LED Traffic Lights (10)	C-20	5,000	2,000	0	10	0.0538
	Perimeter Daylighting	C-21	5,561	4,723	0	18	0.0771
10. Water Heating	Low Flow Fixtures	C-22	6,000	1,000	0	10	0.0224
	Solar Water Heaters	C-23	2,500	6,000	20	25	0.1917
	Heat Pump Water Heaters	C-24	2,000	2,500	20	18	0.1235
11. Cooking and Laundry	Energy Star Hot Food Holding Cabinet	C-25	4,100	1,100	0	15	0.0272
	Energy Star Electric Steam Cooker	C-26	2,200	5,000	0	15	0.2305
	Pre-Rinse Spray Wash	C-27	9,268	235	0	15	0.0026
	Restaurant Commissioning Audit	C-28	18,535	1,300	0	5	0.0165
12. Refrigeration	Grocery Refrigeration Tune-Up and Improvements	C-29	18,535	3,513	0	5	0.0447
	Refrigeration Casework Improvements	C-30	9,268	3,058	10	10	0.0454
13. Other	VendingMiser®	C-31	1,000	215	0	10	0.0289

Note: Dollar amounts are expressed in 2006 dollars.

Cost Effectiveness[11]

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.[12] 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 determining economic potential.

Assumptions on average annual savings, installed cost and measure life come from many sources, including the energy modeling work conducted as part of this project using segment-specific billing data for DEC customers.[13] In other words, our annual savings estimates are linked and consistent with the modeled loads reported in the Market Assessment section of this report. Incremental cost for the EEM screening step includes the incremental costs 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 the cost of 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 come at the possible loss of useful measure life. 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 13 and Table 14 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.

[11] 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 in the final report for a discussion of each type of cost effectiveness analysis.

[12] The formula for this calculation is presented in Appendix B. A real discount rate of 5.77 percent was used based on the SC Avoided Cost filing. The total incremental cost of measures with both electric and gas savings has been prorated between the two fuels. When gas savings are involved the total incremental cost is split 40% electric and 60% gas. This leads to levelized gas savings costs ranging from $0.37 to $0.92/therm.

[13] The modeling is described in more detail in Appendix A and EEM assumptions are described in their respective appendixes.

Cost Effectiveness Rankings

The residential and non-residential measures are ranked by cost effectiveness in Table 15 and Table 16, 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.
Annual Savings per Site (kWh)	Annual kWh savings per customer site.
Potential Sites	An estimate of the potential number of customer sites that could have the EEM installed without regard to cost. See appendixes for more information on determining this estimate for each measure.
Potential Annual Savings (MWh)	Total annual energy savings potential in MWh derived by multiplying the annual savings per site by the number of potential sites.

It is apparent in Table 15 that the most cost effective measures are retrofit measures applied to electrically heated residences, and some efficient appliances (notably washers and lighting). Some measures with large technical potential are shown to have relatively high cost (e.g. replacing resistance heat with a heat pump).

Table 15. Ranked Measures, Residential

EEM Reference	EEM Description	Application	Real Levelized Cost ($/kWh)	Annual Savings per Site (kWh)	Potential Sites	Potential Annual Savings (MWh)
R-27	Set Back HVAC	All	0.003	1,000	50,510	50,510
R-36	Low Flow Fixtures	All	0.007	500	304,280	152,140
R-26	Eliminate Old Refrigerators	All	0.021	1,150	121,712	139,969
R-23	Solar Siting/Passive Design	New Elec	0.026	1,500	97,369	146,054
R-13	Cool Roofs	Elec	0.031	596	121,712	72,540
R-16	Ceiling Insulation (R6-R30)	Elec	0.032	1,800	73,027	131,449
R-15	Programmable Thermostats	Elec	0.032	500	89,465	44,732
R-35	Tank Wrap, Pipe Wrap and Water Temp Setpoint	All	0.034	200	152,140	30,428
R-31	Pool Pumps	All	0.037	648	30,428	19,717
R-18	House Sealing using Blower Door	Elec	0.040	1,000	182,568	182,568
R-25	Energy Star Construction	New Elec	0.042	3,788	152,140	576,305
R-24	Energy Star Manufactured Home	New	0.043	4,632	9,128	42,283
R-32	Compact Fluorescent	All	0.044	800	304,280	243,424
R-21	Wall Insulation (R3-R11)	Elec	0.051	2,100	48,685	102,238
R-33	Daylighting Design	New Elec	0.051	750	12,171	9,128
R-34	Occupancy Controlled Outdoor	All	0.054	250	73,027	18,257
R-6	Refrig Charge/Duct Tune-Up	Elec	0.059	1,200	152,140	182,568
R-17	Ceiling Insulation (R6-R30)	Gas	0.077	300	35,786	10,736
R-40	Efficient Plumbing	New Elec	0.077	500	0	0
R-19	House Sealing using Blower Door	Gas	0.081	200	73,027	14,605
R-29	Energy Star Dish Washers	All	0.090	75	156,563	11,742
R-28	Energy Star Clothes Washers	All	0.091	400	225,167	90,067
R-7	Refrig Charge/Duct Tune-Up	Gas	0.094	300	152,140	45,642
R-22	Wall Insulation (R3-R11)	Gas	0.107	400	22,366	8,946
R-37	Heat Pump Water Heaters	All	0.113	2,000	20,130	40,259
R-8	SEER 13 to Seer 15 Heat Pump	SF Elec New	0.132	800	60,856	48,685
R-12	Efficient Window AC	All	0.134	200	111,831	22,366
R-14	EE Windows	Elec	0.143	1,334	22,366	29,841
R-9	SEER 13 to Seer 15 Heat Pump	MF Elec New	0.151	700	60,856	42,599
R-20	Ground Source Heat Pump	Elec	0.168	3,300	8,946	29,523
R-30	Energy Star Refrigerators	All	0.182	100	268,394	26,839
R-39	Solar Water Heaters	All	0.185	2,594	212,996	552,511
R-10	SEER 13 to Seer 15 CAC	SF Gas New	0.221	400	60,856	24,342
R-2	Resist to Seer 13 Heat Pump	Elec SF	0.227	6,000	35,540	213,239
R-11	SEER 13-Seer 15 CAC	MFGas New	0.253	350	60,856	21,300
R-3	Resist to Seer 13 Heat Pump	Elec MF	0.284	4,800	8,946	42,943
R-38	Tankless Water Heaters	All	0.340	400	4,473	1,789
R-4	SEER 8 to Seer 13 CAC	Gas SF	0.350	1,400	85,198	119,278
R-5	SEER 8 to Seer 13 CAC	Gas MF	0.409	1,200	4,473	5,368
R-1	Solar Photovoltaic	All	0.467	3,300	194,739	642,638

Note: Dollar amounts are expressed in 2006 dollars.
* Refrig Charge/Duct Tune-Up refers to HVAC Refrigerant Charge and Duct Tune-Up.
** Resist to SEER 13 Heat Pump refers to replacing an electric resistance furnace with an efficient heat pump.

Another energy saver with poor cost effectiveness is the replacement of poorly performing central air conditioners on a gas heated residence by more efficient ones. This poor cost effectiveness relates to the high initial cost of the equipment, and to the relatively low cooling savings. 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 16 by cost effectiveness. As with residential, measures pertaining to building efficient new stock are generally cost effective. Also, measures associated with tuning and properly maintaining HVAC and refrigeration equipment are generally cost effective.

Lighting, new design and commissioning are both cost effective and large. Another favored category is small HVAC Optimization and Repair; it is also cost effective and large. As in the case of residential, the least cost effective measures are efficient glazing, solar water heat and solar photovoltaic.

Table 16. Ranked Measures, Non-Residential

EEM Reference	EEM Description	Real Levelized Cost ($/kWh)	Annual Savings Per Site (kWh)	Potential Sites	Potential Annual Savings (MWh)
C-27	Pre-Rinse Spray Wash	0.003	9,268	665	6,161
C-14	Energy Star Transformers (new)	0.007	927	511	474
C-12	Premium Motors	0.011	3,707	1,023	3,791
C-4	Re/Retro-Commissioning Lite	0.015	18,535	19,908	368,990
C-10	Efficient Package Refrigeration (new)	0.015	18,535	511	9,478
C-28	Restaurant Commissioning Audit	0.017	18,535	1,074	19,904
C-15	Efficient AC/DC Power	0.018	2,780	5,387	14,977
C-22	Low Flow Fixtures	0.022	6,000	2,342	14,052
C-5	Low-e Windows 1500 ft2 New	0.023	14,828	2,342	34,728
C-17	New Efficient Lighting Equipment	0.024	18,535	1,171	21,705
C-19	LED Exit Signs	0.025	1,470	29,276	43,035
C-9	Integrated Building Design (new)	0.026	55,606	16,394	911,621
C-25	Energy Star Hot Food Holding Cabinet	0.027	4,100	1,171	4,801
C-31	VendingMiser®	0.029	1,000	1,171	1,171
C-18	Retrofit Efficient Lighting Equipment	0.030	18,535	17,306	320,773
C-11	Electrically Commutated Motors	0.034	3,707	4,099	15,194
C-29	Grocery Refrigeration Tune-Up and Improvements	0.045	18,535	1,171	21,705
C-30	Refrigeration Casework Improvements	0.045	9,268	1,023	9,478
C-3	Commissioning - New	0.050	18,535	0	0
C-20	LED Traffic Lights (10)	0.054	5,000	7,026	35,131
C-2	Small HVAC Optimization and Repair	0.055	7,000	16,394	114,761
C-16	Network Computer Power Management	0.063	3,707	4,216	15,628
C-21	Perimeter Daylighting	0.077	5,561	4,684	26,046
C-8	Large HVAC Optimization and Repair	0.081	5,561	9,368	52,093
C-13	Variable Speed Drives, Controls and Motor Applications Tune-Up	0.087	18,535	3,513	65,116
C-7	Premium New HVAC Equipment	0.092	5,561	9,368	52,093
C-24	Heat Pump Water Heaters	0.123	2,000	1,171	2,342
C-6	Low-e Windows 1500 ft2 Replace	0.155	14,828	3,513	52,093
C-23	Solar Water Heaters	0.192	2,500	1,171	2,928
C-26	Energy Star Electric Steam Cooker	0.231	2,200	1,171	2,576
C-1	Solar Photovoltaic	0.401	44,000	11,710	515,253

Note: Dollar amounts are expressed in 2006 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. It is important to note that only incremental cost of measures are included at this stage of analysis.

The DSM supply curve for residential is shown in Figure 21 which shows the cumulative kWh savings from all measures listed in Table 15 with a levelized cost less than the corresponding point on the graph. For example, there are nearly 1.0 billion kWh of annual savings available at a cost $0.04 per kWh or less. Estimated residential economic potential increases to about 2.1 billion kWh annually at a cost of $0.06 per kWh or less.

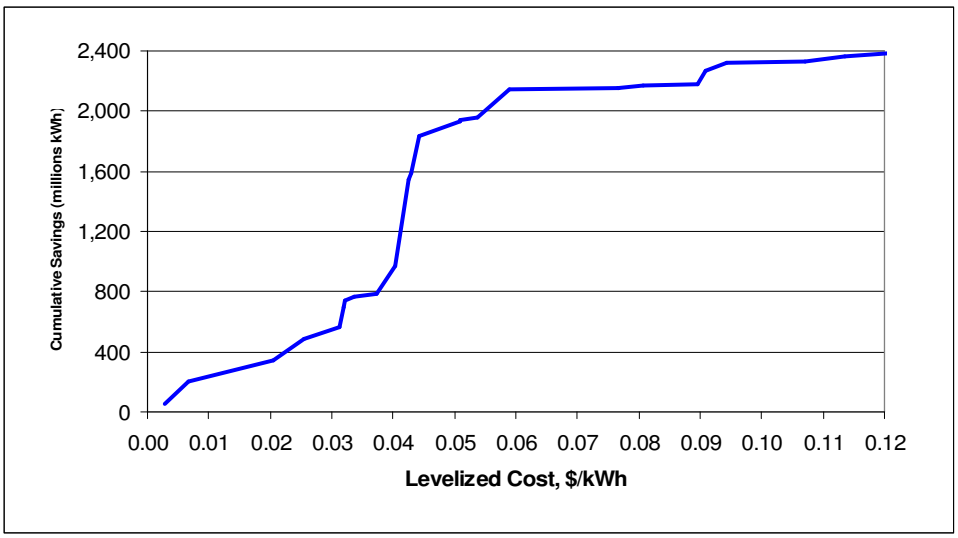


Figure 21. Residential DSM Supply Curve

Since Figure 21 is constructed from the information in Table 15, it is possible to see exactly which measures are responsible for changes along the DSM supply curve. If marginal supply costs increase from $0.04 to $0.05 per kWh, for example, we would pick up about 1.0 billion kWh annually with efficient new construction and compact fluorescents responsible for most of the increase. DEC's marginal cost of avoided supply depends on the load shape and longevity of savings.[14] Using $0.06 per kWh as an approximate marginal cost of supply, residential economic potential is estimated at 2.1 billion kWh annually.

The DSM supply curve for non-residential is shown in Figure 22 and, like residential, represents an alternate format for the information in Table 16.

[14] Marginal cost of supply vary 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 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.

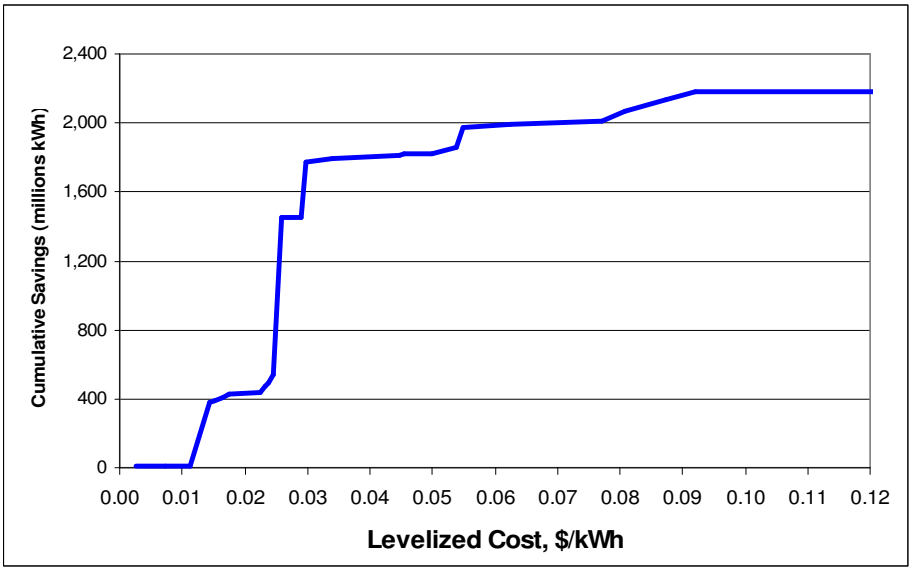


Figure 22. Non-Residential DSM Supply Curve

Figure 22 shows that most of the non-residential efficiency savings are available at levelized costs of less than $0.06 per kWh. One characteristic of the non-residential DSM supply curve is the relatively large amount of energy savings available at less than $0.04 per kWh, excluding administration and program costs. Using an approximate marginal cost of supply of $0.06, we estimate annual economic potential in the non-residential sector to be approximately 2.0 billion kWh.

Both the residential and non-residential DSM supply curves show a diminishing return as the levelized cost rises above $.10 per kWh. Over half of the full technical potential is available at levelized costs of less than $0.06 per kWh. Our estimate of total economic potential in both segments is 4.1 billion kWh annually.

Further perspective on the residential and non-residential savings is developed by classifying the technologies by type of measure and cost as shown in Figure 23 and Figure 24. Figure 23 shows that about half of the residential savings costing less than $0.06/kWh are associated with efficient new construction and appliances (efficient lighting). The other half is associated with site modifications such as efficient showerheads and ceiling insulation. The more expensive savings predominantly involve the more comprehensive site modifications, such as, wall insulation and higher efficiency heat pumps and central air conditioners. In Figure 23 the savings noted as Life Style consist of voluntary usage reductions, including thermostat set back and elimination of old or second refrigerators.

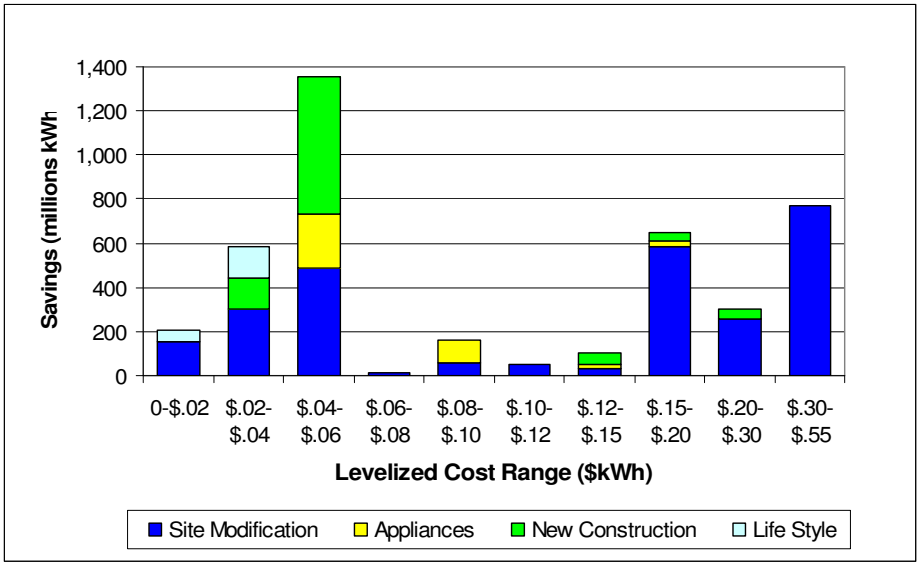


Figure 23. Residential Savings by Type and Cost

On the other hand, in Figure 24, note that most of the non-residential savings costing less than $0.06 are associated with site modifications, principally more efficient lighting and improved HVAC maintenance and new construction. Non-residential site modifications consist of retrofit lighting and HVAC maintenance which require a higher level of site effort than residential site modifications.

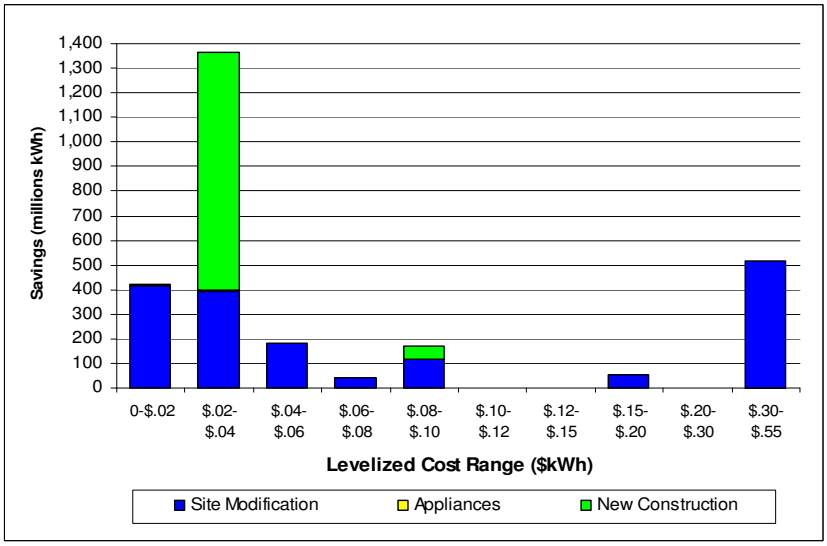


Figure 24. Non-Residential Savings by Type and Cost

DSM PROGRAMS

The DSM program plans in this section of the report cover all sectors, with the perspective that all customers should have an opportunity to participate in energy efficiency programs. Today, nearly all DSM programs are associated with program vendor organizations that maintain the institutional and organizational linkages and relationships that make the programs viable and keep them current. Nearly all of the programs are designed to be vendor driven.

Duke Energy and the Collaborative will need to select programs to file for Commission approval. For virtually all programs approved, Duke Energy will need to develop a scope of work and issue a RFP to the program vendor community to elicit proposals from which a vender may be selected. DSM programs are managed with a small internal staff responsible for vendors who do most of the work to implement the program, develop relationships essential to increasing customer participation, carry out day-to-day program operations, and the work of data entry for tracking system. Although program vendors are employed to bring forward a full program package for implementation, lines of accountability are clear.

The programs were designed to capture the most cost-effective opportunities from the EEMs identified earlier in this report.[15] Development of DSM program plans involves combining the technological elements of the EEMs, program-by-program, with practical program implementation concerns. Program evaluation is also taken into account. All of these elements come together in the DSM program plans. Once preliminary program plans were in place, they were analyzed for their cost effectiveness using DSMore, and also using a simpler method as a check. Cost effectiveness results are presented for all of the programs in the following section of the report.

Each of the program plans presented in this section contains information on program design, participation, expected savings, and implementation budget. This information is organized as follows:

- Description of program design including measures and incentives. This description leads off each program plan.
- Rationale for the program. This is a very brief description of the logic of the program.
- Participation and expected energy savings. This provides a five year overview of number of participants and expected energy savings (annual kWh savings and kW reductions).
- Marketing Plans. A brief description of suggested marketing efforts specific to the program.
- Detailed Budget Plans. Annual program implementation budgets for five years.
- In addition to the specific plans for each program, it is recommended to have a general marketing and promotional effort to support DSM and to help customers become aware of the programs.

Note, that in some of the program descriptions, organizational or product names are given. These are not recommendations of specific groups or brands, but are included as links for developing further information.

[15] Mapping of EEMs into DSM Programs is shown at the beginning of the residential and non-residential EEM documentation, Appendix C and D, respectively

Table 17. Program Recommendations

No.	Program Name	Sectors	Recommended
Multi-Sector Programs			
1	Key Accounts Custom	Large Agricultural, Large Industrial, Large Commercial, Large Institutional	Yes
2	Load Control	Limited Residential, Large Agricultural, Large Industrial, Large Commercial, Large Institutional	Yes - Pending Internal Study
3	Prescriptive	Agricultural, Industrial, Commercial, Institutional, Small Hotel/Motel, Non-Profit, Schools	Yes
Non-Residential Programs			
4	C&I Retro-Commissioning Lite Pilot	Commercial, Institutional	Yes - Pilot
5	New Commercial Construction	Commercial, Institutional	Yes
Residential Programs			
6	Residential Energy Assessment	All Residential	Yes
7	Energy Star Appliances and Lighting	All Residential	Yes
8	Residential HVAC Program	Central Air and Heat Pump	No
9	Solar Heated Domestic Hot Water	Select Residential	No
10	Energy Star Plus	New Homes	Yes
11	Manufactured Homes	Manufactured Homes	Yes
12	On-Site Audit with Direct Install	Single Family to 4-Plex with electric heat and electric hot water	Yes
13	Old Refrigerator Pick-Up and Recycling	Homes with second refrigerators or freezers	Yes
14	Residential Weatherization	Homes with electric heat and electric hot water, income at or below 80% of state median income	Yes
15	Energy Star Cool Roofs	Homes with central air conditioner or heat pump that are being re-roofed	Yes

Programs developed but not recommended (see Table 17, last column) do not meet the requirements of the Total Resource Cost test, which is used in screening programs. Cost effectiveness results follow in the next section of the report.

Multi-Sector Programs

Program 1. Key Accounts Custom Program

This program targets only the largest customers in the following non-residential customer segments: Industrial accounts, Commercial and Institutional accounts, Agricultural accounts, and Hospitals (and related medical facilities). One way to characterize the very largest utility customers is that they will have a Duke Energy officer either as their account representative, or otherwise assigned to the account.

The program is a totally custom program, designed to develop exceptionally productive energy savings opportunities in cooperation with the customer. Because we expect high savings returns from these investments in large scale facilities and processes, the incentive will be 50 percent of incremental cost. Through account representatives, Duke Energy will discuss this program with key accounts. The number of projects each year is limited to four, however the scale may be large and the returns are expected to be high.

Once a project begins to be defined, a company executive and either a Duke Energy engineer or an engineering contractor will meet with a customer executive and customer engineer to fully define the project, plan for implementation, and plan for a level of evaluation that will meet the expectations of the customer's executive management and also satisfy Duke Energy's regulatory requirements for defensible evaluation.

It is expected that projects will be carried out in narrow time windows specific to the customer's operations and that evaluation will consist primarily of short term instrumentation and spot metering. The evaluator will be a Duke Energy or contract engineer. Typically, large industry and other large-scale business organizations have their own energy efficiency engineering group, often integrated with the energy procurement function. By defining custom projects from both a customer engineering and Duke Energy engineering perspectives, new projects will have zero free-ridership, and meet (with the Duke Energy incentive) the hurdle rate for new projects within the customer company, moving DSM projects forward in the internal competition for funding. The internal rate used for project decisions by large customers will generally be proprietary information, and specific to each company. Duke Energy will individually test each proposed custom project for cost-effectiveness with the California tests to insure a reasonable projection of cost-effective conservation for each project.

Table 18. Measures and Incentives – Key Accounts Custom

Measure	Incentive Amount
Custom Program – Designed to meet a selected cost-benefit ratio.	50% of cost of study to develop project proposal and 50% of Energy Efficiency Improvements

Rationale

Large industry and other large business organizations typically have internal energy efficiency engineers and a central department to hand projects related to energy efficiency and power procurement. However, internal DSM projects typically receive low priority and compete for funding with all other potential business projects. By

providing the assurance of a project co-developed with Duke Energy and with the assistance of the "buy down" incorporated in Duke Energy's 50 percent cost share, DSM will be selected.

Participation

Because of the custom nature of the project, it is expected that there will be no more than four projects per year.

Table 19. Estimated Participation and Savings – Key Accounts Custom

Potential participants				140
Per participant savings (kWh):				1,200,000
Per participant savings (kW):				81.9
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	4	2.9%	4,800,000	328
Year 2	4	2.9%	4,800,000	328
Year 3	4	2.9%	4,800,000	328
Year 4	4	2.9%	4,800,000	328
Year 5	4	2.9%	4,800,000	328
Cumulative	20	14.3%	24,000,000	1,638

Marketing Plans

This program is in every respect a custom program. Contacts with key customers will be at an executive level or sponsored at an executive level. The projects will be carefully developed and required to meet a cost-effectiveness test. It is expected that these will be high return projects in terms of savings achieved.

Data Concerns

For each project, data requirements will be carefully defined to insure documentation of energy savings. Generally, due to the complexity of large accounts and of large scale facilities and processes, utility billing meter information is capable of the level of detail required to assess program impacts. For this reason, data requirements are simple. The program manager should collect, at a minimum, information about all customer electrical equipment, hours of operation, etc. It is expected that evaluations will take the form of short term instrumentation and spot metering with engineering review.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to Duke Energy for offering this program to customers involves budgets for:

- Duke Energy administrative costs to develop, advertise, oversee and monitor the program.
- A customer incentive of 50 percent to defray the cost and energy study and improvements.

Costs to participating customers include the remainder of energy study cost to develop project proposals, provision for staff involvement in developing and monitoring the project, and the remainder of equipment costs.

Table 20. Estimated Five-Year Program Budget – Key Accounts Custom

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & other annual cost		$140,000	$100,000	$100,000	$100,000	$100,000	$540,000	14%
DSM Staffing		$22,000	$22,000	$22,000	$22,000	$22,000	$110,000	3%
Program monitoring and evaluation		$120,000	$120,000	$120,000	$120,000	$120,000	$600,000	16%
Variable Program Costs								
Incentives	$125,000	$500,000	$500,000	$500,000	$500,000	$500,000	$2,500,000	67%
Delivery and othber	$0	$0	$0	$0	$0	$0	$0	0%
Total Budget		$782,000	$742,000	$742,000	$742,000	$742,000	$3,750,000	100%

Program 2. Load Control Program

Duke Energy has existing peak load programs. Current DEC programs include:

- Load Control (LC)
- Interruptible Service (IS)
- Standby Generation (SG)

The Load Control and Standby Generation programs are currently open to new customers. Interruptible service is currently closed to new customers but existing customers continue on the rate.

The Load Control program is open to residential and commercial customers and is available for central air conditioners, heat pumps, and water heaters. Standby Generation is targeted to large Commercial and Industrial customers.[16] Each of the programs currently open (Load Control and Standby Generation) are structured so that participating customers receive an annual incentive fee. Standby Generation also pays an event incentive to help offset customers' fuel costs for self-generation when a load event is called.[17] The Load Control program is available for central air conditioners, heat pumps and water heaters.

The Load Control program is a dispatch program. In a dispatch program, a switch can be engaged to send a signal which directly reduces load. The Standby Generation approach requires contact with other industries to cut load when an event is called.

With the advent of active ISOs in some regions of the country, load programs in some cases have shifted from the utilities to the ISO. With deregulation, ISO programs have monetized the value of load reduction at peak times and payments are made for high value to entities that can provide load reductions to the system when load events are called. In the Northeast, payments are also made for the kW reduction associated with traditional DSM programs, following certification of the load effects.

Since Duke Energy is an integrated utility, it is appropriate that the utility is the entity that calls load events and organizes both direct load control and sponsors load cooperatives. It is possible to use sophisticated vendorized systems. For example, as an alternative to both direct load control and cooperatives, some vendors offer computerized systems that permit enrolled customers to curtail their load based on a price determined by the utility, or by countering with an offer of their own. Such vendor systems take care of billing and verification and send reports and invoices to the utility.

Load control programs are an excellent tool to support system reliability, avoid unnecessary cost to both the utility and to customers during times when capacity is short and capacity cost is escalating, manage risk, and provide for economic dispatch. Load control programs can support system efficiency by providing price signals that customers may respond to, either by arrangement in advance or on a real time basis depending on program design. Load control programs are an important customer service, so that customers can help manage peak loads.

[16] Interruptible rates are also targeted to large commercial and industrial customers, though the rates are currently closed to new customers.
[17] Load Control and Interruptible Service are under review by the Company.

In addition to direct load control and standby-generation (the current standby-generation program is a type of curtailable load program), there are several other load control options including, time-of-use rates, interruptible rates, real time pricing, and demand bidding or buyback programs.

Our recommendations are (1) to continue and expand some form of direct load control based on the current program and (2) to develop an energy cooperative as a replacement that would include the functions of the current standby generation program. (3) Additionally, a pricing program using call options might be considered.

Direct Load Control - So long as Duke Energy's direct load control program sufficiently contributes to the need for direct load control developed in the utility's planning function, it remains a superior approach because it offers low cost to the company and is a company controllable economic dispatch program. Direct load control currently covers central air conditioners, heat pumps, and water heaters. It could be extended to swimming pool pumps. DEC should continue to maintain and build the current direct load control program, in a form that is congruent with its policy needs with the goal of increasing its impact over five years.

Curtailable Load - The Standby Generation approach is an historical form of a curtailable load program. Two more highly developed curtailable load programs are Energy Cooperatives and pricing programs that operate using a market form with call options.

We recommend development of a vibrant and reliable traditional Energy Cooperative. Using an Energy Cooperative, when a load event is called, the third-party office of the Cooperative is phoned and asked to curtail load in a given increment. The Cooperative then activates its internal arrangements to supply the load reduction. Generally an Energy Cooperative is a vendorized program, using a special contractor to put the mechanisms for a cooperative in place and build the necessary relationships to grow and sustain the cooperative.[18] While in many cases this will engage standby generation, in others some companies may temporarily suspend production and otherwise curtail load. Part of the value of an Energy Cooperative is that it finds many ways of reducing load. About 20 percent of what is paid to an Energy Cooperative covers overheads, profit, and development. The remaining 80 percent is paid to members. The necessary third-party staff to set up and run an energy cooperative is small, usually an Executive Director who will engage industry, hospital, commercial and institutional executives in setting up the cooperative, and one seasoned technical person to manage it on an ongoing basis.

The specific type of energy cooperative we recommend is the traditional model developed by John Philips and the California Energy Coalition. This model has worked well for other utilities such as Boston Edison. Also, the Pacific Gas & Electric Company's Business Energy Coalition Program (BEC), a current program using the Phillips' model, and made up of more than 30 San Francisco businesses, the utility, and the California Energy Coalition won the Peak Load Management Association (PLMA) Innovative Program Design Award for 2005. Features of the approach cited in the award were implementing a cooperative approach which encourages participation from a customer sector that ordinarily finds demand response programs not conducive to their

[18] The California Energy Cooperative has provided this service for utilities across the US.

business, operation needs, creating an opportunity for businesses, and utility interests to work together towards a common goal, and providing a comprehensive strategy of energy analysis, metering and monitoring tools, along with employee education to help ensure successful results. Additional advantages of the energy cooperative approach is that it minimizes the risk for individual companies (participants) and maximizes reliability for the utility by allowing members of the partnership to reduce power when others cannot, and that utility staff do not have to continually work to maintain relationships and keep everything functional – the energy cooperative executive does that. A further strength of this approach is that it is based on a community model of "pulling together" and so is very compatible in extreme situations in which utilities, business, government, and residential customer face repeated load events, as occurred a few years ago in California. An energy cooperative also helps to minimize the burden of utility staff through the use of directly accountable vendors.

In the area of curtailable load programs, additionally DEC should consider a market-based pricing program in which large customers can contract for callable load reductions of certain size based on a customer selected strike price which they can pre-select. When day-ahead prices are projected to be greater than strike prices, DEC would have the contract option to call the load decrements. In exchange for participation, large customers would receive two types of payment. First, a participation premium which is received for signing on to the program. Second, a dollar credit whenever their load decrement is called during a load event. This type of program also has a penalty for failing to respond to a call which is the market price that has to be paid by DEC to cover the failure to respond (subject to a reasonable cap). Such programs can have high market participation, however, they are probably better suited to single event emergency situations rather than to economic management of load, or to situations as in California a few years ago when cost per MW increased exponentially during load events and the load events became increasingly frequent. Still, it is a good tool with a limited range of benefit.

We believe these recommendations (expand direct load control in a form that is congruent with company policy, build a vibrant energy cooperative, and develop a market based pricing plan with call options) will preserve value for DEC while developing effective load control tools. We recommend that the utility continue as the agent which structures the load control function and that systems in which payment is similar to actual avoided spot market prices are probably not in the interest of the general customer or the utility. Determining the price to be paid for these facilities is an internal policy question. Similarly, the size of the Load Control effort and the Energy Cooperative can only be determined by an internal policy study. For this reason, we do not offer more specific program recommendations in the load control area.

Rationale

Load (KW) constraints are one of the most costly events a utility encounters. During peak times when there is a problem with the system, cost per kW can escalate exponentially. For this reason load control is essential to control costs and insure service.

Marketing Plans

- Proposed marketing efforts are to include mention of the program in any DEC-SC communications with customers regarding energy efficiency program options such as bill inserts, media coverage of how to manage summer electric bills, customer service representatives, and seasonal promotion on DEC-SC website.
- For the Energy Cooperative, Duke Energy should contract with a program vendor and the vendor will implement a packaged approach to set up and maintain the cooperative.
- The commercial program can involve key customer account managers to interact with current and former participants regarding the benefits of the program.

Data Concerns

Both direct load control and energy cooperative approaches are data intensive, and load management data is precise. When load events are called either for capacity shortages or as tests, the systems self-validate.

Program 3. Prescriptive Program

This program targets groups of non-residential customers eligible for prescriptive measures. There are five separate delivery channels: agricultural and industrial, commercial and institutional, small motels and restaurants, non-profit agencies, and schools.[19] Duke Energy will insure funding for each delivery channel by reserving target funding for each of the delivery channels within the Prescriptive Program. There is a common set of measures (see table below), but the delivery channels have different promotional approaches and different incentive levels.

Measures

Measures for the Prescriptive Program are shown in the table below.

Table 21. Measures – Prescriptive Program

Measures
Lighting Measures
Motors/Drives/Pumps
Variable Speed Drives
Controls (Energy Management Systems)
HVAC System Optimization
New Efficient HVAC
Refrigeration Efficiency
Efficient Vending Machines

Participation

As shown, below, the prescriptive program begins with a relatively small number of participants in Year 1, and then ramps through Year 5.[20]

Table 22. Estimated Participation and Savings – Prescriptive Program

Potential Participants				57,600
Per participant Savings (kWh):				27,138
Per Participant Savings (kW):				5.3
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	184	0.3%	4,993,392	967
Year 2	298	0.5%	8,087,124	1,567
Year 3	508	0.9%	13,786,104	2,671
Year 4	787	1.4%	21,357,606	4,138
Year 5	871	1.5%	23,637,198	4,579
Cumulative	2,648	4.6%	71,861,424	13,922

Industrial and Agricultural Delivery Channel

This channel will facilitate energy efficiency measure installation in industrial facilities through incentives. Duke will not provide direct technical services, but will maintain a list of qualified ESCOs that can provide those

[19] While the focus of this program is prescriptive, Duke Energy should request staff and contractors be alert to the presence of any special ad hoc or custom opportunities observed during site visits, and provide flexibility to consider such opportunities when determined to be cost-effective.

[20] The table includes all prescriptive program delivery channels.

services, and make that list available to interested customers. The model is taken from NYSERDA (Commercial/Industrial Performance), as well National Grid and Pacific Gas & Electric.

Rationale - Industrial & Agricultural

Industrial customers account for 39 percent of Duke's demand in South Carolina. While some of the larger industrial customers, such as the tobacco manufacturing facilities, are likely to qualify for the Key Accounts Custom Program, Duke serves an additional 3,600 plus South Carolina manufacturing customers that would be covered by this delivery channel.

This channel addresses multiple barriers associated with installing more efficient products, the most important of which is the first cost barrier. Many customers have concerns about the high first cost associated with some of the larger energy efficiency investments (e.g., HVAC systems, energy management systems, etc.), as well as about system performance. Since processes are at the heart of any industry, many industrial customers are wary of changing what they consider to be proven technologies for something with which they are not as familiar. Duke's proposed incentives will help remove that barrier. The proposed incentive for the Industrial and Agricultural delivery channel is 25 percent of measure cost.

Some industrial customers may need technical assistance to determine what equipment is appropriate for their facilities. Duke will help address that problem by pre-qualifying ESCOs and then making the list of pre-qualified ESCOs available to interested customers. The model for this approach is NYSERDA's EnergySmartSM Commercial/Industrial Performance Program (CIPP), which is implemented entirely by ESCOs. Since the program started in 2004, the number of qualifying ESCOs in New York State has increased exponentially, thus facilitating program implementation. ESCO involvement will provide customers with technical expertise to determine what equipment is most appropriate for them, as well as energy savings monitoring.

Participation – Industrial and Agricultural

Because it will take some time to put this delivery channel in place and to reach the targeted customers, we estimate that participation in the first year will be fairly low, and expect that many of the first year participants are likely to be locally-owned businesses with more flexibility in their decision making. Larger businesses tend to have a longer-term planning horizon, so it will take at least a year, and probably two, for these targeted customers to plan their participation. Thus the participation rates grow more rapidly in years 3, 4, and 5, a pattern that is typical in the history of industrial programs across the US. Participation is projected at 19 customers in Year 1, 19 in Year 2, followed by 38, 57, and 95 for a total of 228.

Participation numbers are based on a conversation with Neal Elliot of ACEEE. While we had initially planned to base participation numbers on NYSERDA's EnergySmartSM CIPP participation numbers, we have learned that the US industrial sector as a whole is moving into a period of reduced capital investment. The trend has been sparked by market instability, and is leading industries to invest only in those measures that have a four to six month

payback period. Smaller manufacturers are showing reluctance to increase manufacturing capacity because of off-shoring concerns, and there is a real hesitance on industry's part to make any capital investments. The issue is not access to capital, since companies with a strong economic position have ready access to funds. But their reluctance to invest in the face of economic uncertainty may mean that even utility incentives will not get industrial customers to invest in energy efficiency measures at this point in time. ACEEE estimates that this slow down could last up to 36 months.

Savings estimates are based on an average of 8 percent savings across all the manufacturing sectors with energy use under 3500 MWh per year. According to Neal Elliot of ACEEE, the Industrial Assessment Center industrial database average shows between 8 percent and 12 percent as the national average savings per industrial facility participating in the documented energy efficiency programs. Duke may not achieve the projected savings in Years 1 or 2 because we do not anticipate the channel will draw the larger customers during that period. We do expect Duke to achieve the full projected savings by the end of the five year.

Marketing Plans - Industrial and Agricultural

Duke will need to advertise this channel during its initial stages, and also will need to actively recruit ESCOs to work in its service territory. We recommend some general advertising within the industrial and agricultural communities, primarily in the form of brochures and mailings targeted to potential participants. Duke also should work directly with trade associations throughout its service territory, and contact its larger customers through Key Account representatives. The budget below provides for some general advertising at business events, as well as brochures and premiums. We expect Duke will also hold several events throughout its service territory at which it can "kick-off" the channel effort.

Data Concerns - Industrial and Agricultural

The program manager should collect, at a minimum, information about all customer electrical equipment, hours of operation, etc.

Commercial and Institutional Delivery Channel

The Commercial & Institutional channel targets all commercial and institutional customers. This channel will facilitate energy efficiency measure installation in commercial and institutional facilities through incentives. Duke will not provide direct technical services, but will maintain a list of qualified ESCOs that can provide those services, and make that list available to interested customers. The channel is modeled after NYSERDA's popular Commercial/Industrial Performance Program, and similar efforts by National Grid and Nevada Power.

Rationale - Commercial and Institutional

Commercial and institutional customers account for 25 percent of Duke's demand in South Carolina. The channel offers incentives for the entire commercial and institutional customer population, from small commercial facilities up to large office buildings, schools, and hospitals.

This channel overcomes multiple barriers associated with installation of more efficient products, the most important of which is the first cost barrier. Many customers have concerns about the high first cost associated with some of the larger energy efficiency investments (e.g., HVAC systems, energy management systems, etc.). Duke's proposed incentives will help remove that barrier.

Larger customers may also need technical assistance to determine what equipment is appropriate for their facilities. Duke will help address that problem by pre-qualifying ESCOs and then making the list of pre-qualified ESCOs available to interested customers. NYSERDA's EnergySmartSM Commercial/Industrial Performance Program (CIPP) is implemented entirely by ESCOs. Since the program started in 2004, the number of qualifying ESCOs in New York State has increased exponentially, thus facilitating program implementation. ESCO involvement will provide customers with technical expertise to determine what equipment is most appropriate for them, as well as energy savings monitoring.

Participation – Commercial and Institutional

Because it will take some time to put the program in place and to reach the targeted customers, we estimate that participation in the first year will be fairly low, and expect that many of the first year participants are likely to be smaller businesses with more flexibility in their decision making. Larger businesses and institutions tend to have a longer-term planning horizon, and thus it will take at least a year for these targeted customers to plan their participation. Thus the participation rates grow more rapidly in years 3, 4, and 5. The participation target is set for 110 in Year 1, 210 in Year 2, followed by 401, 623, and 664 for a total of 2,008.

Marketing Plans – Commercial and Institutional

Duke will need to advertise this program during its initial stages, and also will need to actively recruit ESCOs to work in its service territory. We recommend some general advertising within the business community, primarily in the form of brochures and mailings targeted to potential program participants. Duke also should work directly with business associations throughout its service territory, and contact its larger customers through Key Account representatives. The budget below provides for some general advertising at business events, as well as brochures and premiums. We expect Duke will also hold several events throughout its service territory at which it can "kick-off" the program. The proposed incentive for the Commercial and Institutional delivery channel is 25 percent of measure cost.

Data Concerns – Commercial and Institutional

The program manager should collect, at a minimum, information about all customer electrical equipment, hours of operation, etc.

Controls, Lights and Signs Delivery Channel

The target participants for this delivery channel of the prescriptive program include lodging and restaurants. The prescriptive measures installed are AC controllers, occupancy sensors, in-room programmable thermostats, energy

saving lighting, VendingMiser®, and LED exit signs. Incentives will cover 90 percent of measures plus installation. This delivery channel is designed as a rebate program with no technical assistance component. Note that programmable themostats are included in this delivery channel since staff can check them every day to insure they are properly set.

This delivery channel is modeled after "Nevada Power Cool Controls Plus." At Nevada Power, systems controllers and occupancy sensors are fully rebated. Also, for vending misers, lighting, and LED exit signs, the rebate is 90 percent and the customer pays 10 percent of the cost of the measure and installation.[21]

Rationale – Controls, Lights & Signs

For motel and small hotel, as well as many restaurants, the person is charge is usually the owner. In these markets, there is typically no energy efficiency manager, but simply a business manager or owner/manager who focuses on the business. Investment resources are typically difficult and already committed to other aspects of the business. There is general recognition of the value of energy efficiency, but a lack of resources to follow through. Often, but not always, the building stock is older and contains few, if any, energy efficiency measures. This delivery channel helps customers overcome the cost barrier. The Year 1 participation target for this delivery channel is 38, Year 2 is 38, Year 3 is 38, Year 4 is 76, and Year 5 is 76, for a total of 266.

Participation – Controls, Lights and Signs

Potential participants come from the number of restaurants and lodging sites.[22]

Marketing Plans – Controls, Lights & Signs

Proposed marketing efforts include direct mail and company website presence that is targeted towards motels and small hotels. The marketing materials should include informational pieces which describe the measures, their savings, their costs, and focus on the features and benefits of each measure to the motel or hotel owner.

Data Concerns – Controls, Lights & Signs

The program manager should collect, at a minimum, information about all customer electrical equipment, hours of operation, etc.

Non-Profits Delivery Channel

This delivery channel assists 501(c)3 non-profit organizations located within the Duke Energy South Carolina service area with energy efficient retrofit projects. The grant money must be used to fund energy-efficient retrofits and/or weatherization projects in 501(c)3 residential, office and warehouse facilities. The process is as follows:

- Invitations to submit grants requests are mailed to the non-profit organizations in the first quarter with grants awarded in May.

[21] See Cool Controls Plus June 2006, Pp. A-121 to A-123 in Nevada Power Company 2006 Integrated Resource Plan (2007-2026), Volume 5, Demand Side Plan.

[22] InfoUSA data for DEC-SC territory. Forefront Economics estimate of square footage based on employment and employment density by NAICS.

- Organizations obtain bids for energy efficiency improvement
- Non-Profit Agencies submit grant requests
- Grant requests are reviewed and awarded based on kWh savings and dollars available
- Projects are implemented
- Non Profit Agencies notify Duke when project is complete
- Pre- and post-meter readings are collected and analyzed to develop initial energy savings
- Sites are inspected to see that the measures are installed as claimed

Projects requirements include detailed documentation on what is actually installed be provided by applicants. The information required will vary depending on the project. The documentation will provide the information to calculation project savings. Duke Energy will provide technical support to assist the non-profit organizations to assemble the required information.

The measures for the Non-Profit Agency Grants Delivery Channel are the same as for the Commercial and Institutional Delivery Channel plus weatherization measures. However, for the non-profit agencies, Duke Energy will provide 75 percent of cost for approved measures in approved projects.

Measurement and Verification (M&V) activities will be conducted to verify the installation and proper operation of energy efficiency construction methods and quantify energy savings achieved through the project. Grant applications will be evaluated on an individual basis. Verification will be conducted both onsite and by a web portal. Onsite surveys and verifications will be conducted at Non-Profit Agency sites.

Rationale – Non Profits

Many non-profit organizations work with limited budgets and rely on private donations and grants to provide their services. In addition, non-profit organizations often occupy older buildings due to the reduced cost to own or lease. Often these buildings have significant energy deficiencies. Non-profit organizations can be greatly impacted by increases in energy costs, and their limited resources may only cover routine and emergency maintenance, without consideration for long-term energy reduction. This project assists in identifying areas where the non-profit organization may incorporate energy savings equipment and construction methods into their building plans to reduce energy costs.

This program will target non-profit organizations in South Carolina within Duke's service territory.

Participation – Non Profits

There were 18,500 501(c)3 public charities and private foundations in South Carolina in 2006.[23] The delivery channel will begin with a small number of grants in the first year as the program is organized, staffed, assembled and introduced. The Year 1 target for this delivery channel is 12, followed by 21 per year for each of the following four years, for a total of 96.

[23] National Center for Charitable Statistics (http://nccsdataweb.urban.org/PubApps/profile1.php?state=SC).

Marketing Plans – Non Profits

During the first quarter of each year, letters will be mailed to many non-profit agencies announcing the project and inviting applications. Technical support and energy efficiency information will be made available for existing facilities by the program vendor as directed by Duke Energy. Energy consultants will visit the non-profit agencies that request an improvement grant and suggest improvements they may wish to submit in their grant request. Projected savings will be in the form of an estimated kWh or percentage savings. A post-construction inspection will be conducted upon completion of the improvements.

Schools Delivery Channel

The Schools Delivery Channel is similar to the Commercial and Institutional Delivery Channel, but tailored to serve schools in South Carolina. Its special feature is the development of a utility-wide performance contract vehicle (throughout the Duke territory in South Carolina). The Schools Delivery Channel will function as follows:

- Duke Energy will work with school districts to develop a list of electric energy efficient measures that will be attractive enough for ESCOs to pursue.
- An RFP will be developed, including selection criteria.
- ESCOS will be interviewed and terms and conditions negotiated, including interest rates, margins, M&V protocols, etc.
- There will be documentation of the open and fair selection process that leads to selection of one ESCO.
- The availability of the new contract vehicle to all school districts will be promoted.
- Performance of the ESCO will be monitored. So that Duke is not in the position of judging ESCO performance, a system will be used similar to that provided by Amazon.com in which school districts each rate the ESCO on specific aspects of its performance, and provide a continuously updated "scorecard" showing how the ESCO has been performing.
- M&V requirements will be sufficient to document energy savings and demand reductions.

The performance contracting vehicle will allow school districts—especially small/rural districts with limited size and purchasing power—to "ride" the contract any year for specific energy efficiency projects.

The measures included in the schools delivery channel are the same set as for the Commercial and Institutional delivery channel, though specific measures will be tailored for each job. Electrical energy efficiency measures in schools typically include: T-12 to T-8 (and sometimes T-5) conversions; high-efficiency cooling equipment; roofing insulation; new control systems; and low-cost, no-cost improvements resulting from Building Optimization Assessments (BOAs).

Rationale – Schools Delivery Channel

Schools have a particularly difficult time setting aside funds for energy efficiency upgrades and carrying through on energy efficiency plans. The Schools Delivery Channel is structured to assist in overcoming these barriers, by facilitating a single contract ESCO approach.

Participation – Schools Delivery Channel

Because it will take some time to put the program in place, particularly since schools and school districts are hierarchical organizations and their participation will require approval at several levels, we estimate that

participation in the program's first year will be fairly low. Participation is targeted at 5 schools in Year 1, followed by 10 schools each in Years 2-4, and 15 schools in Year 5 for a total of 50 school buildings in all. In South Carolina, public school districts function at the county level, and in some cases at a city level.[24]

Marketing Plans – Schools Delivery Channel

Duke will need to work with schools, school districts, and higher authorities to develop this program. Duke will also need to work to actively recruit ESCOs to take part in the competition for the single contractor.

The basic concept for the program will be addressed in the development of a memorandum of understanding between Duke Energy and the schools administration. We will develop a technical description and a promotional brochure for circulation to individual school districts and schools.

Incentive is planned for the schools delivery channel at 25 to 100 percent of audit/planning studies, though the intent is to involve the ESCO in covering some of these costs, plus 25 percent of measure cost.

Data Concerns – Schools Delivery Channel

The program manager should collect, at a minimum, information about all customer electrical equipment, hours of operation, etc.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to Duke Energy for offering this program to customers involves budgets for:

- Duke Energy administrative costs to develop, advertise, oversee and monitor the program.
- A customer incentive to defray the cost of an energy audit for those customers, although the primary strategy will be for ESCO development of audits.
- Incentives for installing energy efficient equipment.

Costs to participating customers include the remainder of equipment costs and staff resources to work with the ESCO.

Table 23. Estimated Five-Year Program Budget – Prescriptive Program

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & other annual cost		$295,000	$0	$0	$0	$0	$295,000	4%
DSM Staffing		$44,000	$44,000	$44,000	$44,000	$44,000	$220,000	3%
Program monitoring and evaluation		$45,567	$58,900	$58,900	$141,133	$74,467	$378,967	5%
Variable Program Costs								
Incentives	$2,520	$463,680	$750,960	$1,280,160	$1,983,240	$2,194,920	$6,672,960	88%
Delivery and othber	$0	$0	$0	$0	$0	$0	$0	0%
Total Budget		$848,247	$853,860	$1,383,060	$2,168,373	$2,313,387	$7,566,927	100.0%

[24] There are 85 school district administrative units in South Carolina. Altogether, there are 1,144 public schools in South Carolina, counting child development centers, elementary and middle schools, junior high and high schools, combined schools, charter schools, special education and vocational centers. There are also 397 private schools in South Carolina. The combined total for public and private schools is 1,541 schools. If we assume one-half are provided electric service by Duke Energy, this gives 770 schools. Source: Quick Facts, Education in South Carolina, Division of School Enterprise Operations, Office of Research, August 2006 (http://ed.sc.gov/agency/offices/research/documents/44932_QuickFacts06.pdf).

Non-Residential Programs

Program 4. Commercial and Institutional Retro-Commissioning Lite Pilot

This program targets commercial and institutional customers with a usage profile that indicates a possible high value from retro-commissioning. The program begins off-site with a scan of billing records using EZ Sim[25] or equivalent energy modeling software. This screening process will select a pool of buildings for which it looks like retro-commissioning is highly likely to produce substantial energy savings. This is a pilot program because retro-commissioning is still a somewhat controversial program approach. Many buildings are likely to show no significant energy savings from retro-commissioning, and there are questions about how long the benefits of retro-commissioning are likely to last. The initial scan using EZ Sim is essential to the pilot, in order to locate the most promising candidate buildings.

Building commissioning is a process that is associated with new buildings, and is a quality assurance process that is followed to facilitate new buildings performing as designed. Retro-commissioning applies a similar process to existing buildings. The goal is to insure that a building operates efficiently and effectively. The focus of this pilot program is in insuring efficient operation, rather than on upgrading equipment. The pilot is designed to conduct a low-cost "tuning" of electricity related building systems. The tuning typically involves control systems such as energy management systems that may be improperly programmed, or controls that are out of calibration. When problems are identified and demonstrated, they may have major economic effects. When this type of problem exists, retro-commissioning resolves such problems at low cost.

The pilot will focus on two types of building groups, schools[26] and commercial and institutional buildings run by property managers. The pilot will explore and develop relationships within both buildings areas. There is single measure, retro-commissioning.

Table 24. Measures and Incentives – Retro-Commissioning

Measures	Incentive Amount
Retro Commissioning Engagement	$1,000

Rationale

Commercial and institutional customers account for 25 percent of Duke's demand in South Carolina. The program offers incentives for the schools and managed buildings within the group to participate in the Retro-Commissioning pilot. Most buildings have never been commissioned, so the commissioning of an existing building may be able to identify and correct high priority operating deficiencies and verify proper operations. The focus will typically be on energy-using equipment, lighting, and controls. Further, this program is designated as "retro-commissioning

[25] This prior screening using billing data is essential to the success of the pilot. See: http://www.ezsim.com/.
[26] For schools, the Retro Commissioning Pilot (Program 4) may be combined with the Schools Delivery Channel of the Prescriptive Program (Program 3). Retro Commissioning is focused on low-cost "tuning" of buildings; the Prescriptive Program is focused on installation of energy saving building improvements.

lite," since it will involve engagements of about $2,000 per building[27], rather than the $10,000 to $52,000 associated with full retro-commissioning.[28] The best candidate buildings will have significant problems which can be easily fixed. In addition, the pilot will explore and develop ways to work with two types of buildings' managements, schools and managed commercial and institutional buildings. Energy savings will be documented by engineering calculations and evaluated using EZ Sim or equivalent energy modeling software. The persistence of energy savings will be tested in Program Year 5.

Participation

Since this is a pilot, participation has been projected to be relatively low, with ten participants in Year 1 and twenty-five participants each in Year 2 and Year 3. The field phase of the pilot will end with the end of Year 3, however, in Year 5 the persistence of energy savings will be verified through evaluation. Our participation estimates comes from NYSERDA's EnergySmartSM CIPP participation numbers, as presented in the 2007 Filing to the State Systems Benefits Committee. Because NYSERDA's program does not include smaller commercial facilities, we have used average energy savings from the Wisconsin Focus on Energy (FOE) database. We took the total commercial sector annual savings from the FOE program, and divided it by the number of participants to come up with the per participant savings number shown in Table 25, below. Like the Duke program, the FOE program is open to both large and small commercial and institutional customers. This number represents the average per participant savings, which is driven up by the participation of several very large customers each year. Duke may not achieve the projected savings in Year 1 because we do not anticipate many large customers will participate in Year 1, but we do expect Duke to achieve the full projected savings by the end of the five-year period.

Table 25. Estimated Participation and Savings – Retro-Commissioning

Potential Participants				57,600
Per participant Savings (kWh):				8,850
Per Participant Savings (kW):				1.6
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	10	0.0%	88,500	16
Year 2	25	0.0%	221,250	39
Year 3	25	0.0%	221,250	39
Year 4	-	0.0%	-	-
Year 5	-	0.0%	-	-
Cumulative	60	0.1%	531,000	93

Marketing Plans

Duke will need to advertise this program during its initial stages, and also will need to actively recruit ESCOs to work in its service territory. We recommend some general advertising within the business community, primarily in the form of brochures and mailings targeted to potential program participants. Duke also should work directly with

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

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

business associations throughout its service territory, and contact its larger customers through Key Account representatives. The budget below provides for some general advertising at business events, as well as brochures and premiums.

Data Concerns

The program manager should collect, at a minimum, information about all customer electrical equipment, hours of operation, etc.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. Note that field operations for the pilot go through Year 3, with evaluation of persistence in Year 5. The anticipated cost to Duke Energy for offering this program to customers involves budgets for:

- Duke Energy administrative costs to develop, advertise, oversee and monitor the program.
- A customer incentive to defray the cost of an energy audit for those customers that do not choose to work with ESCOs.
- Incentives for installing energy efficient equipment[29]. (Incentive amounts are based on the average incentive given in NYSERDA's EnergySmartSM CIPP program, discounted to allow participation by smaller commercial customers.)

Costs to participating customers include the remainder of equipment costs.

Table 26. Estimated Five-Year Program Budget – Retro-Commissioning

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & other annual cost		$100,000	$0	$0	$0	$0	$100,000	20%
DSM Staffing		$0	$0	$0	$0	$0	$0	0%
Program monitoring and evaluation		$50,000	$125,000	$75,000	$50,000	$50,000	$350,000	69%
Variable Program Costs								
Incentives	$1,000	$10,000	$25,000	$25,000	$0	$0	$60,000	12%
Delivery and othber	$0	$0	$0	$0	$0	$0	$0	0%
Total Budget		$160,000	$150,000	$100,000	$50,000	$50,000	$510,000	100.0%

[29] Incentive amounts are based on the average incentive given in NYSERDA's EnergySmartSM CIPP program, discounted to allow participation by smaller commercial customers. The average CIPP program participant receives $17,000 in incentives. We have discounted that number to $9,750.

Program 5. New Commercial Construction Program

This program targets new commercial and institutional construction. The program provides rebates for developing projects that are at least thirty percent (30%) more efficient than ASHRAE 2004. Incentives are offered to both project owners and the design team. These incentives will cover seventy-five percent (75%) percent of the incremental cost difference between standard and energy efficient equipment, or the amount of the incentive will be enough to decrease the incremental cost to a 1.5 year payback, whichever is less. These incentives are designed to address the cost barrier.

Table 27. Measures and Incentives – New Commercial Construction

Measures	Incentive Amounts
Design Assistance	75% of Incremental Cost

This program is based on National Grid's Design 2000 Plus program. For comparison, Western Mass Electric's (WMECo's) Energy Conscious Construction program covers most costs plus, for larger and complex projects, provides design assistance.[30] National Grid's Design 2000 Plus program initially covered 60-90 percent of incremental cost plus a comprehensive design approach for larger and complex projects.[31] More recently, as a mature program, National Grid Design 2000 Plus now covers 75 percent of incremental cost.[32] The program will follow the Advanced Buildings System approach developed by the New Buildings Institute.[33]

Rationale

Commercial and institutional customers account for 25 percent of Duke's demand in South Carolina. Project owners and design teams are the intended participants. They should be targeted using seminars on efficient building and by direct customer contact by utility staff. This program is designed to overcome first cost barriers by providing incentives that cover the incremental cost, and to provide information to project developers and design teams.

[30] See: www.wmeco.com/business/saveenergy/energyefficiencyprograms.
[31] See: www.aceee.org/utility/9angriddesign2000.pdf.
[32] See: www.nationalgridus.com/masselectric/business/energyeff/4_new.asp.
[33] See: www.advancedbuildings.net/index.htm.

Participation

Projected participation is shown in the table below.

Table 28. Estimated Participation and Savings – New Commercial Construction

Potential Participants				3,300
Per participant Savings (kWh):				18,959
Per Participant Savings (kW):				3.8
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	30	0.9%	568,770	113
Year 2	201	6.1%	3,810,759	757
Year 3	403	12.2%	7,640,477	1,517
Year 4	607	18.4%	11,508,113	2,285
Year 5	673	20.4%	12,759,407	2,533
Cumulative	1,914	11.6%	36,287,526	7,204

Marketing Plan

The target of the marketing effort will be the project owners and the design teams. Programs of this type usually involve direct personal relationship building, training sessions or seminars, direct marketing, and meetings.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to Duke Energy for offering this program to customers involves budgets for:

- Duke Energy administrative costs to develop, advertise, oversee and monitor the program.
- Incentives for the installation of recommended measures as demonstrated through the provision of receipts by the customer.

Costs to participating customers include the customer share of the costs of covered measures and equipment and installation costs.

Table 29. Estimated Five-Year Program Budget – New Commercial Construction

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & other annual cost		$50,000	$0	$0	$0	$0	$50,000	1%
DSM Staffing		$17,600	$17,600	$17,600	$17,600	$17,600	$88,000	1%
Program monitoring and evaluation		$10,000	$25,000	$15,000	$75,000	$10,000	$135,000	1%
Variable Program Costs								
Incentives	$4,830	$144,900	$970,830	$1,946,490	$2,931,810	$3,250,590	$9,244,620	97%
Delivery and othber	$0	$0	$0	$0	$0	$0	$0	0%
Total Budget		$222,500	$1,013,430	$1,979,090	$3,024,410	$3,278,190	$9,517,620	100.0%

Residential Programs

Program 6. Residential Energy Assessment Program

This program is based on the Spring 2007 Duke filing and includes the two residential energy assessment options that are carried out remotely, by mail or Internet. In both options, a residential customer can conduct a residential energy assessment using a computerized home energy auditing program. The program is the same for both the mail and Internet options, and is customized for the customer in that it links into actually billing data for the account.

In addition, Duke will send a small kit of energy efficiency items to each customer completing an audit. The savings in this program are computed based on the items in the kit, and no savings is assumed for the audit step.

Table 30. Measures – Residential Energy Assessment

Measures
CFLs (4)
Showerheads (2) and Aerators (3)

Rationale

This program provides a free and easy access to energy efficiency recommendations tailored to the home. Since it is conduct by mail or Internet, it can be done to suit a customer's schedule. This part of the overall DSM program provides a way for customers to begin to get direct information on what they can do to make their home more energy efficient. A separate program (No. 12, Home Energy Audit Program) provides the option of an in-home audit for a small fee. The Residential Energy Assessment Program is free to the customer.

Participation

Participation and savings targets are shown in the table below.

Table 31. Estimated Participation and Savings – Residential Energy Assessment

Potential Participants				357,600
Per participant Savings (kWh):				596
Per Participant Savings (kW):				0.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	3,576	1.0%	2,131,296	293
Year 2	4,470	1.3%	2,664,120	367
Year 3	5,364	1.5%	3,196,944	440
Year 4	6,258	1.8%	3,729,768	513
Year 5	7,152	2.0%	4,262,592	587
Cumulative	26,820	7.5%	15,984,720	2,200

Marketing Plans

Duke will need to actively market this program in customer communications, such as bill stuffers. Duke employees can also make customers aware of this program if they contact the company about energy efficiency or a need to lower bills.

Data Concerns

This is a packaged program provided by a vendor. All data requirements should be part of the program database.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to Duke Energy for offering this program to customers involves budgets for:

- Duke Energy administrative costs to develop, advertise, oversee and monitor the program.
- Direct program costs, including a vendorized Internet/mail-in energy assessment program.

There is no cost to participating customers.

Table 32. Estimated Five-Year Program Budget – Residential Energy Assessment

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & other annual cost		$0	$0	$0	$0	$0	$0	0%
DSM Staffing		$44,000	$44,000	$44,000	$44,000	$44,000	$220,000	19%
Program monitoring and evaluation		$50,000	$0	$50,000	$0	$50,000	$150,000	13%
Variable Program Costs								
Incentives	$10	$33,972	$42,465	$50,958	$59,451	$67,944	$254,790	22%
Delivery and othber	$20	$71,520	$89,400	$107,280	$125,160	$143,040	$536,400	46%
Total Budget		$199,492	$175,865	$252,238	$228,611	$304,984	$1,161,190	100.0%

Program 7. Energy Star Appliances and Lighting

The DEC Energy Star Appliances and Lighting Program is a market-based residential DSM program designed to leverage on existing national and collaborative effort in improving appliance energy efficiencies and lighting efficiency to reach residential customers through retail outlets. The program provides direct incentives to consumers to facilitate their purchase of Energy Star appliances and lights. The incentive is in the form of discounted pricing available for appliances that carry the Energy Star logo.

Participation

Participation and savings targets are shown in the table below.

Table 33. Estimated Participation and Savings – Energy Star Appliances and Lighting

Potential Participants				424,700
Per participant Savings (kWh):				381
Per Participant Savings (kW):				0.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	4,247	1.0%	1,618,107	443
Year 2	8,494	2.0%	3,236,214	886
Year 3	10,618	2.5%	4,045,458	1,108
Year 4	12,741	3.0%	4,854,321	1,330
Year 5	14,865	3.5%	5,663,565	1,551
Cumulative	50,965	12.0%	19,417,665	5,319

Energy Star Appliances Promotion

This promotion is justified based on direct energy savings targets but also has a significant market transformation dimension. DEC will become an active part of the Energy Star campaign. Through this participation, it is expected that DEC will move more Energy Star appliances into retail stores, help make energy-efficient appliances more affordable for its customers, and provide a continuing and responsible energy-efficiency education message to customers.

This is a vendorized appliance promotion for which DEC will need to select a vendor. The vendor will supply existing relationships with appliance industry and all manner of marketing and promotional materials as well as a method of systematic tracking and documentation. The DEC Energy Star Appliances promotion will provide rebate coupons to its customers toward the purchase of Energy Star appliances. A coupon approach is recommended because it is more suitable for a large service territory. This approach gives the program administrator direct control over where coupons will be made available and for which sales outlets.[34]

[34] The coupon approach is available as a "packaged" approach through Energy Federation Incorporated (EFI), which can also provide coupon processing services (www.efi.org). WECC administers several similar programs. Marketing and promotional plans for this program area have been developed collaboratively through the Consortium for Energy Efficiency (CEE). Part of the reality of this kind of program is the need to work through a program vendor. The vendor offers a full package of features, one of the most important of which is contact with the national offices of big-box and other chain stores. Promotions should also be made available through locally owned and operated stores.

Table 34. Measures and Incentives - Energy Star Appliances Promotion

Measures	Incentive Amounts
Energy Star Clothes Washers	$100 per unit
Energy Star Refrigerators	$25 per unit
Energy Star Dishwashers	$25 per unit
Energy Star Room Air Conditioner	$15 per unit

Incentives for this promotion are lower than might be expected based on industry experience in prior years. This is due in part to recent changes in the Energy Star program and the gradual increase in energy efficiency of base case (non-Energy Star) equivalent products (clothes washers, refrigerators, dishwashers and room AC). Now that Energy Star is established, there will be years in which Energy Star appliances provide substantial energy savings and years in which the differential from the base case (as the base rises due to the influence of Energy Star) is small. It is important to continue the Energy Star message with customers through rebates throughout the duration of Energy Star, however, there will be years in which the rebates will be small.

For clothes washers, MEEA utilities have been using a $75 to $100 rebate, however, this amount includes an arranged manufacturer rebate of $25 to $50. According to a September 2006 Consortium for Energy Efficiency (CEE) report, Alliant Energy provided a $50 rebate for vertical axis and a $100 rebate for horizontal axis clothes washers. To communicate a consistent message, the rebate for clothes washers is set at $50.

Efficiency Vermont provided a $50 rebate for a CEE Tier 3a clothes washer, $25 for a room AC, and $25 for an Energy Star refrigerator. The Long Island Power Authority clothes washer rebate is $15, $35, or $50 to customers along with a $50 clothes washer rebate for builders who install a clothes washer with a modified energy factor (MEF) of 2.0 or higher.[35] Los Angeles Water and Power (LADWP) provides a $65 refrigerator rebate and a $50 room AC rebate. National Grid provides a $100 clothes washer rebate for washers with MEF of 1.8 or higher. United Illuminating and Connecticut Light & Power both provide a $20 or $50 clothes washer rebate. Sacramento Municipal Utility District (SMUD) has a $50 refrigerator rebate, a $50 room AC rebate, and clothes washer rebates at $75 and $125 depending on CEE tier level. SMUD dishwasher rebates are $30 or $50, depending on CEE tier.[36]

This promotion was developed after a review of existing utility Energy Star appliance promotions. The effort involved combining elements of the best programs and applying a DEC focus to develop the proposed approach. However, it is expected that other program features and coordinated promotional plans will be combined with this approach, depending on the vendor selected.[37]

[35] The higher the MEF, the more efficient the clothes washer.
[36] See "Residential Appliance Programs National Summary, Prepared by the Consortium for Energy Efficiency, September 2006; MEEA 2004 Energy Star Clothes Washer Rewards Rebate Program Final Report to Com Ed, Illinois Department of Commerce and Economic Opportunity, and Southern Minnesota Municipal Power Agency.
[37] Note that Programmable Thermostats are not included in the promotions since it has been found through several evaluations that customers generally do not use the programmable feature, and they are being delisted by Energy Star.

Rationale - Energy Star Appliances Promotion

Energy Star appliance promotions are the current form of one of the earliest DSM program types, originally attempted on a regional level, such as the Bonneville Power Administration "Blue Clue" program and several California programs. But appliance promotions are best developed on a national level with participation by utilities and governments. Energy Star has overcome all of the defects of the earlier local or regional promotional programs through a single national program structured to periodically advance program standards and regulate minimum efficiencies. At the same time, it is structured to work with regional marketing initiative and local promotion.[38]

Participation - Energy Star Appliances Promotion

The pool of potential participants comes from the residential sector. The number of each type of appliance depends on the penetrations of other factors related to that appliance. For example the market for Energy Star (electric) clothes washers depends on the existence of an electric water heater and an electric clothes dryer. The implementation design calls for a program participation rate of about 2 percent of the eligible potential customers over the five-year program period. The penetration for each appliance is discussed in more detail in the technical appendix. As with most other programs, the target for Year 1 is lower than for succeeding years and the program ramps until Year 5. Once experience is gained through Years 1 and 2, the implementation team will have sound contextual knowledge needed to adjust the targets for Years 3, 4 and 5.

Marketing Plans - Energy Star Appliances Promotion

Proposed marketing efforts include the use of utility bill stuffers, and coordinated advertising with selected retail outlets. This type of program is best implemented using an implementation vendor since it has been developed as a national program and selection of a regional vendor will provide added value. DEC will work with the chosen program vendor to tailor the package to DEC's needs.

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.[39] [40]

[38] For example, for 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 (http://www.cee1.org/eval/RCWI_eval.pdf).

[39] 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.

[40] 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/library/includes/techno.cfm?EE=1&RE=0).

Appliance programs can combine commissions, coupon promotions, and consumer rebates.[41] Immediate access to a package approach that offers well developed and ongoing appliance industry relationships will require an experienced implementation vendor. For this plan, we limit the design to energy efficiency consumer rebates sponsored by DEC. However the actual implementation may involve other program features as a part of an overall program package.

The basic marketing goals for the program come from the Consortium for Energy Efficiency and are provided below:[42]

1. Consumers understand and value the benefits from energy-efficient features.
2. Retail sales force is knowledgeable about Energy Star and considers it a meaningful distinction for making a sale.
3. Manufacturers market and promote energy-efficient products and/or features.
4. Energy efficiency, defined by Energy Star performance levels, becomes a standard feature or is available across all manufacturers' product lines.
5. Energy Star represents the most energy efficient quality products available.

Duke Energy has a large contiguous service territory, however, as with other rebate programs, care will have to be taken to either avoid "spillage" across service territory boundaries or to secure commission acceptance of reasonable spillage as integral to state interests in supporting appliance programs across utilities and for the region and the nation. Either way, spillage must be specifically addressed in the micro design of the program.

Markets for Energy Star appliances are steadily developing. As a result, this is a good time to introduce an Energy Star campaign, and to provide continuity of support for a number of years because given these conditions the programs have a major opportunity to advance.

Data Concerns – Energy Star Appliances Promotion

Data collection and documentation for program purposes and annual reporting will be included as features of the vendor program "package." Data estimation of the baseline market and market potential for the specific Energy Star appliances promoted should be refined as a part of the vendor services and developed for each product type (clothes washers, refrigerators, dishwashers, room air conditioners).

The appliance and lighting promotions will be customer focused. However, cooperation with manufacturers and other appliance trade allies to expand the program promotional features should be explored by implementation staff and the vendor from time to time.

Energy Star Lighting Promotion

The Energy Star residential lighting promotion will parallel the Energy Star appliance promotion to reach residential customers through retail outlets. The lighting promotion provides direct incentives to consumers to

[41] See Residential Appliances Exemplary Program, "Northeast Residential Energy Star Appliances Initiative," Northeast Energy Efficiency Partnerships, Inc. and participants at http://aceee.org/utility/3aresappNE.pdf.
[42] CEE's National Residential Home Appliance Market Transformation Strategic Plan, December 2000 (http://www.cee1.org/resid/seha/seha-plan.php3).

facilitate their purchase of energy-efficient lights. The incentive is in the form of discounted pricing available for lighting products that carry the Energy Star logo.

This program is justified based on direct energy savings targets but also has a significant market transformation dimension. Generally, throughout the US, the Energy Star program has been affecting the types of lighting products available in stores:

- The relative amount of available lighting shelf space assigned to Energy Star lighting products is increasing dramatically in "big box" stores.
- The quality of CFL lighting has dramatically increased.
- The diversity of CFL styles and applications has greatly increased.
- There has been as sizable decrease in the cost of energy-efficient lighting, and with it an increase in store sponsored promotions featuring price discounts.

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

Incentives will be implemented by coupons, in-store markdowns, or upstream manufacturer buy-downs. A coupon approach is more suitable for a service territory because it gives the program administrator direct control over where coupons are available and for which sales outlets.[43] The following incentives will be offered to DEC customers.

Table 35. Measures and Incentives - Energy Star Lighting Promotion

Measures	Incentive Amounts
Energy Star CFL Instant Coupon	$1
Energy Star CFL 2-Pak Coupon	$2
Energy Star CFL 4-Pak Coupon	$4
CFL 6-Pak Coupon	$6

The lighting promotion program is modeled after a set of promotional programs that is implemented by Energy Federation Incorporated. These programs are sponsored by Connecticut Light and Power, United Illuminating Company, the Cape Light Compact, National Grid, NSTAR Electric, and Western Massachusetts Electric.

Rationale – Energy Star Lighting Promotion

The rationale for the lighting promotion is epitomized by the Energy Star "Change a Light, Change the World" marketing theme because although each light bulb is a small thing, changing a bulb is within individual control and,

[43] The coupon approach is available as a "packaged" approach through Energy Federation Incorporated (EFI), which can also provide coupon processing services (www.efi.org). An alternative approach offered by some utilities, the "lighting catalog," is not recommended since it would provide competition to existing lighting outlets. Since the long-term goal is to influence a transformation of the market, it seems reasonable to focus on changing the market share within existing supply channels and retail outlets.

together, the cumulative effect is one of the largest of potential DSM measures. Although simple, it is very cost effective.

Participation – Energy Star Lighting Promotion

Potential participants come from the total count of residential customers. It is expected that 95 percent of all customers will be eligible in that they have not already installed energy efficient lighting. Of the eligible customers we expect 8 percent to participate in the program over five years.[44] These targets have been set to provide a reasonable start and a manageable program effort throughout this implementation period. Based on experience in Year 1, these goals may be adjusted for the subsequent years. But the beginning of Year 3, it should be possible to revisit goals based on solid experience in actual service territory markets.

Marketing Plans - Energy Star Lighting Promotion

- Proposed marketing efforts include the use of utility bill stuffers, and coordinated advertising with selected retail outlets. It is assumed that the vendor ensure bulb supply as well as coupon processing. DEC will work with the vendor to tailor the program "package" as much as possible to DEC's needs.
- According to Ecos Consulting, the first approximately twenty years of CFLs did not have much influence in retail markets. "Then, in 2001, the market share gains for CFLs outpaced all of the gains achieve in their first 260 months of existence." National sales reached 2.1 percent of market in the fourth quarter of 2001.[45] Markets have changed since 2001 with CFLs acquiring self space within major chain stores, accompanied by some in-store advertising and promotion. This makes utility support more effective because the utility program can leverage substantial promotional efforts. At the same time, the documentation of baseline market share becomes a dynamic concern and documentation of incremental sales in relation to incremental (utility) cost has to be carefully developed.
- Data collection and documentation for program purposes and annual reporting will be included as features of the vendor program package." Data estimation of the baseline market and market potential for Energy Star bulbs and fixtures in DEC's service territory should be refined as a part of the vendor services and developed for each product type (CFL, CFL pack, exterior fixtures, interior fixtures).
- This CFL program is quite cost effective and attractive to customers. It is a good candidate program for bundling with other gas and electric DSM programs.

Cooperation in Big Box Store Initiatives

Wal-Mart has announced a major CFL initiative designed to introduce at least one CFL to each of its 100 million US customers over the next few years. In initiating this campaign, Wal-Mart has devoted additional shelf space to CFLs and arranged with GE for an initial 21 percent cut in the price of CFLs. We can expect a number of promotions for 4-packs, 6-packs, 12-packs, an increasing variety of bulb types, and possible additional price reductions. Although this initiative has received major buzz, other stores, such as Home Depot and Lowe's are implementing similar CFL promotions, and a trip to any of these big-box stores will show that extensive shelf space is dedicated to promotion of a wide variety of Energy Star CFLs.

[44] California was able to achieve 10%, the NW 5% and Nevada 1%. The 8% represents an aggressive target, but national efforts have been in effect and DEC can leverage off those efforts and achieve 8% participation with a strong effort.
[45] US DOE Energy Efficiency and Renewable Energy, September-October 2003 Conservation Update Feature Article, "Laying the Foundation for Market Transformation by Chris Calwell and John Zugel, Ecos Consulting (www.eere.energy.gov/state_energy_program/update/printer_friendly.cfm/volume=48).

These big-box initiatives are compatible with the lighting promotion design and can be viewed as additional leverage for program efforts. Utilities with current CFL DSM programs have been working with both local and big box retailers, and see any further contributions on the part of manufacturers and retailers in cutting prices and extending promotions as contributing to their programs.[46]

Detailed Budget Plans - Energy Star Appliances and Lighting Promotion

As in the other program the anticipated cost to DEC for offering this program to customers involves budgets for:

- DEC administrative costs to develop, advertise, oversee and monitor the program.
- Vendor services for the program vendor (assuming that DEC buys into to an existing turnkey lighting program, marketing and promotional package such as the Energy Federation's).
- Incentives for the installation of approved measures as demonstrated through the provision of coupons collected and processed from the retail outlets.
- Lighting incentive levels have been set equal to the 2007 levels adopted by N-Star and National Grid companies (www.myEnergyStar.com). These are good levels, reflecting the realities of ongoing market changes and in the middle of the range of currently offered incentives. The bottom of this range is $1.50 for a single bulb (Efficiency Vermont), and a few utilities go slightly higher than the $2 recommended.

The cost to participating customers is the customer's share of the cost (cost of product after the application of the coupon discount).

Table 36. Estimated Five-Year Program Budget – Energy Star Appliances and Lighting

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & other annual cost		$125,000	$100,000	$100,000	$100,000	$100,000	$525,000	22%
DSM Staffing		$22,000	$22,000	$22,000	$22,000	$22,000	$110,000	5%
Program monitoring and evaluation		$25,000	$25,000	$25,000	$25,000	$25,000	$125,000	5%
Variable Program Costs								
Incentives	$31	$132,931	$265,862	$332,343	$398,793	$465,275	$1,595,205	68%
Delivery and othber	$0	$0	$0	$0	$0	$0	$0	0%
Total Budget		$304,931	$412,862	$479,343	$545,793	$612,275	$2,355,205	100.0%

[46] Wal-Mart has asked for utility support in promoting CFLS.

Program 8. Residential HVAC Systems

This program targets residential single-family customers, builders, and heating contractors, and will provide incentives for high-efficiency air conditioners and heat pumps with electronically commutated fan motors. Rebates will go directly to builders for new construction, and to heating contractors for existing homes, with a requirement that cost savings be passed on in customer pricing. Existing home customers pay contractors directly for the systems.

Table 37. Measures and Incentives – Residential HVAC Systems

Measures	Incentive Amounts
Central Air Conditioning	$100[47]
Heat Pump Systems	$250
Inspection	$12.50

Rationale

This program targets residential customers with central air conditioning (CAC) or electric heating, either including both existing customers and new construction. The program is designed to overcome the higher first cost barrier associated with purchasing high-efficiency CAC systems or high-efficiency heat pumps, which may be as high as $1000. Duke will pay 25 percent of the incremental cost as an incentive for installing the more efficient equipment.

The program will work with builders to capture a higher percentage of the new home market. Duke will work with HVAC contractors to educate them about both the more efficiency systems and the incentives so that they will be able to recommend them to customers. The program focuses on contractors because customers tend to rely on recommendations from the contractors they call when a CAC or HVAC system breaks.

Participation

Approximately 55 percent of Duke's South Carolina customers have electric heat, while 41 percent have central air conditioning. Since the average lifespan for both heating systems and central air is about 18 years[48], we assume that 5.5 percent of the total population will turn over each year. The Wisconsin Focus on Energy program, a statewide DSM program in a mature market, captures between 2 percent and 3 percent of the potential HVAC participants in any given year.[49] Participation and energy savings targets are shown in the table below.

[47] Assumes 25% of the incremental cost associated with the replacement equipment. $250 is based on the incremental cost of a SEER 13 to 15 Heat Pump.

[48] Elliott, R. Neil, M. Eldridge, A. Shipley, J. Laitner, S. Nadel, P. Fairey, R. Vieira, J. Sonne, A. Silverstein, B. Hedman, K. Darrow, "Potential for Energy Efficiency and Renewable Energy to Meet Florida's Growing Energy Demands." Report Number E072, American Council for an Energy-Efficient Economy: Washington, DC (February 2007).

[49] "Energy Efficiency and Customer-sited Renewable Energy: Achievable Potential in Wisconsin 2006-2015." Report Number 236-1 and 236-2, Energy Center of Wisconsin: Madison, WI (November 2005).

Table 38. Estimated Participation and Savings – Residential HVAC Systems

Potential Participants				14,000
Per participant Savings (kWh):				1,065
Per Participant Savings (kW):				0.4
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	350	2.5%	372,750	145
Year 2	700	5.0%	745,500	290
Year 3	1,050	7.5%	1,118,250	435
Year 4	1,400	10.0%	1,491,000	580
Year 5	1,750	12.5%	1,863,750	725
Cumulative	5,250	7.5%	5,591,250	2,176

Marketing Plans

This program will be marketed to builders and to HVAC contractors. The program can be marketed through trade associations, breakfast or lunch meetings, and mailing materials. Most marketing will need to be done during the program's first couple of years to introduce the program to the target audiences. Once builders and HVAC contractors begin offering the more efficient equipment on a regular basis, Duke will need only to notify them of program updates and modifications.

Data Concerns

As will all DSM programs, the program manager will need to insure a fully adequate program tracking system is in place when the program begins. The system must support both DEC control and regulatory reporting needs.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to Duke Energy for offering this program to customer in South Carolina involves budgets for:

- Duke Energy administrative costs to develop, advertise, oversee and monitor the program
- Incentive payments to customers at 25 percent of the incremental cost of the more efficient equipment

The cost to participating customers is 75 percent of the incremental cost of the more efficient equipment.

Table 39. Estimated Five-Year Program Budget – Residential HVAC Systems

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & other annual cost		$25,000	$0	$0	$0	$0	$25,000	2%
DSM Staffing		$17,600	$17,600	$17,600	$17,600	$17,600	$88,000	7%
Program monitoring and evaluation		$8,000	$8,000	$35,000	$8,000	$8,000	$67,000	5%
Variable Program Costs								
Incentives	$213	$74,550	$149,100	$223,650	$298,200	$372,750	$1,118,250	86%
Delivery and othber	$0	$0	$0	$0	$0	$0	$0	0%
Total Budget		$125,150	$174,700	$276,250	$323,800	$398,350	$1,298,250	100.0%

Program 9. Solar Heated Domestic Hot Water

This program targets residential customers who have homes with roofs in good condition that are oriented for maximum sun exposure and have limited vegetation or other obstructions which could limit the solar access.[50] This is a traditional utility solar program in which the utility helps the customer purchase and install a system by providing an incentive and access to qualified contractors, and the customer maintains ownership and is responsible for maintenance.[51]

Table 40. Measure and Incentive – Solar Heated Domestic Hot Water

Measure	Incentive Amount
Customer Owned Program Incentive	$1,300

The traditional customer owned program is modeled after the Bright Way to Heat Water program developed by Eugene Water and Electric Board in Eugene, Oregon. The customer owned program has been adopted by Bonneville Power Administration as well as the Energy Trust of Oregon.

Rationale

Residential solar energy for the home presents a dilemma in that it is a desirable alternative with widespread public interest. Extensive public support for residential solar energy is indicated by the existence of government tax credits designed to encourage the customer and the solar industry. Yet, its current performance limits economic applications to niche markets such as remote off-the-grid locations where utility service is not available. Residential solar applications do make sense in such niche markets or in situations where grid electric service may be expected to be subject to interruptions and down time. Beyond these kinds of situations, the market is driven not by the economics of residential applications, but by a customer preference, and a belief in the possibilities of the technologies should there eventually be a performance breakthrough. In a traditional market model, the more activity that is stimulated, the more likely that declining costs per unit may be achieved and the more likely the technologies will progress.

[50] Elements of program design and customer targeting were taken from the US Department of Energy, Florida Sunshine – Natural Source for Heating Water. 2006. The program was modeled using a mix of thermal and PV solar technologies to provide for a mix of renewable resources. Thermal solar is assumed for 85% of participants resulting in a program design and cost effectiveness results that are heavily weighted toward thermal solar.

[51] There is also an alternative utility business model in which the utility retains ownership of the solar equipment. In this model, the utility installs residential solar water heating systems on customers' roofs and sells the hot water to the customer while maintaining ownership. The utility maintains the systems in good working order, monitors the water usage, and bills the customer for the water used. The utility pays the full cost to install the system, provides system maintenance, and owns the system. Customers pay for the system by paying for the hot water used. The model for the "utility owned" solar equipment program model is the Lakeland Electric Company program in Lakeland, Florida. More details on the Utility owned program can be found in Business Opportunity Prospectus for Utilities in Solar Water Heating by the Energy Alliance Group. This document developed in 1999 offers a business case for a utility owned solar water heating program. The Energy Alliance Group includes the Solar Energy Industries Association (SEIA), the US Department of Energy (DOE), and the National Renewable Energy Laboratory (NREL). For more information contact Dell Jones with Regenesis Power, LLC in Ft Meyers Florida, 904 891-3355 or see the web site at www.regenesispower.com. We did not develop this model because we could not understand the financial business case that supports it, and since we see Duke Energy as focused on its core business and probably uninterested in entrepreneuring a "hot water" business.

Participation

Program participation is projected as quite low due to the barriers of technology performance and economics. This is consistent with existing programs, such as the one at Eugene Water and Electric Board. Projected participation and energy savings are shown in the table below.

Table 41. Estimated Participation and Savings - Solar Heated Domestic Hot Water

Potential Participants				200,000
Per participant Savings (kWh):				2,800
Per Participant Savings (kW):				0.6
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	100	0.0%	280,000	64
Year 2	200	0.0%	560,000	129
Year 3	300	0.0%	840,000	193
Year 4	400	0.0%	1,120,000	257
Year 5	500	0.0%	1,400,000	322
Cumulative	1,500	0.0%	4,200,000	965

Marketing Plans

This program targets residential customers with roofs in good condition with the appropriate solar orientation and limited vegetation which could overshadow the rooftop system. These physical requirements are essential for the systems to function. The marketing effort would include bill stuffers, and general communication using a company website. Work with trade allies in the solar industry is probably sufficient to recruit participants.

Data Concerns

The program will collect detailed information about the structure of the home, orientation of the collector, and shading as well as on the equipment installed. A fully developed data collection model can be copied from utilities with long-standing residential solar energy programs. The program will require an internal review stage to approve requests for incentives, and data for program evaluation can also be collected at that stage.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to Duke Energy for offering this program to customers involves budgets for Duke Energy administrative costs to develop, advertise, oversee and monitor the program. Costs to participating customers include the balance of the cost after the utility incentive.

Table 42. Estimated Five-Year Program Budget - Solar Heated Domestic Hot Water

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & other annual cost		$35,000	$0	$0	$0	$0	$35,000	1%
DSM Staffing		$11,440	$11,440	$11,440	$11,440	$11,440	$57,200	2%
Program monitoring and evaluation		$15,000	$75,000	$15,000	$100,000	$15,000	$220,000	6%
Variable Program Costs								
Incentives	$2,078	$207,750	$415,500	$623,250	$831,000	$1,038,750	$3,116,250	91%
Delivery and othber	$0	$0	$0	$0	$0	$0	$0	0%
Total Budget		$269,190	$501,940	$649,690	$942,440	$1,065,190	$3,428,450	100.0%

Program 10. Energy Star Plus Program

For new residential construction a "beyond Energy Star" strategy is employed to insure a cost effective program, since recent changes in Energy Star have negatively affected the cost-effectiveness of the standard Energy Star program. Energy Star homes must meet guidelines for energy efficiency set by the U.S. Environmental Protection Agency. Energy Star qualified homes are at least 15 percent more energy efficient than homes built to the 2004 International Residential Code (IRC), and include additional energy-saving features that typically make them 20 to 30 percent more efficient than standard homes. In the Energy Star program, there is an assortment of builder pathways (Building Options Packages) to meet this criterion.[52] For the South Carolina Energy Star Plus Program, there are a more restrictive set of energy saving improvements.[53] Specified improvements are those with higher energy savings and lower energy cost. The goal is an efficiency improvement of 30 percent beyond code. Some Energy Star builders, in order to be sure of meeting the Energy Star criterion, now build beyond it; builders already know how to go beyond Energy Star. The program will be restricted to homes with electric heat and electric hot water.

Energy Star homes are homes that are independently certified and are more efficient, comfortable and durable than standard homes constructed according to local building codes.

Energy Star homes feature additional insulation; better windows, doors and bath ventilation; and high efficiency appliances such as furnaces, AC units, heat pumps, and water heaters. These measure improvements beyond current practice typically cost home buyers a factor of three times the actual cost to builders for the energy efficiency improvements. This provides excellent leverage in an upstream program model that can provide something like three times the customer value for each dollar of upstream buy down. In order to increase participation, Duke Energy will also pay the Energy Star inspection fee.

Table 43. Measures and Incentives – Energy Star Plus

Measures	Incentive Amounts
Energy Star New Home (Building Options Package)	$1,050
Lighting and Appliance Bonus when 10 energy efficient fixtures and 3 labeled Energy Star appliances are included (or equivalent upgrade)	
Inspection Service Fee	$500

The builder pathway indicated in the table above is indicative of a set of possible pathways – builder options that that will produce a "beyond Energy Star" result.[54] A package such as this is essential to keep the program cost-effective. The incremental cost of $2,017 per home in the illustrative measure package represents a generalized measure package cost of $2,000 per home.

[52] See http://www.energystar.gov/index.cfm?c=bop.pt_bop_northcarolina.
[53] There is also a $2,000 tax credit to the builder of a home that achieves 50 percent energy savings for heating and cooling over the 2004 International Energy Conservation Code (IECC) and supplements. At least 1/5 of the energy savings must come from building envelope improvements. Source: Federal Tax Credits for Energy Efficiency (http://energystar.gov/index.cfm?c=products.pr_tax_credits#s6).
[54] To the extent possible, every home authorized under this program should be oriented on the lot for optimal solar advantage.

Incentives for new residential buildings programs vary greatly across utilities. For example, the Eugene Water and Electric Board (EWEB) provides incentives of $250 or $1,000, and other utilities in the Pacific Northwest states provide $1,000, $1,500, or $2,000. NYSERDA and Long Island Power Authority (LIPA) in New York provide incentives from $750 to $3,500 to builders of Energy Star homes. New Hampshire utilities provide up to $3,000. Southern California Edison provides incentives up to $700, depending on climate zone.

Rationale

Since Energy Star standards were raised recently, the program has become much less cost-effective that under the previous standards. For that reason, Duke's program needs to go beyond Energy Star to improve its cost-effectiveness ratios.

Participation

An average of 12 to 14 thousand new homes have been added in Duke Energy Corporation's South Carolina service territory over the last several years. However, the market for new housing is currently undergoing some problems, so potential participants should be adjusted downwards. There are currently 78 builders of Energy Star homes in South Carolina and 87 Energy Star homes in the state.[55] The number of existing Energy Star homes in Duke Energy's South Carolina service territory can be taken as negligible and the Energy Star Plus program can be treated as a new program with well developed, skilled builders in place. Projected participation and energy savings are shown in the table below.

Table 44. Estimated Participation and Savings – Energy Star Plus

Potential Participants (yearly)				12,000
Per participant Savings (kWh):				3,788
Per Participant Savings (kW):				0.7
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	240	2.0%	909,120	178
Year 2	840	7.0%	3,181,920	621
Year 3	1,440	12.0%	5,454,720	1,065
Year 4	2,040	17.0%	7,727,520	1,509
Year 5	2,400	20.0%	9,091,200	1,775
Cumulative	6,960	11.6%	26,364,480	5,148

Marketing Plans

The market segment targeted for this program is upper income households. The housing market differentiates into segments, and only the top segments are likely to be effectively in the market for very energy efficient new homes.[56] This is particularly so now with problems in mortgage markets and general tightening of credit.

The financial incentive is provided directly to homebuilders to help offset the additional cost to build an Energy Star home. This gives the incentive a leverage (multiplier) of between two and three.

[55] See "New Homes Partner Results in South Carolina" (www.energystar.gov).

[56] A notable exception is the Advanced Energy effort to build Energy Star homes for low-income families through its high performance System Vision building program. This program is funded by the N.C. State Energy Office and from federal funding in partnership with the N.C. Housing Finance Agency and with the N.C. Community Development Initiative.

This program is a vendorized program requiring an experienced Energy Star program vendor. The program vendor provides all of the detailed knowledge and relationships to put the program in place with a restricted set of measures to reach savings levels significantly beyond Energy Star. This costs the customer more, but the customer pays less for energy over the life of the home and on a life cycle basis comes out well ahead financially.

The program vendor will provide the established channels to national builders, establish relationships with local builders, and will come supplied with all manner of promotional materials.

In addition to the incentive paid to the builders, Duke/homebuilder cooperative advertising and promotion will valuable in attracting the builders, and may be more attractive that the amount of incentive dollars paid. The key, according to the Texas Energy Star program is in promoting the value of the brand to builders who would like to differentiate their product. Marketing methods include:

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

Key elements that should be incorporated into this program to make it successful include:[57]

1. Establish a single stable multi-year approach. This will give stability to builders and allow the program to grow more readily.
2. Establish a single, simple, and high program standard of efficiency. This is important because it lets builders know where they stand and what is expected.
3. Establish good relationships with area builders and developers.
4. Ensure that staff professionalism, delivery systems, equipment, marketing materials and quality assurance are all of high quality.
5. Maintain strict adherence to specifications based on sound building science and economics to maintain program credibility and consistency.
6. Establish a process for certifying and documenting homes built to requirements.[58]
7. Develop a solid infrastructure of experienced, well-known and respected organizations.
8. Develop targeted incentives that are well coordinated with marketing and other service-related materials.
9. Coordinate with health and safety standards and codes for residential construction.
10. Provide ongoing technical training for builders and subcontractors.
11. Promote builders buy-in into the program by getting them financially invested in the program through advertising, building requirements, and training so they will support all aspects of the program.[59]
12. New construction is an excellent area to review for strategic combination of gas and electric energy efficiency measures.

[57] Drawn from Vermont Energy Star Program, managed by Efficiency Vermont.
[58] Texas Energy Star Program.
[59] Texas Energy Star Program.

Data Concerns

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

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to Duke Energy for offering this program involves costs for:

- DEC administrative costs to develop, oversee and monitor the program. The Duke staffing requirement is projected at 1/8 FTE since this is a fully vendorized program.
- A vendor contract to market and deliver the new home program, including funding of HERS raters.
- Cooperative advertising budget as part of an inclusive marketing and promotional budget.
- Incentives to be paid to the builder.

Costs to participating customers include the customer's outlay for any remaining incremental cost of the Energy Star Plus home. Under Duke residential rate schedules, owners of Energy Star homes receive a discount on electric rates.

Table 45. Estimated Five-Year Program Budget – Energy Star Plus

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & other annual cost		$145,000	$105,000	$105,000	$105,000	$105,000	$565,000	5%
DSM Staffing		$11,440	$11,440	$11,440	$11,440	$11,440	$57,200	0%
Program monitoring and evaluation		$0	$25,000	$0	$75,000	$0	$100,000	1%
Variable Program Costs								
Incentives	$1,050	$252,000	$882,000	$1,512,000	$2,142,000	$2,520,000	$7,308,000	63%
Delivery and othber	$500	$120,000	$420,000	$720,000	$1,020,000	$1,200,000	$3,480,000	30%
Total Budget		$528,440	$1,443,440	$2,348,440	$3,353,440	$3,836,440	$11,510,200	100.0%

Program 11. Manufactured Homes Program

A manufactured home is a home built in a factory meeting the federal Manufactured Home Construction and Safety Standards, commonly referred to as the HUD Code. An Energy Star qualified manufactured home is a home that has been designed, produced, and installed in accordance with Energy Star's guidelines by an Energy Star certified plant. This is an upstream program that targets manufacturers and applies home heated with electricity, natural gas, and propane. The Duke Energy program will apply only to manufactured homes with electric heat (resistance heat is replaced by a heat pump for the Energy Star units). It is a type of program that requires a skilled and seasoned program vendor who will offer a package with established relationships in the manufactured home industry and develop new relationships in the Carolinas. Over forty percent (40%) of new single-family homes purchased in South Carolina are manufactured homes.[60]

The vendor arranges for the program with manufacturers and for both the manufacturing plants and individual homes to be inspected. Inspection of the individual homes is important because the quality of installation can greatly influence the effectiveness of the energy saving improvements in these homes. Quality control in the plants is typically excellent, but installation standards must be closely observed.

There are thirteen South Carolina builders of Energy Star manufactured homes listed as partners on the US DOE Energy Star website (www.energystar.gov). Ten of these are listed as new partner. No Energy Star manufactured homes are listed for South Carolina as of July 2007.

Energy Star homes feature an energy-efficient building envelope (properly installed insulation, tight construction, and high performance windows), energy-efficient air distribution (duct sealing and testing to ensure proper performance), ventilation that moves fresh air through the home, energy-efficient equipment (heat pumps for space heating and cooling, water heating, and dishwashers) and compact fluorescent lighting. Specific improvements to build new homes to Energy Star level may vary with different manufacturers, but the energy savings value of Energy Star (more than 30 percent more efficient than HUD code) is strictly observed.[61]

The incentive in this program is designed to encourage the manufacturers to make Energy Star homes available and encourage sales agents to promote the homes. The incentive to the manufacturer is applied to the Energy Star certification which may be approached by different manufacturers by different paths. As a rule of thumb, the retail value of the Energy Star improvements over a "base case" home has been double to triple the cost upstream at the manufacturer's level, so the value obtained by Duke will be leveraged by this multiplier.

[60] $aving Money in your Manufactured Home Through Energy Efficiency, A Guide for South Carolinians, P. 1. See: http://www.energy.sc.gov/publications/$aving%20Money%20in%20Your%20Manufactured%20Home.pdf.
[61] To the extent possible, every home authorized under this program should be oriented on the lot for optimal solar advantage.

Table 46. Measures and Incentives – Manufactured Homes

Measures	Incentive Amount
Buy Down of Energy Star Package	$900
Sales Center Incentive	$100

In programs that move markets some manufacturers will be near to completely adopting better practices, some will have taken initial steps, and most will have taken either no steps or very few steps at the time the program is launched. However, it is not workable to begin with different incentives to different manufacturers. Amounts shown in Table 47 are based on review of other programs. For more information, see Energy Star Manufactured Home (R-24) in Appendix C, Residential EEM Documentation.

Rationale

The program aims to encourage manufacturers to have Energy Star homes available to home buyers, to educate sales agents about the value of an Energy Star manufactured home, and help potential customers understand the advantages. The price barrier is addressed by buying down the incremental cost at the manufacturer level.

Participation

Because the energy office and the three universities have done much of the preliminary work to make this program possible in South Carolina, it will be possible to put the program in place just at the point at which South Carolina manufacturers are ready for it. The economics of the manufacturing plants require them to move to at least 50 percent when the program is seriously engaged, and there are economic benefits in moving to 100 percent of electrically heated units. The goal is to shift Energy Star from a special order to standard practice. Generally, as the percentage Energy Star homes reaches 50 percent or more, efficient stocking and assembly practices cause the stocking and assembly of Energy Star equipment on non-Energy Star homes, so this type of program has substantial "spill over" savings.

The number of homes sold in South Carolina each year is approximately 2,700.[62] The average number placed in Duke Energy's service territory in South Carolina is 1,100. Over five years, this would be 5,500 homes. Of this amount, we assume that 90% have electric heat, so potential participants each year are about 990. Projected participation and energy savings are shown in the table below.

[62] Data from manufactured homes placed by state (http://www.census.gov/const/mhs/placbystate.html), 2006 Excel spreadsheet.

Table 47. Estimated Participation and Savings – Manufactured Homes

Potential Participants				990
Per participant Savings (kWh):				4,632
Per Participant Savings (kW):				0.6
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	198	20.0%	917,136	109
Year 2	198	20.0%	917,136	109
Year 3	297	30.0%	1,375,704	164
Year 4	396	40.0%	1,834,272	219
Year 5	495	50.0%	2,292,840	274
Cumulative	1,584	32.0%	7,337,088	876

Marketing Plans

Duke Energy will focus first on manufacturers and dealers who are likely to permanently alter their manufacturing and marketing. This strategy is designed to leverage the stocking and assembly practices in the plants which provide and advantage to stocking and installation of standard parts, rather than options. A program vendor will be selected to design, conduct, oversee, and facilitate all elements of the project. Steps include:

1. Recruit and work with industry partners. Build a strategic alliance with home manufacturers and retailers.
2. Retailer training. This will include educational workshops with motivational materials, case studies, and a focus on retailer role in promoting Energy Star.
3. Marketing materials. Develop marketing plan and promotional materials. One of the challenges of this program is to insure the presence of sales personnel who understand and believe in the value of energy efficiency as a product attribute.
4. Coordination with MHRA. The Manufactured Home Research Alliance (MHRA) is the national quality assistance provider for the Department of Housing and Urban Development and oversees a network of Energy Star certifiers.

Data Concerns

The program contractor will be responsible for securing, entering, and maintaining data in the program database sufficient to meet program control and Commission regulatory needs.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to Duke Energy for offering this program to customers involves budgets for:

- Duke Energy administrative costs to develop, advertise, oversee and monitor the program. The Duke staffing commitment is estimated at 1/8 FTE per year.
- Contractor to vend the program (this requires coordinating with key industry players, knowledge of Energy Star, and knowledge of manufactured housing industry, system of inspections, federal oversight). The contractor will set up the project, create management systems, and carry out day-to-day project administration and problem solving. The contractor will be responsible for administration liaison with Duke and the project partners. The contractor will also be responsible for compliance tracking and reporting to Duke.
- Incentive – paid to manufacturer.
- Commission – paid to the agent or dealership.
- Customer's outlay for any remaining incremental cost of an Energy Star manufactured home.

Costs to participating customers include the customer's outlay for any remaining incremental cost of an Energy Star manufactured home.

Table 48. Estimated Five-Year Program Budget – Manufactured Homes

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & other annual cost		$135,000	$95,000	$95,000	$95,000	$95,000	$515,000	23%
DSM Staffing		$11,000	$11,000	$11,000	$11,000	$11,000	$55,000	2%
Program monitoring and evaluation		$25,000	$25,000	$25,000	$25,000	$25,000	$125,000	5%
Variable Program Costs								
Incentives	$900	$178,200	$178,200	$267,300	$356,400	$445,500	$1,425,600	63%
Delivery and othber	$100	$19,800	$19,800	$29,700	$39,600	$49,500	$158,400	7%
Total Budget		$369,000	$329,000	$428,000	$527,000	$626,000	$2,279,000	100.0%

Program 12. On-Site Audit with Direct Install Program

This program targets single-family households, but can include up to a fourplex in which one of the units is owner occupied. This program encourages households to save electricity through the installation of energy efficiency measures.

The On-Site Audit with Direct Install program will provide households with a walk-through examination of their home by a trained auditor/contractor using standard audit software for identifying existing conditions related to electric energy usage. The auditor will identify specific energy saving opportunities that could be installed by the contractor upon approval of a job scope by the customer. The contractor will convey energy saving tips during the walk-through, and attempt to be comprehensive in their assessment of opportunities regardless of their particular specialization. Customers will pay $50 out of a total audit cost of $150, and have their costs reimbursed if they proceed with installation of recommended measures.

At the same time, during the walk-through audit, the contractor will install the measures in the Direct Install Kit (see table below) at no cost to the customer, with the customer's approval. At the conclusion of the site visit, customers will be provided with a check list of preliminary recommendations from the audit, to be followed within one week by a full report generated by the audit software. The program will take credit for only the installed measures at the time of the audit. These measures are listed in the table below.

Table 49. Measures – On-Site Audit with Direct Installed Measures

Measures
CFLs (15 bulbs)
Showerheads (2) Faucet aerators (3)
Water Heater Pipe Insulation
Water Heater Tankwrap

The package of direct install measures is modeled after Wisconsin's Home Performance with Energy STAR program with emphasis on their E-Saver Kit component, which includes these measures plus a programmable thermostat, but only included one CLF.[63] Evidence from various evaluations shows that programmable thermostats are rarely used as intended and therefore have shown a very low realization rate for the energy savings predicted, so we do not include them here.

Rationale

The basis for this program model is to provide customized information to homeowners regarding energy efficiency opportunities in their homes, and provide a package of measures that are directly installed at the time of the audit to start contributing energy savings right away. It builds upon the energy audit service already being provided by DEC. The program will reduce the hassle involved in finding quality contractors and identify a reasonable prioritization of what work should be done to improve a home's energy efficiency. Surveys from evaluations

[63] State of Wisconsin Department of Administration Focus on Energy Statewide Evaluation, Evaluation of the Home Performance with Energy STAR Whole House Component, April 24, 2003.

nationally show that a primary barrier to energy saving in existing residential homes is the lack of awareness on the part of consumers at to what measures are worth pursuing, coupled with the search process that is involved in finding a reputable reasonably priced contractor.[64] Consumers in lower priced electricity rate markets, such as South Carolina, are also hard pressed to justify the expenditures for measures unless they see a short payback or return on their investment. In spite of significant increases in awareness among the general population as to the importance of saving energy, households require specific easily obtainable information before they will act.

The program design overcomes these barriers through providing auditors sanctioned by the utility, who are trained and certified to conduct high quality walk through audits, using comprehensive audit software and techniques that includes on-site home education.

Participation

All residential customers of the company with electric heat and electric hot water will be eligible. A nominal audit fee of $50 is charged to the customer for the audit service and measures, to discourage households that have no intention of installing measures from participating.

The amount of participation to be expected by year depends upon several factors, however since DEC has already launched some residential services, it appears that consumer awareness may be higher than zero and that once advertising and outreach commence, the program could expect relatively quick start up. Projected participation and energy savings are shown in the table below.

Table 50. Estimated Participation and Savings – On-Site Audit with Direct Installed Measures

Potential participants				219,000
Per participant savings (kWh):				1,357
Per participant savings (kW):				0.3
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	3,285	1.5%	4,457,745	1,137
Year 2	3,285	1.5%	4,457,745	1,137
Year 3	4,380	2.0%	5,943,660	1,516
Year 4	6,570	3.0%	8,915,490	2,274
Year 5	6,570	3.0%	8,915,490	2,274
Cumulative	24,090	11.0%	32,690,130	8,337

Marketing Plans

This program will be marketed directly to consumers through bill inserts, direct mailing materials, and through participating contractors. The program will need to mail information to customers on a regular (twice a year basis, or more frequently as needed to produce the desired participation rates. As with any DSM program, Duke may need to market the program more frequently during its early years to introduce it to the target audience. We expect Duke will also hold several events throughout its service territory at which it can "kick-off" the program.

[64] Evaluations in New York, Wisconsin, Maine, and EPA (see ACEEE Summer Study Proceedings, 2006).

Data Concerns

Duke Energy's Audit and Direct Install program manager will need to maintain a database of household participants to track activity levels. The implementation contractor performing the audits will likely maintain the more detailed audit input and output data; however, the company should also retain this data as a planning resource. Regarding energy savings-related data, the program manager should collect, at a minimum, information about the number of direct installation packages delivered, the number of audits delivered, monthly or periodic summaries from the implementation contractor of all before and after audit data (both the as-found characteristics of the home and the audit results), results of all diagnostic tests, and projected energy savings that are calculated from the audit software. The databases maintained by the program manger or the implementation contractor will also include records of any customer fees received and reimbursed, plus information on which of the recommended measures were installed (this information could come from receipts required as documentation for reimbursement of the audit fee).

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to Duke Energy for offering this program to customers involves budgets for:

- Duke Energy administrative costs to develop, advertise, oversee and monitor the program.
- Costs to Duke Energy for the packages of direct-install measures (see Table 49).
- Customers pay $50 out of $150 audit fee. The costs of the audit to participating customers are waived if customers proceed with the work, so the costs to DEC are either $100 per audit or $150 per audit.

Table 51. Estimated Five-Year Program Budget – On-Site Audit with Direct Installed Measures

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & other annual cost		$0	$0	$0	$0	$0	$0	0%
DSM Staffing		$11,000	$11,000	$11,000	$11,000	$11,000	$55,000	1%
Program monitoring and evaluation		$25,000	$25,000	$100,000	$25,000	$25,000	$200,000	3%
Variable Program Costs								
Incentives	$46	$151,110	$151,110	$201,480	$302,220	$302,220	$1,108,140	16%
Delivery and othber	$240	$788,400	$788,400	$1,051,200	$1,576,800	$1,576,800	$5,781,600	81%
Total Budget		$975,510	$975,510	$1,363,680	$1,915,020	$1,915,020	$7,144,740	100.0%

Program 13. Old Refrigerator Pick-Up and Recycling Program

This program targets households with second refrigerators or freezers. The program will provide free refrigerator pick up. Duke's contractor will pick up, disable, and recycle the refrigerator. Once Duke receives verification that the refrigerator has been recycled, the customer will receive a $30 incentive. This number is based on the amount offered by Nevada power Company.[65]

Table 52. Measure and Incentive – Old Refrigerator Pick-Up and Recycling

Measure	Incentive Amount
Refrigeration/Freezer Recycling	$30

Rationale

This program targets residential customers with second refrigerators, preferably those older than 1997. The program is designed to take these inefficient older refrigerators off the market entirely, and to do so in an environmentally-sustainable manner. Duke will pay a $30 incentive to each customer to help persuade them to get rid of the second refrigerator, and will also cover the cost associated with removing the refrigerator or freezer and recycling its components. Duke will hire a contractor to handle the latter activities.

Participation

Approximately 20 percent of Duke South Carolina's residential customers (including those in multi-family homes) have second refrigerators. Many of these refrigerators are less efficient older models. Based on participation numbers from both the Wisconsin Public Service and Nevada Power Company programs, Duke can expect up to 11 percent of those eligible may enroll in the program annually by Program Year 5. Table 53 shows the total estimated number of South Carolina program participants over the five-year period. We anticipate that program participation will begin at around 2.25 percent in Year 1, and will increase steadily each year. Participation and energy savings targets are shown in the table below.

Table 53. Estimated Participation and Savings – Old Refrigerator Pick Up and Recycling

Potential Participants				80,460
Per participant Savings (kWh):				1,150
Per Participant Savings (kW):				0.2
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	1,810	2.3%	2,081,500	272
Year 2	4,023	5.0%	4,626,450	605
Year 3	4,023	5.0%	4,626,450	605
Year 4	4,023	5.0%	4,626,450	605
Year 5	4,023	5.0%	4,626,450	605
Cumulative	17,902	22.3%	20,587,300	2,691

[65] The $30 incentive is based on the Nevada Power Company incentive, which has elicited a strong positive response from customers. Wisconsin Public Services offers a $50 incentive, but we believe Duke's program will be successful with the lower incentive amount.

Marketing Plans

This program will be marketed directly to consumers through bill inserts, direct mailing materials, and through refrigerator distributors. The program will need to mail information to customers on a regular schedule (twice a year basis, or more frequently as needed to produce the desired participation rates), and through point-of-purchase information at trade ally facilities. As with any DSM program, Duke may need to market the program more frequently during its early years to introduce it to the target audience.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to Duke Energy for offering this program to customers in South Carolina includes:

- Duke Energy administrative costs to develop, advertise, oversee and monitor the program.
- Incentive payments to customers of $30.
- Contractor payment at a rate of $100 per recycled refrigerator.

There are no costs to participating customers.

Table 54. Estimated Five-Year Program Budget – Old Refrigerator Pick Up and Recycling

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & other annual cost		$250,000	$150,000	$150,000	$150,000	$150,000	$850,000	26%
DSM Staffing		$11,000	$11,000	$11,000	$11,000	$11,000	$55,000	2%
Program monitoring and evaluation		$8,000	$8,000	$35,000	$8,000	$8,000	$67,000	2%
Variable Program Costs								
Incentives	$30	$54,300	$120,690	$120,690	$120,690	$120,690	$537,060	16%
Delivery and othber	$100	$181,000	$402,300	$402,300	$402,300	$402,300	$1,790,200	54%
Total Budget		$504,300	$691,990	$718,990	$691,990	$691,990	$3,299,260	100.0%

Program 14. Residential Weatherization Program

This program will serve residential customers. It will serve in parallel with the state Office of Economic Opportunity Weatherization Assistance Program for customers from zero to 150 percent of the federal poverty level. For customers from 150 percent of poverty to 80 percent of state median income, the program will serve as an independent "GAP Program." For the parallel component, Duke Energy proposes to work together with the Weatherization Assistance Program[66] implemented by the Office of Economic Opportunity (OEO) in South Carolina, through its sub-recipient agencies.[67] In this parallel program approach, Duke will cooperate with OEO by accepting single family (single family to quadplex) households with electric heat, electric hot water, and high energy use. This will insure the cost-effectiveness of the parallel program, while permitting OEO to focus on other homes.

In Census 2000, South Carolina had 365,047 households from zero to 150 percent of the federal poverty level, and another 248,687 from 150 percent of poverty to 80 percent of the state median income. The state Weatherization Assistance Program (WAP) provides service to the 24% of household up to 150% o poverty. According to the South Carolina Office of Economic Opportunity, WAP is planned to serve approximately 506 households in Program Year 2007. Projected on a yearly basis, this is about one out of every one-thousand potentially eligible households each year. Thus there is ample need for a parallel program. Duke Energy's parallel program will be limited to homes with electric heat and electric hot water.

The comparison of income levels for 150 percent of poverty and 80 percent of South Carolina median income, by household size, is shown below.[68]

[66] The U.S. Department of Energy's (DOE's) Weatherization Assistance Program was created by Congress in 1976 under Title IV of the Energy Conservation and Production Act. The purpose and scope of the Program as currently stated in the Code of Federal Regulations (CFR) 10CFR 440.1 is "to increase the energy efficiency of dwellings owned or occupied by low-income persons, reduce their total residential expenditures, and improve their health and safety, especially low-income persons who are particularly vulnerable such as the elderly, persons with disabilities, families with children, high residential energy users, and households with high energy burden" (Code of Federal Regulations, 2005).

[67] The South Carolina Weatherization Assistance Program is implemented in all counties in the state through nine (9) subgrantee agencies. The agencies conduct energy audits and perform diagnostic testing to determine air infiltration, heat loss, levels of carbon monoxide and identify recommended energy efficiency, safety and health measures. Measures installed may include: air sealing; insulation of attics, dense-pack sidewall insulation, smart thermostats, compact fluorescent lamps (CFLs), sealing and insulating ducts, floor insulation, and refrigerators. Families with incomes below 150% of poverty or those receiving cash assistance payments under Title IV or XVI of the Social Security Act, or applicable South Carolina law at any time in the twelve-month period preceding determination of eligibility are eligible. Source: South Carolina Weatherization Assistance Program PY 2007 State Plan (Draft).

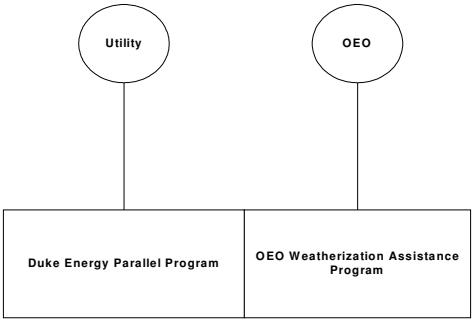
[68] The numbers in the Income Levels table are nominal 2007 dollars. As a perspective on what these numbers mean, the highest number in the table ($56,800) is equal to $8,604 in 1965 dollars using the inflation calculator on the Bureau of Labor Statistics website (http://data.bls.gov/cgi-bin/cpicalc.pl).

Table 55. Income Levels - GAP Delivery Channels

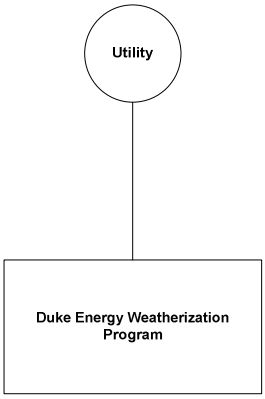
Household Size (Number of Persons)	1	2	3	4	5	6	7	8
150% of Federal Poverty Level	$15,314	$20,535	$25,755	$30,975	$36,195	$41,415	$46,635	$51,855
80% of South Carolina Median Income	$29,600	$33,850	$38,100	$42,300	$45,700	$49,100	$52,500	$55,850
Note: Incomes are for 2007. Poverty numbers are from the Income Guidelines as Published in the Federal Register on January 24, 2007. The 80% of South Carolina Median Income numbers are as calculated by the Department of Housing and Urban Development.								

Rationale

A picture of the parallel program is shown below.



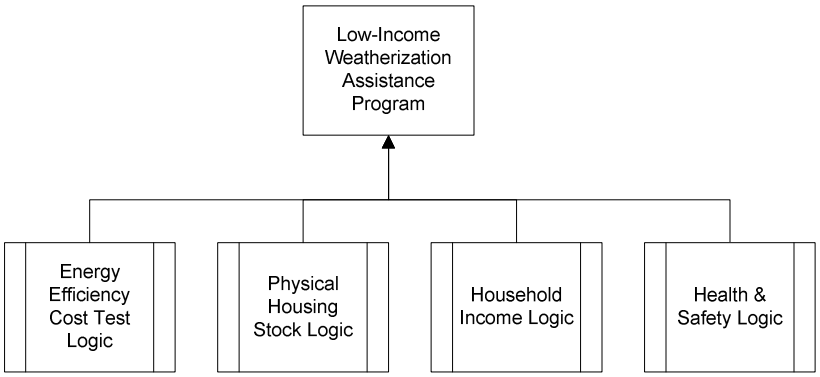
A picture of the GAP portion of the program follows.



As indicated in both pictures, Duke Energy is solely responsible for both program segments and the delivery contractor will report to Duke Energy.

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

1. Like other DSM programs, energy savings (DSM savings).
2. Unlike other DSM programs, repairs necessary to install energy savings improvements
3. DSM service to customers who otherwise could not obtain DSM improvements due to cost.
4. Due to problems with low-income housing stock, health and safety concerns.



For this reason, 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.[69] 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 if the Benefit Cost ratio on the initial test is 0.8 or above; the California commission uses a "Modified Participant Test" and Utility Cost Test (including "non-energy benefits") for screening measures for low-income programs. A measure is accepted into the program if it passes either test. Thus, the TRC for the Southern California Edison Low-Income Energy Management Assistance Program was 0.63 for 2004 and 0.61 for 2005. Similarly, the TRC for Pacific Gas & Electric's Low-Income Energy Partners Program was 0.41 for 2004. As a final example, the Public Utilities Commission Nevada approved a Nevada Power whole house AC replacement addition coordinated with the Community Action Agency WAP program with a TRC of 0.55 on a trial basis in 2006.

[69] For low-income programs, program cost-effectiveness is a lesser issue, although still an important objective. Because of their particular focus on the special needs of disadvantaged households, low-income energy efficiency programs are generally not held to the same cost-effectiveness criteria as utility energy-efficiency "resource" programs (i.e., they are not judged with a strict "total resource cost" test, or TRC). More typically, the focus is on the magnitude of utility bill savings to participating customers, rather than the utility system avoided production 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. 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.

A methodology for a analyzing the benefits and costs of a coordinated program has been developed at Oak Ridge National Laboratory. This method can be used for allocating costs and benefits between the utility and the state when there is joint utility and public funding.[70]

In the parallel portion of the program, homes with electric heat, electric hot water, and high usage will be assigned to Duke's program. This provides a clean partition of service to support the cost tests, and direct accountability of the program vendor to Duke Energy.

Measures

Weatherization measures offered by the program are shown in the table below.

Table 56. Measures - Weatherization

Measures
Water Heater Blanket
Showerhead (2.0 GPM) and Flow Restrictors
Ceiling Insulation
Wall Insulation
Ducts
House Sealing
CFLs (8)

Participation

Participation is expected to begin slowly in Year 1 and then increase to a steady-state level in Year 2, as shown in the table below.

Table 57. Estimated Participation and Savings - Weatherization

Potential Participants				125,900
Per participant Savings (kWh):				2,386
Per Participant Savings (kW):				0.3
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	806	0.6%	1,923,116	260
Year 2	2,518	2.0%	6,007,948	811
Year 3	2,518	2.0%	6,007,948	811
Year 4	2,518	2.0%	6,007,948	811
Year 5	2,518	2.0%	6,007,948	811
Cumulative	10,878	8.6%	25,954,908	3,503

[70] Brown, M.A. and L.J. Hill, Low-Income DSM Programs: The Cost Effectiveness of Coordinated Partnerships. Oak Ridge, Tennessee: Oak Ridge National Laboratory, ORNL/CON-375, May 1994; Hill, L.H. and M.A. Brown, Standard Practice: Estimating the Cost-Effectiveness of Coordinated DSM Programs. Oak Ridge, Tennessee: Oak Ridge National Laboratory, ORNL/CON-390, December 1994; Hill, Lawrence J. & Marilyn A. Brown, "Estimating the Cost-Effectiveness of Coordinated Utility Programs, Evaluation Review, Vol. 19, No. 2, April 1995: 181-196.

Marketing Plans

- The delivery contractor will be responsible for recruitment and both the Parallel and GAP portions of the program will be delivered in all counties in the Duke Energy South Carolina service territory.
- Duke Energy will work with the state Office of Economic Opportunity to arrange that customers who contact OEO and its Community Based Organizations but are over the WAP 150 percent of poverty ceiling will be referred to GAP, and that high usage customers from 0-150 percent of poverty will be referred to the Parallel portion of the Duke program. All portions of the Duke Energy program will be limited to homes with electric heat and electric hot water.
- Proposed marketing efforts include the use of utility bill stuffers for customer education, and mention of the program in any Duke Energy communications with customers regarding energy efficiency program options.
- Duke Energy customer relations and collections staff will be trained to refer customers if they are within the income range and enquire about weatherization or experience payment problems. (And have both electric heat and electric hot water.)

Data Concerns

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

Detailed Budget Plans

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

Table 58. Estimated Five-Year Program Budget - Weatherization

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & other annual cost		$150,000	$0	$0	$0	$0	$150,000	1%
DSM Staffing		$22,000	$22,000	$22,000	$22,000	$22,000	$110,000	0%
Program monitoring and evaluation		$24,000	$24,000	$24,000	$144,000	$144,000	$360,000	2%
Variable Program Costs								
Incentives	$998	$804,227	$2,512,460	$2,512,460	$2,512,460	$2,512,460	$10,854,068	46%
Delivery and othber	$1,100	$886,600	$2,769,800	$2,769,800	$2,769,800	$2,769,800	$11,965,800	51%
Total Budget		$1,886,827	$5,328,260	$5,328,260	$5,448,260	$5,448,260	$23,439,868	100.0%

Program 15. Energy Star Cool Roofs Program

The DEC Cool Roofs program is designed to decrease cooling energy use, lower energy bills, and to increase indoor comfort. It will also have a small effect in reducing energy demand on summer peak days.

Residential roofs are usually dark colored and have low-reflectance surfaces which reach temperatures from 150 to 190°F on hot summer days. Attic space is similarly superheated compared with the conditioned space in the home and when a hot attic contains part of the cooling system it can lead to inefficient cooling.

One solution is "cool roofs," that is replacing the traditional dark roofing materials with "cool roof" replacements that have high solar reflectance and high thermal emittance. Solar reflectance is the percentage of solar energy that is reflected by a surface. Thermal emittance is defined as the percentage of energy a material can radiate away after the energy is absorbed. Roof replacement is an infrequent but periodic need in all homes with composite shingles. Dark colored roofs can now also be "cool" (having high solar reflectance and thermal emittance).[71] While ventilation is not part of this program, when replacing a roof a customer should ask the contractor about adequate attic ventilation.[72]

Because the program is designed to save cooling energy, the program is limited to homes with central air conditioning or heat pumps.

Table 59. Measure and Incentive – Energy Star Cool Roofs

Measures	Incentive Amounts
Cool Roof	$200

This program is modeled on the Pacific Gas & Electric Cool Roof Program.[73] For the PG&E program, rebates are ten cents per square foot or twenty cents per square foot, depending on the slope of the roof and level of initial solar reflectance. For Duke Energy's program this is simplified to a $200 one-time incentive for re-roofing with qualifying products.

Rationale

The Cool Roofs program will substantially lower interior attic temperature during hot summers, reducing cooling load. The program helps reduce the air conditioning load by reducing the amount of solar energy absorbed by roof surfaces during summer. It can help mitigate heat island effects, increase comfort in the home, and increase roof life by protecting the roof material from ultraviolet and thermal degradation. In addition it can increase the life of the cooling equipment and offers the potential to downsize any new equipment being installed.

[71] Energy Star reflective roofing decreases roof surface temperature by up to 100 degrees Fahrenheit, decreasing the amount of heat transferred into the residence. It is estimated to reduce peak cooling demand by ten to fifteen percent (http://www.energystar.gov/index.cfm?c=roof_prods.pr_roof_products).

[72] Ventilation moves air through the attic by the natural force of wind or by the natural force of heat rising through natural convection. Ventilation also has the ability to remove humidity and improve the effectiveness of attic floor insulation. Attic ventilation is very important because hot air needs to escape from the attic.

[73] See: http://www.pge.com/res/rebates/cool_roof/index.html.

Participation

Participation begins at a relatively low level in Year 1, then ramps aggressively through Year 5. It is anticipated that by Year 5 stocking practices will change to further enable the program.

Table 60. Estimated Participation and Savings – Energy Star Cool Roofs

Potential Participants				14,000
Per participant Savings (kWh):				596
Per Participant Savings (kW):				0.4
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	2,100	15.0%	1,251,600	879
Year 2	4,900	35.0%	2,920,400	2,051
Year 3	7,000	50.0%	4,172,000	2,930
Year 4	8,400	60.0%	5,006,400	3,516
Year 5	9,800	70.0%	5,840,800	4,101
Cumulative	32,200	46.0%	19,191,200	13,476

Marketing Plans

- Proposed marketing efforts include the use of utility bill stuffers for customer education, and mention of the program in any DEC communications with customers regarding energy efficiency program options.
- Marketing efforts should also target roofing contractors who can promote the program to their customers and program staff should work with "big-box" stores such as Lowe's and Home Depot to stock Cool Roof materials, so that they will not be "special order."
- Currently, while a wide variety of choices of Cool Roof materials are available, they are typically not stocked where housing materials are sold, so there can be a significant price differential to a customer placing an order between materials that are stocked and Cool Roof as a special order. However, the actual price difference is essentially zero, once Cool Roof materials are distributed and stocked in the same manner as conventional materials. The table below shows this contrast.[74]

Traditional Roof				Cool Roof			
Type	Reflectance	Emittance	Cost ($/ft2)	Type	Reflectance	Emittance	Cost ($/ft2)
BUR			1.2 - 2.1	BUR			1.2 - 2.15
w/ dark gravel	0.08 - 0.15	0.80 - 0.90		w/ white gravel	0.30 - 0.50	0.80 - 0.90	
w/ smooth asphalt,	0.04 - 0.05	0.85 - 0.95		w/ gravel and cementi-	0.50 - 0.70	0.80 - 0.90	
surface	0.25 - 0.60	0.20 - 0.50		tious	0.75 - 0.85	0.85 - 0.95	
Single-Ply			1.0 - 2.0	Single-Ply			1.0 - 2.05
black (EPDM, CPE, CSPE,				white (EPDM, CPE,			
PVC	0.04 - 0.05	0.85 - 0.95		CSPE, PVC	0.70 - 0.78	0.85 - 0.95	
gray EPDM	0.15 - 0.20	0.85 - 0.95					
Modified Bitumen			1.5 - 1.9	Modified Bitumen			1.5 - 1.95
w/ mineral surface				white coating over a			
capsheet (SBS, APP)	0.10 - 0.20	0.85 - 0.95		mineral surface	0.60 - 0.75	0.85 - 0.95	

A goal of the marketing plan will be to change stocking practices to bring this benefit of virtually zero cost differential to Duke's service territory in South Carolina.

Data Concerns

Data collection and documentation for program purposes and annual reporting will require tracking of rebates, verification of central air conditioning or heat pump, and documentation of jobs to insure that Cool Roof materials have been used.

[74] Pacific Gas & Electric Company, Cool Roof Design Brief, P. 13. (The Design Brief is downloadable from PG&E website cited above.)

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to DEC for offering this program to customers involves budgets for:

- DEC administrative costs to develop, advertise, oversee and monitor the program
- Cost of rebates.

Costs to participating customers:

- Customer's time
- The balance of cost, if any, beyond the customer incentive. This cost is expected to show a significant differential from cost of current (non Cool Roof) materials until stocking practices have changed. If the program is successful, over five or more years the differential can be brought to zero.

Table 61. Estimated Five-Year Program Budget – Energy Star Cool Roofs

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & other annual cost		$115,000	$80,000	$80,000	$80,000	$80,000	$435,000	8%
DSM Staffing		$11,440	$11,440	$11,440	$11,440	$11,440	$57,200	1%
Program monitoring and evaluation		$8,000	$8,000	$35,000	$8,000	$45,000	$104,000	2%
Variable Program Costs								
Incentives	$158	$330,750	$771,750	$1,102,500	$1,323,000	$1,543,500	$5,071,500	89%
Delivery and othber	$0	$0	$0	$0	$0	$0	$0	0%
Total Budget		$465,190	$871,190	$1,228,940	$1,422,440	$1,679,940	$5,667,700	100.0%

PROGRAM COST EFFECTIVENESS

Program cost effectiveness analysis answers the question of would we be better off with the DSM 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 that will be addressed in this report:

- Total Resource Cost (TRC)
- Societal (a variant of the TRC)
- Participant
- Ratepayer Impact (RIM)
- Utility Cost (also known as Administrator Cost)

We used DSMore software from Integral Analytics to compute each of the tests listed above. 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 DSM program.

Expected Program Costs

Program budgets over the first five years of program activity are shown for each program in the DSM Programs section. We recommend a minimum of five years for program implementation and tuning for maximum effectiveness. Program budgets include the cost of incentives and other program specific expenses including evaluation. They also include costs for fully loaded program staffing, administration and overhead.

Fully loaded staffing costs were calculated using assumptions regarding FTE required for program administration multiplied by the cost per FTE. A weighted average cost per FTE was calculated assuming a 4-to-1 ratio of support to managerial labor requirements. These calculations are shown in the table below.

Table 62. DSM Staffing Cost Assumptions

Staffing	FTE	Fully Loaded Cost per FTE	Cost
Analyst and Support Staff	4.0	$80,000	$320,000
Managerial Staff	1.0	$120,000	$120,000
Total Staffing	5.0	$88,000	$440,000

The program budgets presented in this report include all program-specific fixed and variable expenses paid by the program administrator. 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.

We recommend that flexibility include the following:

1. Roll over unspent funds within program budgets at end of year to categories within the same program in the next year.
2. Reallocate program funds across line items within a program.
3. Shift up to 25 percent of total budget among approved programs at any time within a program year.

Having some flexibility in the administration of program funding will assist in the management of programs and enable staff to fine tune efforts for maximum resource effectiveness.

Miscellaneous Program Assumptions

Energy savings expected from the program 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 65 below. Most of the items listed in Table 65 were addressed in the Program Plans section. The savings life is calculated from the life of individual measures weighted by program savings and represents the duration of energy savings flowing from a participant in the program. The net-to-gross ratio captures the effect of free riders, participants in the program who would have installed the energy efficient measures without the program. Higher ratios imply a lower rate of free riders in the program.

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 loads. Duke's avoided costs are the reduction in the cost of supplying kWh and kW compared to what they 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 vary by time of day and month. We used the assumptions embedded in DSMore to capture this variance, along with the hourly savings profile we constructed for each program from our modeling efforts.

Cost Effectiveness Results

In this section, we present the findings of the cost effectiveness analysis which provides a systematic comparison of the program benefits and costs discussed in previous sections. Results are shown for the five perspectives mentioned at the beginning of this section. Benefit-costs ratios returned by DSMore are shown for all perspectives.

The Societal and TRC perspectives are the broadest of the cost effectiveness tests. As the name implies, TRC shows the total cost of the resource relative to supply side resources. Since environmental externalities were set to zero in DSMore, the TRC and Societal only differ with respect to tax credits paid to the participant. Such credits lower the TRC but are considered a transfer payment from the perspective of the societal test. 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 programs the lost revenue calculation in the RIM test exceeds the avoided cost of

supply causing the programs to fail the RIM test. The Utility Cost Test reveals that when only costs paid by the program administrator are considered, the cost of the acquired resource is generally lower than the TRC unless the utility pays for the full cost of installation. From a TRC perspective, all but four of the programs are cost effective.

Other Assumptions

Free-riders, program participants who would have installed the measure without the program, are measured through the net-to-gross ratio. A ratio of 1.0 assumes no free-riders. Most programs assume 5 to 10 percent free-riders, net-to-gross ratios of 0.95 to 0.90, respectively. 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. There is debate over the appropriateness of including free-riders without also including free-drivers, an opposite and offsetting impact. Our approach is conservative since free-riders may be offset by program spillover effects.[75]

Currently Recommended Programs

We initially formulated our slate of DSM programs from the results of our market assessment, a review of best practices and our own experience. All programs turned out to be cost effective with the exception of Commercial and Institutional Retro-Commissioning, Residential HVAC, Solar Heated Domestic Hot Water, and Residential Weatherization. We are recommending two of these programs for implementation despite the cost-effectiveness, each for different reasons. In the case of Commercial and Institutional Retro-Commissioning we are recommending a pilot program to explore the magnitude and persistence of energy savings opportunities. The key to this program will be the successful identification, recruitment and treatment of customers with large savings opportunities and the longevity of savings after treatment. Residential Weatherization Program is recommended because it is targeted toward low-income customers.

Based on the cost-effectiveness results we are unable to recommend a solar program at this time. We have also chosen not to recommend a pilot based on the current potential for cost-effectiveness. Unlike the retro-commissioning program, we can not recommend a solar pilot based on the likelihood that the program could be made cost effective with the right recruitment and treatment methods. Still, the solar potential has been demonstrated in this report to represent a large energy resource that could be tapped into to meet a significant amount of future demand. The solar resource is also technically mature and readily deployable. These and other issues that go beyond the scope of this report may well argue for a solar pilot program. Also, conditions may change in the future which cause solar or other programs to become cost effective. For now, however, we feel that the emphasis should be placed on implementing those programs have been shown to be currently cost effective.

[75] Although conservative, our approach did not impact the slate of recommended programs since the non-cost-effective programs are still not cost effective at a net-to-gross ratio of 1.0.

Our recommendation is to implement the following programs:

- Key Accounts Custom
- Load Control – pending internal study[76]
- Prescriptive
- Commercial and Industrial Retro-Commissioning Lite Pilot
- New Commercial Construction
- Residential Energy Assessment
- Energy Star Appliances and Lighting
- Energy Star Plus
- Manufactured Homes
- On-Site Audit with Direct Install
- Old Refrigerator Pick-Up and Recycling
- Residential Weatherization
- Energy Star Cool Roofs

The budget and savings impacts of recommended programs are provided in Table 63.

Table 63. Energy Savings and Annual Budget for Recommended Programs

Year	Cumulative kWh Savings (Millions)	Program Budget (millions $)	Cost per Customer	Percent of Revenue
1	26	7.2	13.67	0.6%
2	71	13.0	24.50	1.1%
3	132	16.4	30.85	1.3%
4	212	20.1	37.96	1.6%
5	300	21.5	40.56	1.7%

* Although demand response programs are recommended, program budgets and savings are not included in this table and were not developed as part of this report.

Recommended programs are expected to achieve 300 million kWh in annual savings after five years of operation. The annual budget for recommended programs increases with program implementation efforts, reaching $21.5 million in Year 5. Spending on recommended programs reaches nearly $41 per customer, 1.7 percent of total annual revenue, in program Year 5.

Demand side management spending and savings information reported to the Energy Information Administration (EIA) is shown in Table 64 for utilities with between 500,000 to 2,000,000 customers. Spending levels reported for 2005 have been adjusted to 2006 dollars. The results show a wide range of spending and savings. Spending per customer ranges from less than one dollar to nearly $90 on the high end. When expressed as a percent of revenue DSM spending ranges from less than one tenth of a percent to over four percent. Energy savings ranges from one-tenth of a percent of kWh sales to over 10 percent.

The spending levels per customer recommended in this action plan are on the high end of spending per customer reported in Table 64, a reasonable result for the high fixed cost associated with DSM ramp up that is spread over fewer customers. Duke's recommended programs achieve average percentage savings that are typical of the utilities reported in Table 64.

[76] The Load Control program is recommended but requires internal study before proceeding.

Table 64. Comparison of DSM Program Spending and Savings

Name of Utility	Ownership	DSM Spending per Customer	kWh Saved as % kWh Sales	DSM Spending as % Revenue
Cincinnati Gas & Electric Company	Investor Owned	0.95	0.9	0.0
Pennsylvania Electric Co	Investor Owned	3.32	0.1	0.2
Metropolitan Edison Co	Investor Owned	3.64	0.0	0.2
Wisconsin Electric Power Co	Investor Owned	3.85	0.9	0.2
Entergy Gulf States Inc	Investor Owned	4.67	0.0	0.1
Salt River Project	Political Subdivision	5.54	0.5	0.3
Kentucky Utilities Co	Investor Owned	6.15	0.2	0.3
San Antonio City of	Municipal	7.35	0.1	0.3
PSI Energy Inc	Investor Owned	7.70	1.5	0.4
Central Maine Power Co	Investor Owned	11.66	0.1	1.6
Nevada Power Company	Investor Owned	14.55	0.9	0.6
Public Service Co of Colorado	Investor Owned	16.54	1.9	1.0
PacifiCorp	Investor Owned	19.65	2.4	1.2
Jersey Central Power & Lt Co	Investor Owned	21.50	2.6	1.0
Tampa Electric Co	Investor Owned	25.01	3.1	0.9
Puget Sound Energy Inc	Investor Owned	25.47	9.3	1.7
Progress Energy Florida Inc	Investor Owned	37.56	1.8	1.7
MidAmerican Energy Co	Investor Owned	38.46	2.4	2.0
Sacramento Municipal Util Dist	Political Subdivision	38.77	10.7	2.1
Massachusetts Electric Co	Investor Owned	44.10	6.5	2.5
Connecticut Light & Power Co	Investor Owned	48.25	6.6	1.9
Boston Edison Co	Investor Owned	60.60	8.5	2.3
Northern States Power Co	Investor Owned	62.16	6.3	3.3
San Diego Gas & Electric Co	Investor Owned	65.62	1.9	3.7
Interstate Power and Light Co	Investor Owned	89.37	2.6	4.1
Average		26.50	2.9	1.3
Note: Values are for total residential and commercial customers at utilities with 500,000 to 2,000,000 customers.				

Source: US DOE Energy Information Administration Form 861

Table 65. Program Assumptions

Program #	1	3	4	5	6	7	8	9	10	11	12	13	14	15
Program Name	**Key Accounts**	**Prescriptive**	**C&I RetroCom**	**C&I New Constr**	**Res Energy Assess**	**ES Appl & Lights**	**Res HVAC**	**Solar Hot Water**	**ES Plus**	**Manuf Homes**	**OnSite Audit**	**Old Refrig Pick Up**	**Res Weatheriz ation**	**ES Cool Roofs**
Electric Savings (kWh)	1,200,000	27,138	8,850	18,959	596	381	1,065	2,800	3,788	4,632	1,357	1,150	2,386	596
Installed Incremental Cost	$250,000	$8,527	$2,000	$6,446	$38	$154	$984	$8,310	$2,100	$2,600	$96	$0	$998	$158
Incentive	$125,000	$2,520	$1,000	$4,830	$10	$31	$213	$2,078	$1,050	$900	$48	$30	$998	$158
Savings Life (years)	7.0	12.6	5.0	25.0	9.3	11.4	15.8	25.0	20.0	25.0	5.6	5.0	17.6	25.0
Net to Gross Ratio	1.00	0.75	1.00	1.00	0.80	0.85	0.90	1.00	0.95	1.00	1.00	1.00	1.00	0.60
Incentives	$125,000	$2,520	$1,000	$4,830	$10	$31	$213	$2,078	$1,050	$900	$46	$30	$998	$158
Govt Payments (tax rebates, etc, per participant)	$0	$0	$0	$0	$0	$0	$0	$3,400	$0	$1,000	$0	$0	$0	$0
Participant Paid Incremental Cost (per participant)	$125,000	$6,007	$1,000	$1,616	$29	$123	$771	$2,833	$1,050	$700	$50	-$30	$0	$0
Note: Program assumptions and results were not developed in the Load Control Program (Program 2)														

Table 66. Benefit-Cost Ratios

Program #	1	3	4	5	6	7	8	9	10	11	12	13	14	15
Recommendation (Yes/No)	**Yes**	**Yes**	**Yes-Pilot**	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Program Name	**Key Accounts**	**Prescrip tive**	**C&I RetroCom**	**C&I New Constr**	**Res Energy Assess**	**ES Appl & Lights**	**Res HVAC**	**Solar Hot Water**	**ES Plus**	**Manuf Homes**	**OnSite Audit**	**Old Refrig Pick Up**	**Res Weather ization**	**ES Cool Roofs**
Utility Test	2.05	3.78	0.30	3.08	4.40	3.60	3.19	1.03	1.75	2.61	1.32	1.71	0.78	3.02
TRC Test	1.23	1.62	0.27	2.32	2.98	1.15	0.86	0.46	1.12	1.75	1.13	2.04	0.78	4.70
RIM Test	0.68	0.73	0.22	0.71	0.55	0.58	0.70	0.43	0.52	0.57	0.47	0.50	0.37	0.89
Societal Test	1.23	1.62	0.27	2.32	2.98	1.15	0.86	0.27	1.12	1.20	1.13	2.04	0.78	4.70
Participant Test	2.02	2.30	2.21	3.35	10.37	2.09	1.25	1.08	2.50	3.80	6.07	NA	3.36	6.09
Note: Program assumptions and results were not developed in the Load Control Program (Program 2) NA-Not available, currently under review.														

PROGRAM EVALUATION

The table below provides a summary of the recommended DSM Monitoring & Verification (M&V) plans for each DSM Program. These are not complete plans, but they outline the type of M&V commitment that will be required to conservatively demonstrate results with high confidence and to generally understood industry practice standards.

Table 67. Recommended Measurement and Verification Approaches

Program	Type of M&V Required
Multi-Sector Programs	
1. Key Accounts Custom	Evaluation will combine engineering calculations with limited short-term data logging or spot metering. Evaluation for this program will have to be kept simple, but adequate to satisfy needs of executives and managers of the key account, plus Duke Energy's and the Commission's need for defensible evaluation results. Typically in these contexts, measurement is direct and short so as not to interfere with production. For each project selected for verification, a verification plan will be developed for the site, depending in part on the measures (EEM complexity, technologies, anticipated interactive effects), the project estimated value of energy conserved, and site review including site specific and institutional constraints. For each project selected, there will be a pre-installation site review, as site-specific plan detailing how measurements will be taken (with assumptions), any pre-installation M&V effort as required by the plan (to establish the baseline), post-installation M&V (with post-installation metering), and development of a post-installation M&V report. A final Evaluation report will summarize results over the sites and characterize the yearly savings due to the program. Spot or short-term metering is expected to determine baseline and post-installation energy use. Analysis will follow the International Performance Measurement and Verification Protocols (IPMVP) under options A (Partially Measured Retrofit Isolation, B (Retrofit Isolation), C (Whole Facility), and D (Calibrated Simulation) as suitable under IPMVP to the specific measures installed at specific sites.
2. Load Control	Evaluation of load control programs, both direct load control and using energy cooperative is inherently self-documenting each time a load event is called, and does not require subsequent evaluation except for engineering review. In the engineering review, the evaluation will produce load shape impacts for selected curtailment events, and curtailment events will be interpreted with reference to Duke Energy's load duration curve. The evaluation will include reference to Duke Energy internal planning and will recommend, if economic, further ramp up in load control programs.
3. Prescriptive	The prescriptive program will require elements of both process and impact evaluation for each delivery channel (agricultural & industrial, commercial & institutional, small hotels & motels, non-profits, and schools). Each delivery channel will require an individual evaluation, followed by a general summation of evaluation results for the prescriptive area. For each project selected for verification, a verification plan will be developed for the site, depending in part on the measures (EEM complexity, technologies, anticipated interactive effects), the project estimated value of energy conserved, and site review. For each project selected, there will be a pre-installation site review, a site-specific plan detailing how measurements will be taken (with assumptions), any pre-installation M&V effort as required by the plan (to establish the baseline), post-installation M&V (with post-installation metering), and development of a post-installation M&V report. A final Evaluation report will summarize results over the sites and characterize the yearly savings due to the program. Spot or short-term metering is expected to determine baseline and post-installation energy use. Analysis will follow the International Performance Measurement and Verification Protocols (IPMVP) under options A (Partially Measured Retrofit Isolation, B (Retrofit Isolation), C (Whole Facility), and D (Calibrated Simulation) as suitable under IPMVP to the specific measures installed at specific sites.

Non-Residential Programs	
4. Commercial and Industrial Retro-Commissioning Lite	Evaluation of retro-commissioning will look particularly at savings claims and test the duration of energy savings. For the most part, evaluation in this area involves an engineering review. However, for selected sites where measurement is possible an evaluation approach with baseline, post treatment, and subsequent year measurement will be employed.
5. New Commercial Construction	Savings calculations will follow the International Performance Measurement and Verification Protocol (IPMVP) Option D (Calibrated Computer Simulations), assisted by information from the DOE website, onsite survey and verification of selected buildings, and limited data logger monitoring. An evaluation plan will provide the specifics of the instrumentation for the datalogger, calculation methods, and assumptions.
Residential	
6. Residential Energy Assessment	Since this is a remote audit program using the Internet and mail-in forms, energy savings claims will be limited to the low-cost measures sent out to accompany audit results. This is an engineering calculation. It will be checked using a mini-survey approach to develop information on installation rates to modify results using a net-to-gross ratio.
7. Energy Star Appliances and Lighting	For lighting, the evaluation approach will be to verify the CFL wattage and CFL life of all rebated units according to vendor/brand specifications. Also to verify the typical wattage of incandescent bulbs replaced by CFLs (the basic assumption is that all CFLs will replace an incandescent bulb of equivalent luminosity; other assumptions will be taken from the national Energy Star program, as listed on their website). Results will be quantified according to standard M&V protocols to estimate the annual and lifetime energy savings. The evaluation report will present these results and report the distribution of CFLs by brand, model, and wattage. For appliances, the evaluation approach will be to gather complete technical descriptive information to identify each Energy Star appliance rebated (brand, model, characteristics). Results will be quantified using industry standard M&V calculations for each appliance type. The evaluation report will summarize this information and calculation results to document energy savings. The evaluator will review program records and independently check program savings calculations maintained in the program tracking system.
8. Residential HVAC	For most sites, evaluation will be based on program records and engineering calculations. For selected sites, M&V will utilize a combination of short-term and spot metering plus an analysis of utility metered data by season using a non-equivalent control group design.
9. Solar Heated Domestic Hot Water	Evaluation will combine engineering calculations with limited site monitoring of selected sites and utility metered data on all sites. For solar units, solar orientation will be recorded for each site, and direct monitoring will be conducted on selected sites. The monitoring protocol, including specification of instrumentation, and the data analytic protocol will be developed prior to implementation.
10. Energy Star Plus	The primary method of evaluation will be an engineering review of program records, since Energy Star qualification will be certified by the program. For a few selected homes, savings calculations will follow the International Performance Measurement and Verification Protocol (IPMVP) Option D (Calibrated Computer Simulations), assisted by information from the DOE website, onsite survey and verification of a few selected homes, and limited data logger monitoring. An evaluation plan will provide the specifics of the instrumentation for the datalogger, calculation methods, and assumptions.
11. Manufactured Homes	The primary method of evaluation will be an engineering review of program records, since the program provides inspections both in the plant and on site. For a few selected units, savings calculations will follow the International Performance Measurement and Verification Protocols (IPMVP), Option A (Partially Measured Retrofit Isolation). Energy savings will be calculated using engineering calculations, short-term measurements, and specified assumptions. The basic approach will be to attach data loggers to an equal number of Energy Star and non-Energy Star manufactured homes and measure during the same weather conditions. The particular

	focus will be on indoor temperature, and electrical usage characteristics of the home under summer, winter, and shoulder seasonally conditions. Homes will be selected in pairs to be of the same class.
12. On-Site Audit with Direct Install	Energy savings claims will be limited to direct install items. Evaluation will be based on engineering review of audit records of actions taken and measures installed.
13. Old Refrigerator Pick Up and Recycling	The evaluation will first verify via sample telephone survey that participating customers received the pick-up service and the rebate. For each pick-up the program vendor will be required to gather technical information on each refrigerator or freezer (manufacturer/brand, model number, defrost auto or manual, ice maker included, location (such as kitchen or garage), pick up date, and refrigerant type (cf11, cf12, cf22, hfc134, hfc141b). Calculation of energy savings and demand reductions will be carried out using industry standard M&V protocols. Environmental effects will also be estimated using standard calculations. All calculations will make use of unit specific data maintained on the DOE website to insure standard results. The evaluation report will summarize and present the results of this analysis.
14. Residential Weatherization	M&V will follow a traditional non-equivalent control group design using either PRISM or regression modeling, with an equal number of treated and similar untreated homes.
15. Energy Star Cool Roofs	M&V will be based on short-term temperature logging before and after installation, and a comparison of utility metered data by season using a non-equivalent control group design.

Customer Satisfaction Metrics

Customer satisfaction for each program is best assessed using a system of continuous mini-surveys. Mini-surveys are "mini" in three ways:

- First, they typically have no more than ten or twelve questions (and may have less) so they are easy to answer and not a burden for the customer.
- Second, all of the questions (or almost all) are answerable with a "yes/no" "0/1" or a percentage type response. This permits use of small sample theory.
- Third, the sample sizes are small, perhaps 30 completed satisfaction survey forms in each survey wave for a program.

However, they are repeated every quarter so that a time series tracking record of responses to the individual satisfaction question can be developed and graphed. This provides an easy to deploy method of assessing customer satisfaction on a continuous basis that is able to detect changes that might require management response. Since the tracking is continuous, the feedback is in the form of a periodic management report with graphs.

Typically, customer satisfaction is best surveyed by an independent third party such as a marketing firm or an independent evaluator. For Key Accounts (Program 1) since there are only a small number of persons involved at high company and engineering levels, there is an exception. For this program, the evaluator will talk directly with principals in person or by phone and fill out the survey responses. For all other programs, surveys will be by mail or phone, and conducted on a sample basis.

Because the response format for the questions is constrained, small sample theory can be used and the sample sizes will be small for each survey wave, but the waves will be repeated quarterly. The survey questions will be tailored separated for each program (by program delivery channel where there is more than one delivery channel for a program).

The load control (Program 2) surveys will be developed in two forms, one if there has not been a recent load event, and the other for a specific load event. Both direct load control and energy cooperative participants will be surveyed.

Similarly, for the prescriptive program (Program 3), a survey will be tailored for each delivery channel. Individual mini-surveys will be tailored for Program 4 through Program 15.

For each survey wave (and with the exception of programs with a small number of customers) the goal will be a completed sample size of at least 30 and not more than 60. By repeating the same survey with new customers each quarter, the customer satisfaction results will cumulate to much larger samples over a year or the five year horizon developed in the plan, so statistical confidence, significance, and power are all addressed over time. Also, buy keeping a few common questions across all surveys, a general assessment of customer satisfaction in the whole DSM effort is possible.

APPENDIX A. METHODOLOGY

At the root of most DSM analysis there is some form of energy usage model. The model 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 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 25 and Figure 26, shows that the daily average energy use has a close relationship to temperature.

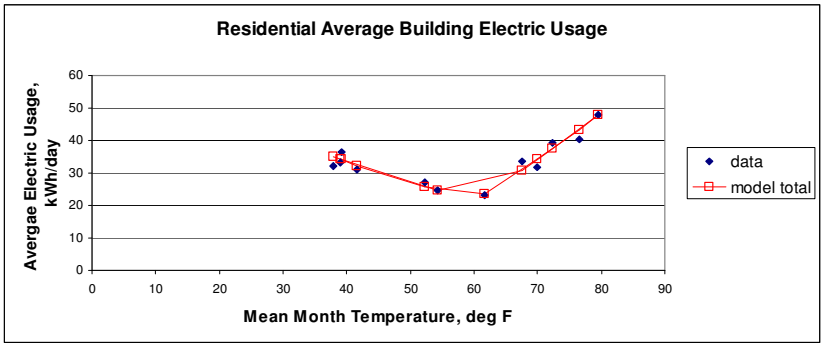


Figure 25. Existing Single Family

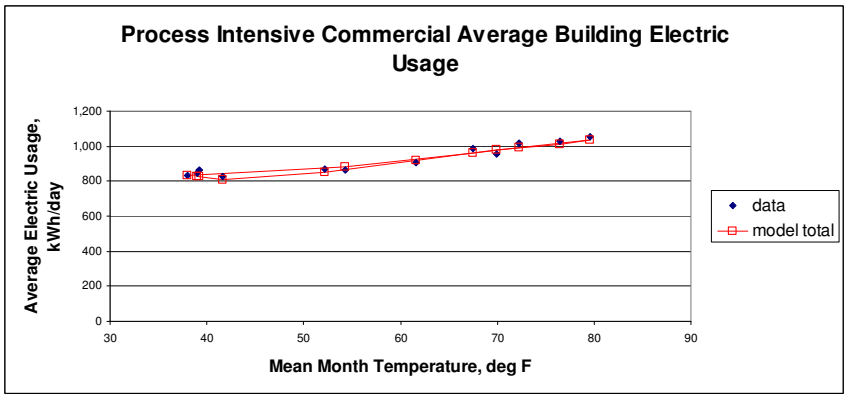


Figure 26. Grocery

Figure 25 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 three other smaller portions of the 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 26 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 26 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:

- Heating
- Cooling
- Hot Water
- Lighting
- Internal Uses, Plugs, Cooking, Dishwasher
- External Uses, Outdoor Lights, Washer, Dryer

Note that the fundamental end-uses distinguish between internal and external electric energy use. This 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.

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 68.

Table 68. 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 69. These are the variables that are changed in the process of fitting a model to the data. It is noteworthy that the relatively few systems inputs are sufficient to fit a model so closely to the data, but that lies in the nature of fitting the averages of hundreds or thousands of sites.

Table 69. Residential Energy Model Inputs

	Existing Housing		New Construction	
Model Input	**SF**	**MF**	**SF**	**MF**
Customers - Percent of Sector	79%	14%	6%	1%
Water Heat Saturation	82%	95%	44%	75%
Hot Water Use Gallons per Day	65	55	65	55
Tank Loss btu/degree hour	4	4	4	4
Hot Water Tank Set Temperature	130	130	130	130
Hot Water Tank Efficiency	100%	100%	100%	100%
Space Heat Saturation	56%	75%	54%	31%
Space Heat Efficiency	1.73	1.75	2.2	2.4
Space Heat Set Temperature	67.5	60	62.7	60
Space Heat Use btu/degree hour	450	250	420	220
Lights kWh/day	5.4	3.75	6.85	2.78
Lights and Misc Saturation	100%	100%	100%	100%
Kitchen Use kWh/day	8.06	5.60	10.23	4.15
Kitchen Use Saturation	100%	100%	100%	100%
Washer, Dryer and External kWh/day	2.03	1.41	2.58	1.05
Washer, Dryer and External Saturation	100%	100%	100%	100%
Space Cooling Saturation	95%	80%	95%	85%
Space Cooling Set Temperature	62	65	65	67
Space Cooling Use btu/degree hour	450	250	420	220

This model is very simple in an attempt to be reasonably transparent and reviewable. 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 70. Energy Systems Performance Inputs

DHW saturation	Lights saturation
DHW gal/day	Internal loads kWh/day
Tank loss btu/deghr	Internal penetration
DHW set temp	External Loads
DHW efficiency	External penetration
Space Saturation	Cool saturation
Space efficiency	Cool set temp
Space set temp	Cool slope BTU/deg hr
Space slope btu/deghr	Cool efficiency
Lights kWh/day	Cooling fraction

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 30-year temperatures for the service area. Figure 27 shows the actual temperatures in the test year and the long-term average temperatures.

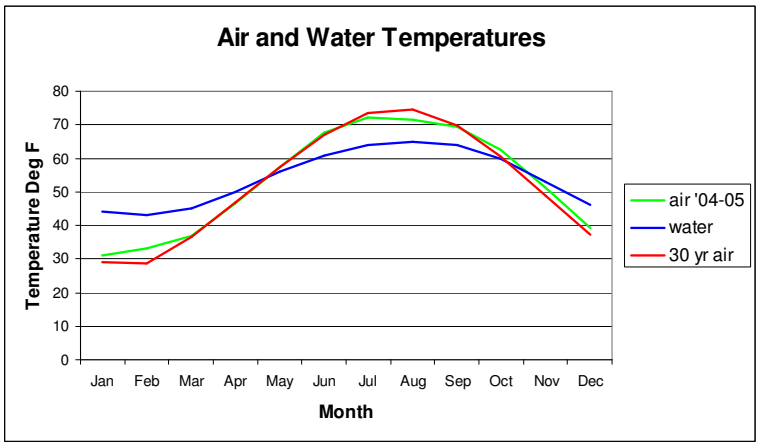


Figure 27. Air and Water Temperatures

In Figure 27, it is evident that the test year, green, is close to the 30-year average, red. The water temperature in Figure 27 refers to the ground water temperature which is used in the end-use models for hot 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.

Demand Model

Available Data

Duke made available hourly load data by rate class for 2006. This analysis proceeded from a load metered sample worked to an estimate of the total system load, and to the load of the principal customer sectors. Loads that we excluded from the analysis include the direct sales to municipalities 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, 2006. 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 DEC 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*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 28 and Figure 29 show the hourly demand factors empirically derived from this analysis and applicable to the residential customers.

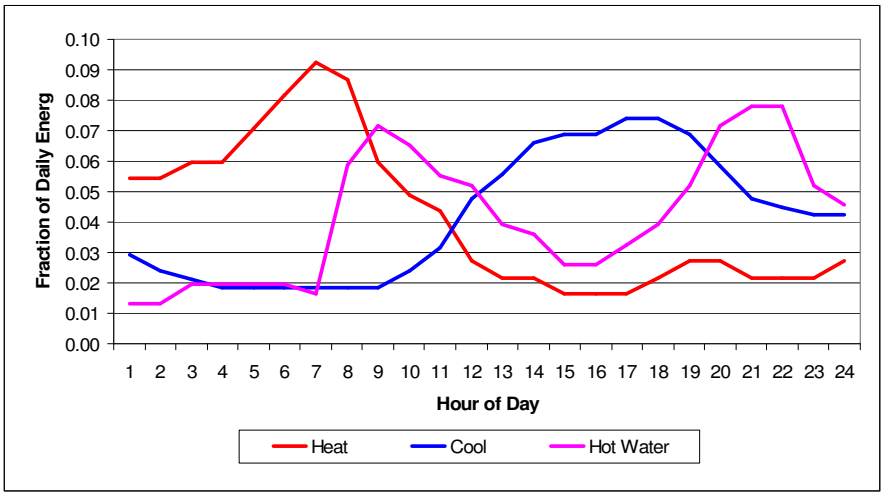


Figure 28. Residential Hourly Demand Factors for Heat Cool, Hot Water

Notice in Figure 28 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.

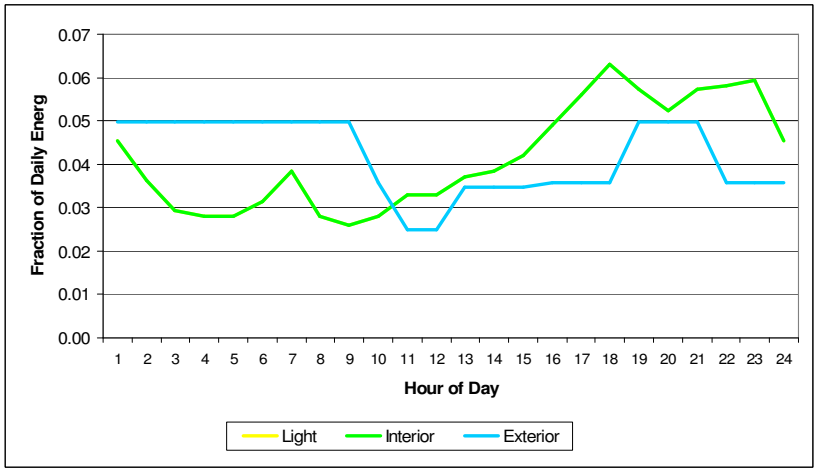


Figure 29. Residential Hourly Demand Factors for Lighting, Interior, and Exterior Loads

Notice in Figure 29 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 16 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 30 and Figure 31.

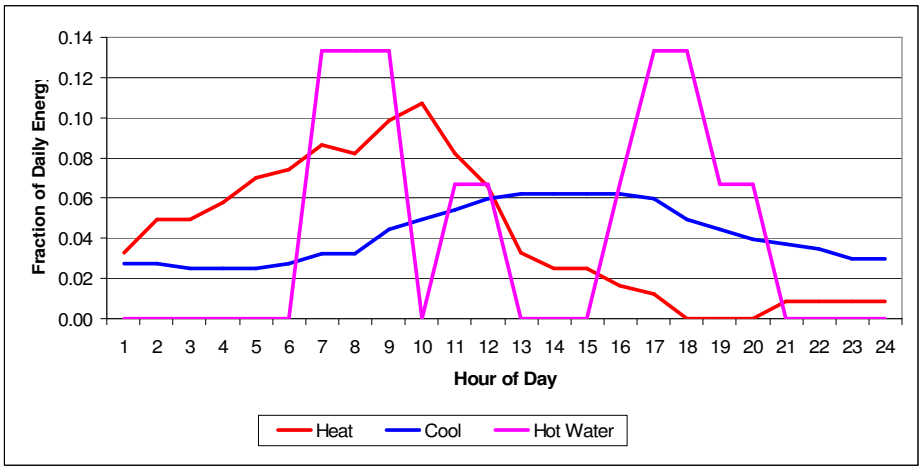


Figure 30. Commercial Hourly Demand Factors for Heating, Cooling, and Hot Water

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 30 the demand factors for cooling are the most important.

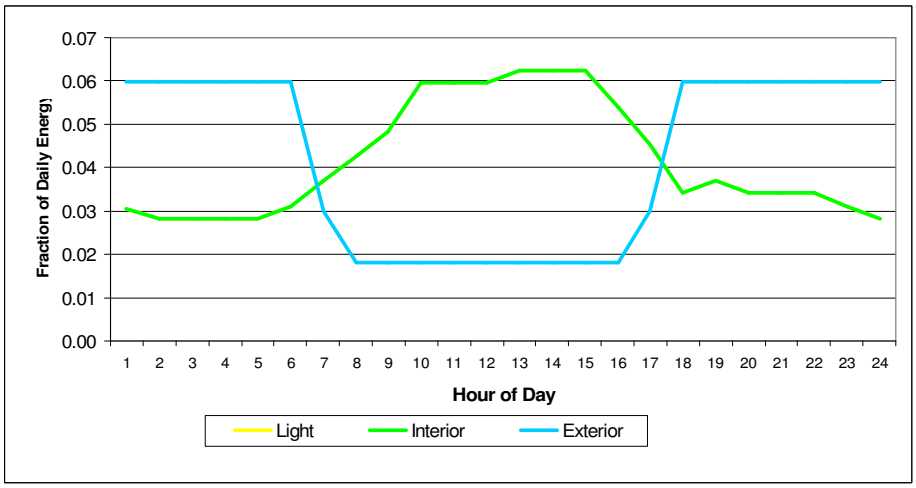


Figure 31. Commercial Hourly Demand Factors for Lighting, Internal and External Loads

In Figure 31, 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 32 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.

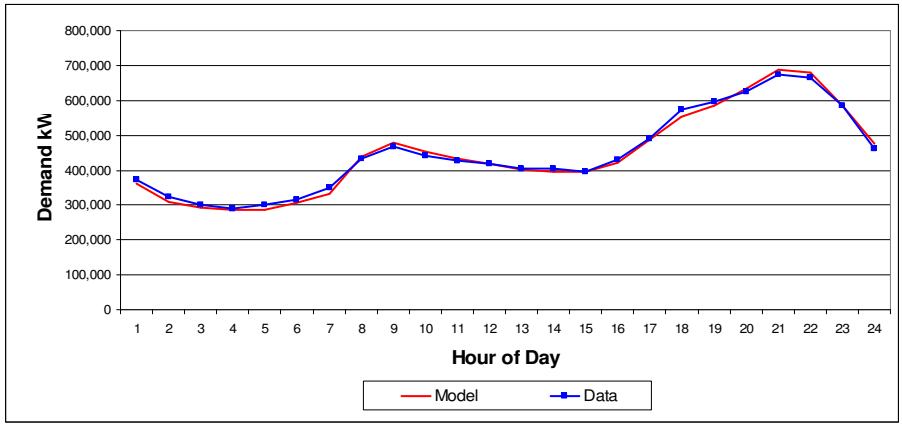


Figure 32. Base Load True-Up – Residential, September

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.

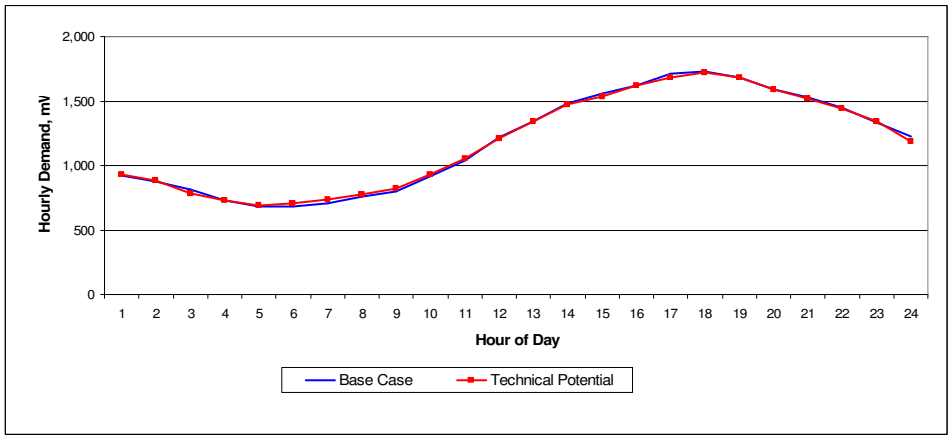


Figure 33. Cooling True-Up – All Customers, August

Figure 33 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.

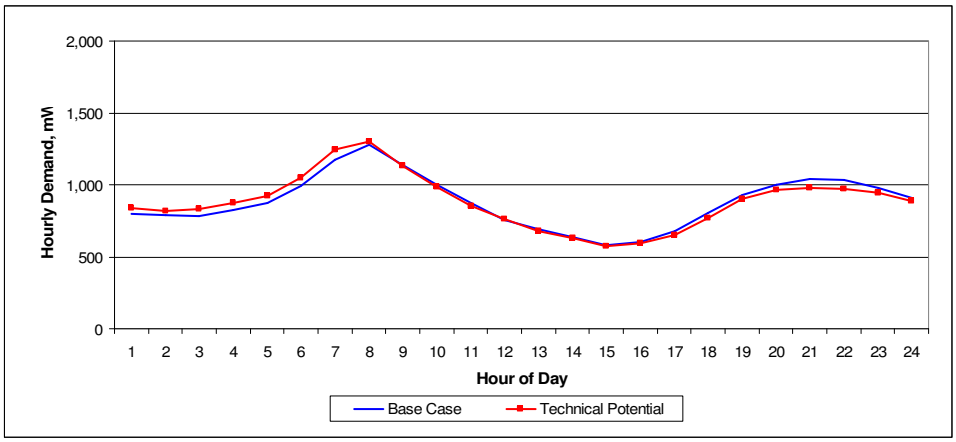


Figure 34. Heating True-Up – All Customers, January

Figure 34 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 will be reported as the demand impact. As such, this demand impact does not include effects of transmission and distribution losses that will be in the financial analysis to both energy and demand.

Estimating the Technical Potential for Demand Savings

This model will estimate the change in average hourly demand for each month corresponding to any group of efficiency measures or all the measures used to express full technical potential. This month by month change in hourly demand will be reported as the demand impact. As such, this demand impact does not include effects of transmission and distribution losses that will be in the financial analysis to both energy and demand.

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 estimate technical potential at a five and 20 year planning horizon, it is necessary to forecast customer and loads over the same forecast periods. This provides us with three distinct points of reference regarding technical potential, the base period (2006). As one would expect, the mix of DSM potential changes over time with new construction growing in importance the further we go out in the forecast. The technical potential estimated for 2011 will be used as a benchmark for evaluating DSM program objectives and performance.

Estimates for future energy use and customers were taken from the DEC Spring 2006 forecast. Since this forecast is for all of Duke Carolinas, we used the growth rates in the forecast to calculate future customers and loads for North Carolina and South Carolina separately. The DEC Spring 2006 forecast only goes out to 2016 so the compound average growth rates over the last five years in the forecast (2011-2016) were used to derive estimates through 2026. Table 71 summarizes energy and customers derived in this manner.

Table 71. Customer and Load Forecast

	Residential		Commercial		Industrial	
Year	Energy GWh	Customers	Energy GWh	Customers	Energy GWh	Customers
			Levels			
2006	25,468	1,906,020	25,771	318,207	25,165	7,425
2011	28,039	2,066,780	29,465	350,793	24,923	7,357
2016	30,575	2,229,113	33,301	384,561	25,216	7,361
2026	36,356	2,593,031	42,536	462,162	25,812	7,369
			Compound Annual Growth Rates (CAGR)			
2011	1.94%	1.63%	2.72%	1.97%	-0.19%	-0.18%
2016	1.75%	1.52%	2.48%	1.86%	0.23%	0.01%
2026	1.75%	1.52%	2.48%	1.86%	0.23%	0.01%

Derived in this manner, it should be clear that our 20 year forecast is simplistic but does serve the purpose of estimating technical potential. A more rigorous forecast would consider the effects of energy price elasticity and fuel choice, for example. For our purposes, estimation of technical potential, the above forecast will allow us to estimate future building stock.

The growth in customers was used to derive state specific estimates of customer counts in the technical potential models. A slight increase in the energy use per customer found in the spring 2006 forecast was also included in the technical potential models. Summer and winter peak loads were estimated from the 2006 observed peak loads by ratioing up the 2006 load by the proportional increase in energy noted in Table 71.

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),[77] 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

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

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

[77] 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.

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:

$$LC = (OM\text{-}PMT(d,N,IC))/EN$$

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

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.[78]

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 rations 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 72. 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

[78] 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.

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.

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. Our assumptions are based on references cited throughout this section as well as the direct experience of our team with technologies in the field and actual DSM program evaluations. While not all of the field and DSM program experience can be cited in published works, published references are used to establish a reasonable range of assumptions. The point estimate used within that range is based on our professional opinion. The mapping of EEM to residential DSM programs is shown in the table below.

Table 73. Mapping of EEM to Residential DSM Programs

Program #			6	7	8	9	10	11	12	13	14	15
End Uses	**EEM Description**	**EEM Ref #**	**Res Energy Assess**	**ES Appl & Light**	**Res HVAC**	**Solar Hot Water**	**ES Plus**	**Manuf Homes**	**Onsite Audit**	**Old Refrig PickUp**	**Res Weatherization**	**ES Cool Roofs**
1. Customer-Sited Generation	Solar Photovoltaic	R-1				X						
2. Residential Space Conditioning	Resist to Seer 13 Heat Pump	R-2										
	Resist to Seer 13 Heat Pump	R-3										
	SEER 8 to Seer 13 CAC	R-4										
	SEER 8 to Seer 13 CAC	R-5										
	Refrig Charge/Duct Tune-Up	R-6									X	
	Refrig Charge/Duct Tune-Up	R-7										
	SEER 13 to Seer 15 Heat Pump	R-8			X							
	SEER 13 to Seer 15 Heat Pump	R-9			X							
	SEER 13 to Seer 15 CAC	R-10			X							
	SEER 13-Seer 15 CAC	R-11			X							
	Efficient Window AC	R-12		X								
	Cool Roofs	R-13										X
	EE Windows	R-14										
	Programmable Thermostats	R-15										
	Ceiling Insulation (R6-R30)	R-16									X	
	Ceiling Insulation (R6-R30)	R-17										
	House Sealing using Blower Door	R-18									X	
	House Sealing using Blower Door	R-19										
	Ground Source Heat Pump	R-20				X						
	Wall Insulation (R3-R11)	R-21									X	
	Wall Insulation (R3-R11)	R-22										
	Solar Siting/Passive Design	R-23					X	X				
	Energy Star Manufactured Home	R-24						X				
	Energy Star Construction	R-25					X					
3. Load Management	Eliminate Old Refrigerators	R-26								X		
	Set Back HVAC	R-27	X									
4. Residential Appliances	Energy Star Clothes Washers	R-28		X								
	Energy Star Dish Washers	R-29		X								
	Energy Star Refrigerators	R-30		X								
	Pool Pumps	R-31										
5. Residential Lighting	Compact Fluorescent	R-32	X	X					X			
	Daylighting Design	R-33										
	Occupancy Controlled Outdoor	R-34									X	
6. Water Heating	Tank Wrap, Pipe Wrap and Water Temp Setpoint	R-35							X		X	
	Low Flow Fixtures	R-36	X						X		X	
	Heat Pump Water Heaters	R-37										
	Tankless Water Heaters	R-38										
	Solar Water Heaters	R-39				X						
	Efficient Plumbing	R-40										

Solar Photovoltaic (R-1)

This technology consists of a roof or ground mounted solar electric array with a full sun output of 2 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 35% of residential buildings are suitable sites.

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 solar electric panels. In the current supply-constrained 2007 market, costs are $5.00-$7.00/watt peak for the solar cells alone. Installation and balance of system can be expected to add $3.00/watt. For the 2.5 kW array considered here the total cost will be taken as $20,000[79] or $8.00/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 1,100 kWh/yr. For the 2.5 kW array considered here the annual savings for the DEC service territories in NC and SC are estimated to be 3,300 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% 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. For these purposes the lifetime is taken as 25 years.[80]

Resistance Electric Furnace to SEER 13 Heat Pump (R-2, R-3)

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

[79] The C&RD Database lists the incremental capital cost as $6,000 per kW, which would be comparable for an installed 2 kW system.
[80] The Conservation and Renewables Database lists a measure life of 20 years for standard technology solar PV.

Measure Applicability

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

Incremental Cost

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

Average Annual Expected Savings

The average annual expected savings from this measure depends on the size of the residence. Based on DEC-SC specific simulations we find savings in the range of 6,000 kWh/yr for a single family residence and 4,800 kWh/yr in the multifamily application.

Expected Useful Life

The physical life of this measure is about 20 years, but for the purposes of this analysis we will take 10 years as the useful life of this measure to reflect the application of this measure in an early retirement context.

SEER 8 to SEER 13 Central Air Conditioner (R-4, R-5)

This measure is designed to save cooling energy by preemptively replacing an inefficient old central air conditioner by a modern efficient one. This measure is applied to a gas heated residence.

Measure Applicability

This measure is applicable to existing residential air conditioners, about 79% of the residential stock.

Incremental Cost

This measure physically involves replacing the entire air conditioning unit but not the ducts. The cost would be $3,500 at a minimum.

Average Annual Expected Savings

The average annual expected savings from this measure depends on the size of the residence. Based on DEC-SC specific simulations we find average cooling of 1,400 kWh for single family residence and 1,200 for a multifamily residence.

Expected Useful Life

The physical life of this measure is about 20 years, but for the purposes of this analysis we will take 10 years as the useful life of this measure to reflect the application of this measure in an early retirement context.

Refrigeration Charge and Duct Tune Up (R-6, R-7)

This measure is designed to save electric energy by increasing the operating efficiency of the refrigerant system by insuring that it is properly charged. It is common in residential cooling or heat pump systems to have an incorrect amount of refrigerant charge because these systems are usually charged on site during installation. This measure also leads to savings from finding and sealing duct leaks which increases the system distribution efficiency.[81]

Measure Applicability

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

Incremental Cost

The incremental cost of this measure pays for a visit by a specially trained HVAC technician. For this analysis this cost is taken as $300.

Average Annual Expected Savings

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

Expected Useful Life

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

Upgrade the Heat Pump Efficiency from a SEER 13 to a SEER 15 (R-8, R-9)

This measure is designed to encourage the installation of more efficient heat pump equipment. Rather than installing a heat pump with a SEER of 13, the homeowner is encouraged to install a more efficient heat pump with a SEER of 15.

Measure Applicability

This measure is applicable to new or replacement heat pump installations. In recent years the rate of heat pump installations has increased. For this study we will take this measure as applicable to 25% of the new electrically heated residential stock.

Incremental Cost

The incremental cost of $1,000 used in this analysis is very similar to the value of $1,062 given in DEER for this measure.

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

Average Annual Expected Savings

The average annual expected savings from this measure depends on the size of the residence. Based on DEC-SC specific simulations we find savings in the range of 600-900 kWh/yr. For this study we will take savings of 800 kWh/yr for single family sites and 700 kWh/yr for multifamily.

Expected Useful Life

The DEER uses an expected useful life (EUL) of 15 years; however, for other heat pump measures the DEER uses 18 years which is similar to the 20 years used in this analysis.

Upgrade the Central Air Conditioner from a SEER 13 to a SEER 15 (R-10, R-11)

This measure is designed to encourage the installation of more efficient central air conditioning equipment. Rather than installing a central air conditioner with a SEER of 13 the homeowner is encouraged to install a more efficient central air conditioner which has a SEER of 15.

Measure Applicability

This measure is applicable to new or replacement central air conditioner installations. Central air conditioners (and not heat pumps) are used by about 74% of DEC-SC residential customers. In this study we assume that the replacements in the next ten years are applicable to about 20% of residential customers and that efficient central air conditioners are applicable to about 60% of new residential construction.

Incremental Cost

The incremental cost of $800 used in this analysis is comparable to DEER's $970 for this measure.

Average Annual Expected Savings

The average annual expected savings from this measure depend significantly on the size of the residence and the thermal integrity of the shell. Simulations of savings using DEC-SC specific information show savings in the range of 250-500 kWh/yr. For this study we will use 400 kWh/yr for single family residences and 350 kWh/yr for multifamily.

Expected Useful Life

The DEER uses an EUL of 18 years, which is similar to the 20 years used in this analysis.

Efficient Window AC (R-12)

An efficient window or room air conditioner saves energy by slightly more efficient operation, and often by use of an internal timer to restrict operation to occupied periods. An equally important consideration in the selection of a room air conditioner is to avoid over-sizing the unit, in which case additional spaces may be unintentionally cooled.

Measure Applicability

This measure is applicable in the residential and small commercial sector where central air conditioning is not used. The DEC-SC market survey finds 16% of residences with window AC units. For this analysis, the applicability is taken as 15% of the residential sector and 15% of the commercial sector.

Incremental Cost

The incremental cost of the more efficient unit will vary with the size of the unit. For this study we will take the average incremental cost to be $150.

Average Annual Expected Savings

The energy savings from this measure will vary considerably with the size of the unit and the particular application. In this study we assume an application where the room air conditioner is used as the primary means of cooling a space that is used through out the cooling season. In the DEC-SC service area the average cooling energy for a small residence is about 2,000 kWh/yr. A properly sized efficient window air conditioner can be expected to save 10% of this cooling energy or 200 kWh/yr.

Expected Useful Life

In this study we assume the expected useful life to be 13 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 or optically reflective roofs. Recent improvements in roofing have led to roofing in attractive architectural colors that can reflect solar gain almost as well as white or reflective roofs. This reflection of solar gain along with adequate attic ventilation can lower attic temperatures significantly thereby reducing heat gain to the home and also improving the distribution efficiency of any ductwork or distribution fans that are located in the attic space. Attic cooling lowers the thermal gain to the residence below, and it also improves the distribution efficiency of any attic duct work. At least half the cooling savings attributable to this measure proceed from the improved distribution efficiency, and therefore this measure is intended for application where there are attic ducts or distribution fans. This is essentially a site built measure including the installation of roof vents and the installation of several hundred square feet of reflective material to the inside of the roof rafters.

Measure Applicability

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

Incremental Cost

The incremental cost for this measure is taken to be the incremental cost of the Energy Star Qualified roofing which is reported to be currently $.20/ft2, but which is expected eventually to be zero. All other roofing costs and required

are ventilation assumed to be unchanged by this measure. For this study we will take the incremental cost to be an average of $.10/ft2 over the five year planning period. For the average residence, $158.

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%. The cool attic strategy also improves cooling distribution efficiency if the cooling ducts or fan unit is in the attic. For this study we will take the average annual savings to be 596 kWh/yr. Savings larger than these will be found in the extreme cases with poorly insulated air conditioning distribution located in the attic spaces.

Expected Useful Life

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

EE Windows (R-14)

This measure involves increasing window insulation from a U value of 1.1 BTU/sqft/hr deg F to a U value of .45. This measure saves both heating and cooling energy. In the case of gas heated residences, the electric savings are for cooling only and are much less than the heating savings. So the cost effective application of this measure is to electric heated residences only.

Measure Applicability

This measure is considered applicable to a portion of the 23% of residential customers that heat with electricity. Of these customers about 5% have heat pumps and live in more recent stock that is probably insulated. Of the remaining 17% we will assume that half are poorly insulated enough to benefit from this measure. Overall the applicability is taken as 8% of the residential sector.

Incremental Cost

We assume a cost of $25 per square foot of window area. DEER uses a value of $28.00 per square foot of window area, and C&RD uses a value of $16 per square foot. For the average residence considered here with 100 square feet of window upgraded, the cost would be $2,500.

Average Annual Expected Savings

Savings from this measure are strongly dependent on the efficiency of the electric heat source and the square feet of windows replaced. The stock to which this measure is applied consists primarily of electric furnaces. Therefore the simulations assume the displacement of resistance heat. Building simulations from DEC-SC specific weather data show savings of 900 kWh to 1,300 kWh/yr for electric heated residences and less than 400 kWh/yr for gas heated residences. For this analysis the annual savings will be taken as 1,334 kWh/yr for electric heated residences.

Expected Useful Life

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

Programmable Thermostats (R-15)

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

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

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

Measure Applicability

The DEC-SC Appliance study shows 23% of the respondents reported the use of a programmable thermostat. Also the Appliance Study reports 23% have electric heating in the form of resistance heat or heat pumps. It is not clear if the reported programmable thermostats were all on electric heating situations. For this analysis one half the electric heating situations, 11.5%, are taken as good candidates for a new programmable thermostat.

Incremental Cost

Programmable thermostats cost retail in the range of $50-$100. A utility program may be able to purchase in bulk. It may be necessary to have a range of options which include at least line voltage and low voltage. For these purposes we take $70 as the melded cost of the thermostats.[82] It is assumed here that thermostats will be installed as part of a site visit in a broader program with $25 allocated for installation labor. In total the installed cost will be taken as $120 per thermostat.[83] Some sites with line voltage thermostats may require more than one thermostat.

Average Annual Expected Savings

Thermostat savings are best realized when the set back interval is of the order of 8 hours or longer, and the amount of savings depends on the number of degrees the thermostat is set back. The rule of thumb is 1% heating savings

[82] DEER lists the incremental cost as $56.3, and the installed cost as $73.33 per unit.
[83] DEER lists the incremental cost as $73.33 of which $56.37 is equipment cost and $16.96 in labor. This analysis uses $50 for the labor cost which accounts for some of the difference in the costs.

for every degree the thermostat is set back for at least 8 hours. For this estimate a five degree thermostat set back is assumed, leading to heating savings in the average electrically heated home of 500 kWh/yr.

Expected Useful Life

In principal, these thermostats can last for in excess of 20 years, but the backup batteries have a finite life and the programming can be changed or confused. In this case, the effective lifetime will be taken as 10 years.[84]

Ceiling Insulation R6-R30 (R-16, R-17)

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

Measure Applicability

This measure is considered applicable to a portion of the 23% of residential customers that heat with electricity. Of these customers about 5% have heat pumps and live in more recent stock that is probably insulated. Of the remaining 17% we will assume that half are poorly insulated enough to benefit from this measure. Overall the applicability is taken as 8% of the residential sector.

Incremental Cost

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

Average Annual Expected Savings

Savings from this measure are strongly dependent on the efficiency of the electric heat source. The stock to which this measure is applied consists primarily of electric furnaces. Therefore the simulations assume the displacement of resistance heat. Building simulations from DEC-SC specific weather data show savings of 1,500 kWh to 2,700 kWh/yr for electric heated residences and less than 400 kWh/yr for gas-heated residences. For this analysis, the annual savings is assumed to be 1,800 kWh/yr for electric-heated residences and 300 kWh/yr for gas-heated residences.

Expected Useful Life

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

House Sealing Using Blower Door (R-18, R-19)

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

[84] DEER list the EUL as 12 years.

Measure Applicability

This measure is applicable to most of the residential stock.

Incremental Cost

The incremental cost of sending a technician to a home and performing a Blower Door test and sealing the identified leaks is assumed here to be $300. By comparison, the C&RD database lists $0.16 per 0.1 air change per square foot which translates to $320 per house with 0.2 air changes per square foot.

Average Annual Expected Savings

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

Expected Useful Life

The life of the savings for this measure depends on the quality of the materials used especially for the gaskets for the windows and doors. An expected useful life of 15 years is being used. DEER lists 13 years and C&RD 20. We feel 20 years is too optimistic and have chosen a conservative value of 10 years.

Ground Source Heat Pump (R-20)

The ground source heat pump uses the ground as the energy source/sink in a heat pump cycle. This allows the ground source heat pump to operate with about twice the efficiency of a conventional air source heat pump. Because the ground is at a much more stable temperature than the air, resistance backup heat can be avoided. And it also simplifies the operation of the heat pump because defrost is not an issue.

Measure Applicability

This measure is applicable to new electrically heated residential construction and to existing DEC-SC heat pump customers that have suitable sites. The total pool of candidate customers will be taken as 10% of residential customers, and we will assume that only 30% of these have suitable sites. Overall measure applicability is taken as 3% of residential sector.

Incremental Cost

The ground source heat pump is essentially a standard heat pump except that the outdoor unit is replaced by a trenched pipe as a ground heat exchanger a few hundred feet long. The burying of the pipe is highly site specific. In this study the incremental cost will be taken as the cost of the ground heat exchanger only and the remainder of the system will be considered similar in cost to a conventional heat pump. Although the site costs are highly site specific we will take $7,000 as incremental cost.

Average Annual Expected Savings

This measure saves on both heating and cooling relative to the basecase which is a standard heat pump. Using DEC-SC specific weather conditions, the savings relative to a heat pump are 3,300 kWh/yr.

Expected Useful Life

This measure is considered to have a useful life of 25 years.

Wall Insulation (R-21, R-22)

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

Measure Applicability

This measure is considered applicable to a portion of the 23% of residential customers that heat with electricity. Of these customers, about 5% have heat pumps and live in more recent stock that is probably insulated. Of the remaining 17%, we will assume that half are poorly insulated and could benefit from this measure. Overall the applicability is taken as 8% of the residential sector.

Incremental Cost

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

Average Annual Expected Savings

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

Expected Useful Life

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

Solar Siting Passive Design (R-23)

This measure applies to new construction that can be designed and sited to capture solar gain through windows in-order to displace space heating. In a new building, the cost of proper orientation and of solar design is small to non existent if the orientation and design decisions are made before construction starts.

It is well known that if a new residence is tightly designed thermally, and oriented so that about 75-100 feet of glazing is near south facing, then its heating requirements can be reduced by about 30%. Much larger heating

reductions have been demonstrated, but then the designs need to become more extreme with respect to south glass and with respect to protection from unwanted summer sun. This measure is intended to represent a "minimum graceful design", yielding the maximum savings with the least departure from a normal residential appearance. Physically, this measure consists of re-orienting and re-distributing glazing that would have been used anyway, and in using proper overhang to provide some summer shade. In passive solar design, the south glazing should usually have a high solar heat gain factor. This is an unusual glazing specification for current residential applications because most residential glazing is intended to reject solar gain for cooling purposes. Passive solar design also includes increasing the thermal mass, such as floor tile, adjacent to south facing glazing. The thermal mass of the existing sheetrock and furniture etc in a building also plays a role in thermal storage. Building codes generally try to discourage excessive glazing and solar gain, but they allow for exceptions where thermal design has been explicitly considered and documented.

Measure Applicability

This measure is applicable to new electrically heated construction with suitable solar exposure. In this study the measure will be applied to the 40% of new residential construction that will potentially use heat pumps, and of these 50% are assumed to have a suitable solar exposure. The overall applicability of this measure is taken as 20% of the residential sector.

Incremental Cost

This measure is considered a minimum passive design, and it essentially consists of a redistribution or reorientation of materials that would have been used anyway. The cost of this measure is taken as the cost for the information or advice necessary to "tune the design to the sun". The cost for this measure is taken here as $500 per building. Not very much needs to be done to capture these minimal passive solar heating savings, especially if it is done at the outset. The context for this incremental cost is assumed to be to a developer for some extra consideration in overall site planning.

In many reported cases of solar design, the cost is many times this and the building is usually much more expensive as well, but these costs are the common costs associated with personalized new construction, not particularly related to solar design.

Average Annual Expected Savings

The annual savings for this measure are considered only for electrically heated residences, though this measure is well suited to gas heated sites as well. For this analysis, the savings are taken as one-third of the electric energy used in typical heat pump-heated residences in DEC-SC territory, 1,500 kWh/yr. These savings have been referenced to a heat pump as base case because it is unlikely that a new electrically heated residence would be built with electric resistance heat. However, relative to the rare case of a new resistance heated building, the savings would be much larger, about 3,000 kWh/yr.

Expected Useful Life

This measure will last the life of the building which can easily be 50 years or more. However for this analysis the measure life is taken as the maximum life used in this analysis, 25 years.

Energy Star Manufactured Home (R-24)

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

Measure Applicability

This measure is applicable to all new manufactured home construction. But for the purposes of this study the measure is restricted to new residential manufactured all electric construction. In the DEC-SC service area manufactured homes are not a major component of new construction and are estimated here to be 10% of new construction.

Incremental Cost

The incremental cost for this measure consists of the increased cost of building components such as insulation, windows, lighting and appliances. This cost is site specific, but for the DEC service areas in North and South Carolina, the cost is taken as $2,600 which includes the cost of upgrading from resistance heating to heat pump heating. Generally the incremental measure cost for manufactured housing is less than noted for Energy Star site built construction because it is derived from the manufacturing environment where the costs increment is at the OEM level. But in this case, the total incremental cost is greater than for Energy Star site built because it includes the cost of an upgrade from resistance space heat to heat pump space heat.

Average Annual Expected Savings

The savings for this measure are specifically modeled based on an assumed upgrade from resistance heat to a heat pump, because this building stock is predominantly sited where there is no gas service and electric energy is the primary source of space heating. Savings estimates for an energy star manufactured home including an upgrade to a heat pump are in the range of 4,500 kWh/yr to 6,000 kWh/yr. For this study these savings are taken as 4,632 kWh/yr.

Expected Useful Life

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

Energy Star Construction (R-25)

An Energy Star qualified new home is required to be 15% more efficient than a similar home that meets the 2004 International Energy Conservation Code, IECC. The mechanism for estimating Energy Star compliance is through

the use of a HERS (Home Energy Rating System) score calculated from a brief estimate of annual energy use. The savings proceed principally from heating, cooling, lighting and water heating savings.

Measure Applicability

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

Incremental Cost

The incremental cost for this measure consists of the increased cost of building components such as insulation, windows, lighting and appliances. This cost is site specific, and there is some choice in selecting the package of measures. An initial cost effectiveness screening of this measure showed that the maximum cost effective cost is $2,000. This requires composing a package of only the most cost effective measures. Therefore this package includes the strongly cost effective measures of a flow efficient showerheads and inspection and checkout of heat pump that are not commonly part of the Energy Star package (but should be). Based on the choice of the most cost effective measures, the cost used for this study is $2,100.

Average Annual Expected Savings

The savings from this measure are specifically site modeled, estimates for this region are in the range of 3,000-4,000 kWh/yr. For this study, the savings is assumed to be 3,788 kWh/yr.

Expected Useful Life

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

Eliminate Old Refrigerators (R-26)

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

Measure Applicability

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

Incremental Cost

The incremental cost of this measure will be taken as the cost of acquiring and recycling the unit. For this study that cost will be assumed to be $100.

Average Annual Expected Savings

Savings from this measure are dependent on the age of the refrigerator and the location where it is used. Savings estimates for this measure also need to include the zero effects of including operable but not operating refrigerators. Reported savings estimates vary widely from an astonishing 1,900 kWh/yr for C&RD to 413 kWh/yr observed in

the Connecticut Appliance Turn-In program. For this program, the savings will be assumed to take the middle road, 1150 kWh/yr.

Expected Useful Life

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

HVAC Set Back (R-27)

This measure is a voluntary set back of both the heating and cooling set points by 3 deg F. This is the average set back for the whole day not just the night set back. This type of set back 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.

Measure Applicability

This measure is applicable throughout the residential sector. But the greatest savings will be where the measure is applied to electrically heated homes which are 23% of the residential sector.

Incremental Cost

This measure has essentially no cost. As a token cost here we assume $5.

Average Annual Expected Savings

The savings for this measure depend strongly on the amount of set back and the heating type. Based on DEC-SC 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. For this study we will take 1,000 kWh/yr as the savings.

Expected Useful Life

This is a temporary measure. The set back strategy may only work for one or two seasons. Accordingly the useful life is taken as 2 years.

Energy Star Clothes Washers (R-28)

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

Measure Applicability

This program applies only to customers who have electric water heaters, electric dryers, and who have no high efficiency clothes washer. This applies to 40% of DEC-SC customers.

Incremental Cost

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

Average Annual Expected Savings

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

Expected Useful Life

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

Energy Star Dishwashers (R-29)

This measure is defined as the purchase of a new Energy Star dishwasher. By definition Energy Star dishwashers are more efficient than a comparable standard new dishwasher. This measure applies strictly to the improved level of performance, Energy Star versus Standard. An Energy Star qualified dishwashers uses at least 41 percent less energy than the federal minimum standard for energy consumption, which was set in 1994. In this measure the dishwasher being replaced has an EF of 0.46 and is being replaced by a 0.58 EF dishwasher, and has an average usage of 215 washes.

Measure Applicability

The DEC-SC market survey does not address Energy Star dishwashers. For this study, we will take the applicability of these units to be 60% of the existing residential sector and all of the new residential sector. In fact, Energy Star dishwashers are a required item in Energy Star new construction.

Incremental Cost

The incremental retail cost for dishwashers, varies depending on the features present in the model chosen. The value used in this analysis is $50, DEER uses a value of $133 and the C&RD lists $6 as the incremental cost, this analysis has incorporated an intermediate value.

Average Annual Expected Savings

The savings from this measure are primarily due to decreased hot water usage. The C&RD lists 119 kWh/yr and DEER lists 72 kWh/yr. This analysis uses 75 kWh per year.

Expected Useful Life

The expected useful life used in the analysis is 10 years. However DEER lists 13 years and C&RD lists 9 years.

Energy Star Refrigerators (R-30)

This measure is defined as the purchase of a new Energy Star refrigerator which is slightly more efficient than a comparable standard new refrigerator. This measure applies strictly to the improved level of performance, Energy Star versus Standard.

It should be noted here that this measure definition will under-count the real savings because the current stock of new refrigerators is much more efficient than the older stock more than 10 years old, and significant savings will result when an old refrigerator is replaced by a new one, even a non-Energy Star one. These savings are a natural part of the background residential usage changes in response to the current standard market and are considered savings that would have happened absent any particular measure. For this particular measure, the measure savings used in program cost effectiveness are only for the Energy Star increment, but the technical potential estimate inherently captures the full replacement savings.

Measure Applicability

This measure is assumed to apply to 90% of the residential sector, essentially all of the residential sector for which an Energy Star model is available.

Incremental Cost

The incremental retail cost for refrigerators, vary significantly depending on the features present in the model chosen. The value used in this analysis is $200, DEER uses a value of $135.75 and the C&RD does not list a value due to the variability in the possible costs. Due to the wide variety of costs for Energy Star refrigerator, $200 is a good mid-range value for the purposes of this analysis.

Average Annual Expected Savings

Savings vary by type of refrigerator/freezer configuration and by size. The range is 80-100 kWh/yr. Savings for this analysis will be taken as 100 kWh/yr. These savings are relative to the energy use of a new but non-Energy Star refrigerator. In fact a significant portion of the new refrigerator purchases are to replace old refrigerators, and even a non-Energy Star refrigerator will save about 300 kWh/yr relative to the old refrigerator it replaces.

Expected Useful Life

The expected useful life used in the analysis is 18 years and both DEER and C&RD also use 18 years.

Pool Pumps (R-31)

This measure saves energy by employing a two speed pool pump motor. At the lower speed the pump is still doing a good job of filtering, but it uses about 75% less energy. This is typical of the savings from slowing down pumps or fans. While these savings are significant it should be noted that the slower pumping rate can adversely affect pool accessories such as a solar pool heater.

Measure Applicability

This measure is applicable to in ground pools only and is expected to be applicable in less than 5% of the residential sector.

Incremental Cost

The incremental cost for this measure consists of the increased cost of a 2 speed pump, ($180) and the increased labor to install it. In a retrofit case the labor is of the order of $300, but in a new installation there is no increased labor. For this study we will take $180 as the incremental cost.

Average Annual Expected Savings

The savings from this measure depend on the degree of flow reduction and the number of hours of reduced flow. A typical power reduction to be expected is 500 watts, and in a full season the duration of reduced flow is 1,000-1,500 hours. For this study we will take the annual savings as 648 kWh/yr.

Expected Useful Life

The expected useful life of this measure is assumed to be 10 years.

Compact Fluorescent (R-32)

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

Measure Applicability

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

Incremental Cost

The cost for this technology continues to decrease, and there are various sales or promotions where the cost may be as low as $2.00/bulb. But for the purpose of this program planning we will assume $3.00/average bulb to cover the costs of larger or outdoor rated bulbs, and another $5.00/bulb for installation or adaptation labor. Full application of this measure, assuming treatment of the 15 most important fixtures in a residence is taken here as costing $150. The C&RD lists $5.73 for the incremental cost and the DEER lists $8.03 for the incremental installed cost.

Average Annual Expected Savings

It is assumed here that the fifteen treated sockets reduce the connected load by 750 watts, and that the average on time for these sockets is 3 hours/day, leading to energy savings of 2.25 kWh/day. This equates to 55 kWh/yr/bulb. The savings listed in DEER range from 20 to 59 kWh/yr/bulb, depending on which CFL is replacing which incandescent bulb. For these purposes the various applications of this measure are assumed to save 55 kWh/yr per bulb, and a total of 800 kWh/yr for replacing 15 bulbs at a single site.

Expected Useful Life

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

Daylighting Design (R-33)

This measure is intended to reduce the lighting energy in new residential construction. Daylight has the highest lumens/watt of any light source. A little bit of daylight can go a long way toward lighting a space without introducing as much heat as other light sources. Physically daylighting takes the form of small skylights or clearstories, and high small windows coordinated with light colored interior wall and ceiling surfaces. In practice, good daylighting design involves the avoidance of glare and over lighting as well.

Measure Applicability

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

Incremental Cost

This measure is being applied in new residential construction where lighting is a natural consequence of window placement. In this context daylighting design is considered in the distribution of the windows and skylights to make light distribution more uniform and to avoid glare. These design impacts will have minimal cost if they are brought in at the planning stage. For this study the incremental cost is assumed to be $500.

Average Annual Expected Savings

Properly designed daylighting can save almost all the lighting energy used during daylight hours, but not all residences are used during the day. The DEC-SC market assessment shows about 2,300 kWh/yr for lighting in the average residence. The savings will wary widely from site to site, but for this study we will take 30% lighting savings, 750 kWh/yr.

Expected Useful Life

Daylighting features integrated into a house during construction will last the life of the house. For these purposes the lifetime will be taken as 25 years.

Occupancy Controlled Outdoor Lighting (R-34)

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 through out the existing residential stock.

Incremental Cost

This measure physically involves replacing three frequently used outdoor lights by occupancy controlled lights. It is assumed that a single occupancy controller and light costs $50, and that a full installation consisting of two lights would cost $100.

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. Annual savings for these purposes is taken as 250 kWh/yr.

Expected Useful Life

For the purposes of this analysis, we will take 10 years as the useful life of this measure.

Tank Wrap, Pipe Wrap, and Water Temperature Setpoint (R-35)

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

Measure Applicability

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

Incremental Cost

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

Average Annual Expected Savings

The dwelling savings for these measures is discussed under low flow fixtures. Based on prior experience and evaluation work on other programs it is estimated that the savings would be about 1 kWh per day.[85] For this program we have used the conservative value of 200 kWh/yr savings.

Expected Useful Life

The lifetime of these measures is potentially quite long. For practical purposes the lifetime will be considered limited by the expected lifetime of the hot water tank, 10 years.[86]

Low Flow Fixtures (R-36)

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

Measure Applicability

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

Incremental Cost

Low flow fixture costs vary widely, and depend on whether the fixtures are purchased retail or in bulk. The costs for a bulk purchase for a showerhead and three aerators also have a wide range, about $8.00-$15.00/set. The most important feature of these fixtures is the long-term acceptability and durability because these factors have a direct impact on the lifetime savings. With a long enough lifetime, this is such a cost effective measure that all prices in

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

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

the range are quite cost effective. Because the cost of the showerhead varies significantly and quality is so important for this program, it is essential to test, choose and pay the price for a high quality showerhead. This measure is so cost effective that even with a more expensive showerhead the program will still remain cost effective and a quality showerhead will ensure measure persistence. The per-unit-installed cost will be taken as $25/residence.[87]

Average Annual Expected Savings

Field monitoring studies can demonstrate the flow savings, but ultimately the overall savings will be a combination of flow savings and the duration of use. The flow of the showerhead used has a significant impact on savings. This program is designed around a 2.0 gpm showerhead as compared to a 2.5 gpm showerhead. Therefore the savings will be more than the 120–133 kWh per unit listed in DEER. In addition the climate is different and the inlet water temperature is lower so the savings in this DEC-SC 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 very from program to program depending strongly on the choice of showerhead. Savings can also diminish with "takeback" in the event that the new showering experience is longer than the original. Actual savings observed in the comprehensive cases include these takeback effects, and are in the range of 650 kWh/yr to 950 kWh/yr. The savings from a showerhead and aerator change alone are taken as 500 kWh/yr.

Expected Useful Life

The life time of this equipment is the key to its cost effectiveness. If an adequate, even pleasant, shower can be provided through lifetime warranted equipment, then the practical lifetime of the equipment is the length of time until the equipment is replaced in the course of renovation. For these purposes that lifetime is taken as 10 years.[88] Normally showerheads will last longer but with renovations and changes in ownership a 10 year EUL is a good planning number.

Heat Pump Water Heaters (R-37)

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

[87] The DEER Database lists measure costs as $22.946 per unit and $37.946 installed cost
[88] DEER Database, 2005

Measure Applicability

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

Incremental Cost

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

Average Annual Expected Savings

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

Expected Useful Life

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

Tankless Water Heaters (R-38)

Water heating is one of the largest energy uses in the home. In the case of electrically heated water, the annual water heating energy is about 4,800 kWh/yr. This measure saves energy by eliminating the standby energy losses attributable to a hot water storage tank. However these relatively small energy savings are at the cost of a significant demand increase. In the case of gas water heating, this type of measure has greater energy savings and no troublesome demand savings, and the measure makes sense. In the context of a switch from an electric tank to an electric tankless heater, this measure makes no sense.

Measure Applicability

This measure is applicable in the residential sector only where space is a premium.

Incremental Cost

The incremental installed cost for this measure is $1,500.

Average Annual Expected Savings

The expected savings are 400 kWh per year. But it should be recognized that this type of appliance has a negative demand impact.

Expected Useful Life

This measure's expected useful life is 18 years.

Solar Water Heaters (R-39)

Water heating is one of the largest energy uses in the home. In the case of electrically heated water, the annual water heating energy is about 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% 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 intended to apply to the 40% of residential customers with electrically heated hot water. Of these electric hot water customers, only 50% are assumed to have an adequate solar exposure and an adequate roof mounting site. Overall measure applicability is assumed to be 20% of the residential 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 to $7,000. For this study we will take the cost to be $6,000.

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 DEC-SC service area, leads to average annual savings for a system sized and designed to be in the cost effective range to be 2,594 kWh/yr.

Expected Useful Life

Solar water heating systems are essentially plumbing fixtures that are certified products (SRCC) and are often inspected by local building officials. A well designed system will have a lifetime in excess of 25 years, even though the system will take some intermediate maintenance such as inspecting the pump and fluid level. This study will take 25 years as the useful life.

Efficient Plumbing (R-40)

This measure saves hot 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.

Average Annual Expected Savings

The savings from this measure have not been widely measured but savings of 10% of the hot water end use are reasonable. For this analysis, savings is assumed to be 500 kWh/yr.

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. Therefore for this study an incremental cost of $500 is assumed.

Expected Useful Life

This is a very long-lived measure and an expected useful life of 25 years can be assumed.

Sources

DEER: 2004-05 Database for Energy Efficient Resources (DEER) Version 2.01 October 26, 2005 developed by the California Public Utility Commission and the California Energy Commission.

C&RD: Northwest Power and Conservation Council's Conservation Resource Comments Database, which is continually updated as new information becomes available.

APPENDIX D. NON-RESIDENTIAL EEM DOCUMENTATION

The purpose of this appendix is to provide documentation of the assumptions used to screen the Commercial Energy Efficiency Measures identified for consideration in this report. Our assumptions are based on references cited throughout this section as well as the direct experience of our team with technologies in the field and actual DSM program evaluations. While not all of the field and DSM program experience can be cited in published works, published references are used to establish a reasonable range of assumptions. The point estimate used within that range is based on our professional opinion. The mapping of EEM to non-residential DSM programs is shown in the table below.

Table 74. Mapping of EEM to Non-Residential DSM Programs

Program #			**1**	**3**	**4**	**5**
End Uses	**EEM Description**	**EEM Ref #**	**Key Accounts**	**Prescriptive**	**C&I RetroCom**	**C&I New Constr**
1. Customer-Sited Generation	Solar Photovoltaic	C-1		X		
2. C&I Space Conditioning	Small HVAC Optimization and Repair	C-2		X		
	Commissioning - New	C-3	X			X
	Re/Retro-Commissioning Lite	C-4	X		X	
	Low-e Windows 1500 ft2 New	C-5		X		X
	Low-e Windows 1500 ft2 Replace	C-6		X		
	Premium New HVAC Equipment	C-7	X	X	X	X
	Large HVAC Optimization and Repair	C-8	X			
5. Design (new)	Integrated Building Design (new)	C-9				X
	Efficient Package Refrigeration (new)	C-10		X		
6. Motors & Drives	Electrically Commutated Motors	C-11	X	X		
	Premium Motors	C-12	X	X		
	Variable Speed Drives, Controls and Motor Applications Tune-Up	C-13	X	X		
7. Power Distribution	Energy Star Transformers (new)	C-14	X	X		X
	Efficient AC/DC Power	C-15		X		
8. Data Processing	Network Computer Power Management	C-16	X			
9. Lighting	New Efficient Lighting Equipment	C-17	X	X		X
	Retrofit Efficient Lighting Equipment	C-18	X	X		
	LED Exit Signs	C-19	X	X		X
	LED Traffic Lights (10)	C-20		X		
	Perimeter Daylighting	C-21				X
10. Water Heating	Low Flow Fixtures	C-22		X		
	Solar Water Heaters	C-23				
	Heat Pump Water Heaters	C-24				
11. Cooking and Laundry	Energy Star Hot Food Holding Cabinet	C-25		X		
	Energy Star Electric Steam Cooker	C-26		X		
	Pre-Rinse Spray Wash	C-27		X		
	Restaurant Commissioning Audit	C-28		X		
12. Refrigeration	Grocery Refrigeration Tune-Up and Improvements	C-29		X		
	Refrigeration Casework Improvements	C-30		X		
13. Other	VendingMiser®	C-31		X		

Solar Photovoltaic (C-1)

This technology consists of a roof or ground mounted solar electric array with a full sun output of 40 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 25% of large 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 supply constrained 2007 market, costs are $5.00-$7.00/watt peak for the solar cells alone. Installation and balance of system can be expected to add $3.00/watt. For the 33 kW array considered here the total cost will be taken as $230,000[89], or $7.00/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 1,100 kWh/yr. For the 33 kW array considered here the annual savings will be taken as 44,000 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% 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. For these purposes the lifetime is taken as 25 years.[90]

Small HVAC Optimization and Repair (C-2)

This measure applies to packaged rooftop units. These units are the predominant means of conditioning for small to medium scale commercial buildings. The savings proceed from improved compressor performance, better run time control, and fresh air cooling. These rooftop units are a homogenous pool of equipment that has been identified as underperforming. Typically, the refrigerant charge is out of specification, the economizers perform

[89] The C&RD Database lists the incremental capital cost as $6,000 per kW, which would be comparable for an installed 2 kW system.
[90] The Conservation and Renewables Database lists a measure life of 20 years for standard technology solar PV.

poorly if at all, and the airflow is too low for proper operation. Many utilities are offering programs employing a structured diagnosis and repair protocol, SCE, PG&E, National Grid. Often these programs use trade named processes such as Proctor Engineering "check me", or PECI "aircare plus" etc. Candidates for this measure are roof top units found in a wide range of sizes with output capacities of from 4 tons to 50 tons with the most predominant capacity being 5 tons.

Measure Applicability

This measure is applicable in 70% of the large building 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. In the average large commercial building considered here, the cost will be $1,417/site treated.

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. In the average commercial large building considered here, we will assume 7,000 kWh/yr as the whole building savings where 2-3 units have been improved.

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. The effective life of this measure is taken as 5 years.

Commissioning New and Re/Retro (C-3, C-4)

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.

Measure Applicability

This measure is applicable in 75% of commercial sector, and to all of the new commercial buildings.

Incremental Cost

The cost for this technology is quite site specific, based on NWPCC estimates commissioning costs about $0.37/ kWh/yr. For the average building considered here that cost would be $6,873/site. For this study we are assuming a

much briefer version of retrofit commissioning , commissioning lite, that prescreens buildings on the basis of billing data. This lighter commissioning is assumed to cost $2000/site.

Average Annual Expected Savings

Savings from this measure can vary widely. It is assumed here that the building electric energy use can be reduced by on average 10%, leading to energy savings of 18,535 kWh/yr for the average large building.

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. The effective life of this measure is taken as 10 years.

Low E Windows New and Replace (C-5, C-6)

This measure saves energy by reducing the thermal losses and gains through windows. This measure assumes that the efficient window has a heat loss rate of 0.45 BTU/deg F hr, representing the performance of a quality, double glazed argon filled low E window. The original window is assumed to have a heat loss rate of 0.75 BTU/deg F hr, representing the average losses from a mix of single and double glazed windows.

Measure Applicability

This measure is applicable in 100% of new commercial buildings and 30% of existing commercial stock.

Incremental Cost

The incremental cost for this technology depends strongly on the context of use. If the efficient windows are used in a replacement context, then the full cost of $20/sqft is applicable which leads to a total cost of $30,000 for the average building considered here. But if the efficient windows are used as an upgrade in new construction then an incremental cost of only $3.00/sqft is used, leading to a total cost of $4,500 for the average building in this study.

Average Annual Expected Savings

It is assumed here based on DEC-SC specific simulations that 1500 square feet of high efficiency window replacement will have savings of 14,828 kWh/yr for an electrically heated building.

Expected Useful Life

This is a very long lived measure with an assumed life of 25 years.

Premium New HVAC Equipment (C-7)

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 and energy star rating or by 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 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% 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. For the average building considered here that cost would be $2,577/site.

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% of total energy use, in the average building considered here that is 5,561 kWh/yr.

Expected Useful Life

The premium upgrades can be expected to last the life of the equipment, taken here as 15 years.

Large HVAC Optimization and Repair (C-8)

This measure refers to restoring large HVAC equipment to its nominal operating performance. This measure needs to be distinguished from commissioning which is used to refine the controls of large HVAC which generally leads to large savings. By contrast this measure applies to the operation of the equipment and includes chiller and condensing tower cleaning, filter maintenance and tune up etc. It also includes the optimization of economizer operation by verifying that the enthalpy sensors and economizer controls are functioning properly.

Measure Applicability

This measure is applicable in 20% of the commercial sector with large HVAC systems.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. Based on NWPCC estimates, the premium upgrade costs about $0.34/ kWh/yr. For the average building considered here that cost would be $1,901/site.

Average Annual Expected Savings

Savings attributable to this measure are generally fairly small because they claim only the savings due to restoring equipment to its original operation. For this study these savings are assumed to be 3% of building energy use. On the average building, this will be 5,561 kWh/yr.

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. The effective life of this measure is taken as 5 years.

Integrated Building Design (C-9)

This measure applies to new construction where careful design and specific engineering can get beyond the rules of thumb to the use of smaller equipment more carefully matched to load. Efficient new construction with lower lighting loads, variable speed control of fans, anticipatory controls, daylighting, enhanced duct design, and other energy efficient details all taken together in a design can result in significant energy and demand savings.

Measure Applicability

This measure is applicable in 100% 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. Based on NWPCC estimates, the premium upgrade costs about $0.34/ kWh/yr. For the average building considered here that cost would be $18,839/site.

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% of the standard code compliant design. The current US tax code allows preferred treatment for new buildings that are 50% better than code or lighting systems that are 30% better than code. For this analysis we consider 20% better than code to be an achievable and significant goal. For the average building considered here the savings are taken to be 55,606 kWh/yr.

Expected Useful Life

Integrated design can be expected to last the life of the building, taken here as 25 years.

Efficient Package Refrigeration (C-10)

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. The applicability is estimated here to be 4 percent of the commercial sector.

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. For the average building considered here that cost would be $2,748/site.

Average Annual Expected Savings

It is assumed here that this measure can reduce a building energy use in applicable sites by 10 percent. The average commercial building considered here is assumed to save 18,535 kWh/yr.

Expected Useful Life

Electrically commutated motors are assumed to have a useful life of 15 years.

Electrically Commutated Motors (C-11)

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 are especially favored because the power reduction leads to a lower refrigeration load.

Measure Applicability

This measure is broadly applicable throughout the commercial sector. For this study we assume the measure is applicable in 60% of 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. For the average building considered here that cost would be $1,238/site.

Average Annual Expected Savings

It is assumed here that this measure can reduce a building energy use by 3%. The average commercial building considered here is assumed to save 3,707 kWh/yr.

Expected Useful Life

Electrically commutated motors are assumed to have a useful life of 15 years.

Premium Motors (C-12)

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% 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.

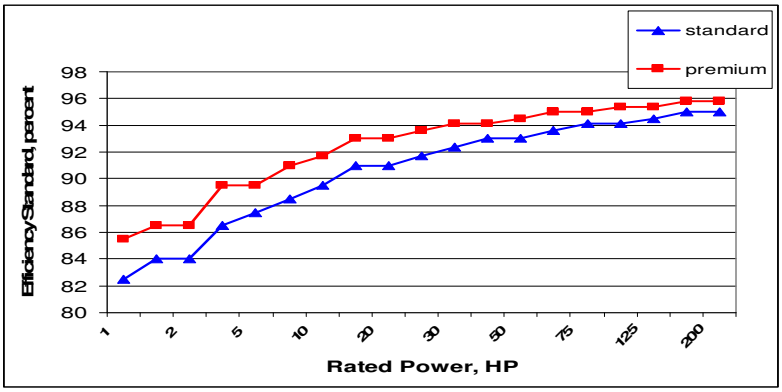


Figure 35. Motor Efficiency specification NEMA premium

The figure above shows the efficiency improvement to be gained by using the more efficient motor. While the efficiency gain is only about 2% 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 36. 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%.

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 increases 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.

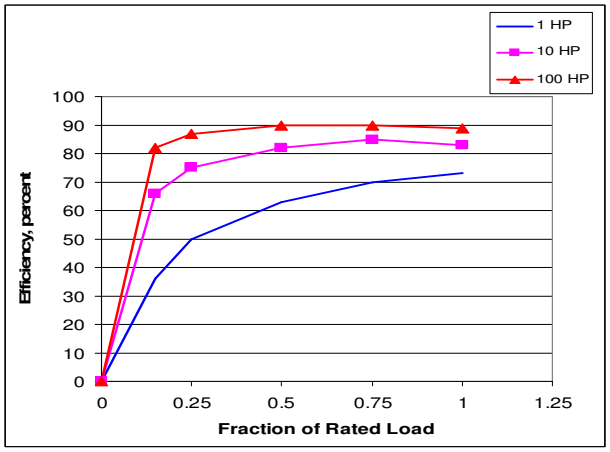


Figure 36. Typical Motor Operating Efficiencies versus Load

Measure Applicability

This measure is applicable in the new commercial and manufacturing sectors, and in suitable retrofit situations. In all, this measure is taken as applicable to 60% of the commercial and manufacturing sectors.

Incremental Cost

The incremental cost for this technology will be very diverse, and dependent on the size of the motor. For this study we will take an incremental cost of $200 for a 15 kW motor, considered here an average size, For an average site, the cost is taken as $.11/kWh/yr. For the average site, $408.

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. For this average motor we take a duty cycle of 6,000 hours/yr and annual savings of 1,800 kWh/yr. For an average site the savings associated with premium motors is taken as 2% of energy use, 3,707 kWh/yr.

Expected Useful Life

This measure is essentially a built in measures and is assumed to have a useful life of 15 years.

Variable Speed Drives, Controls and motor applications tune up (C-13)

This measure saves energy by providing an efficient way to match a motor to a varying load. Motor controls commonly referred to as variable speed or variable frequency drives, alter the frequency applied to the motor and thereby permit the motor to run more efficiently at lower outputs. This control capability is particularly important in process applications where a pump or fan is being controlled to maintain a particular and often varying fluid flow. Often the fluid flow is controlled by means of dampers or throttling valves that force the fan or pump motor to operate inefficiently. The savings associated with the proper speed control are most pronounced when the motor is operating at less than its rated capacity. At full capacity there may be little savings.

Situations involving fans 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% with only minor reductions in flow.

In this manner, variable speed motor control permits finer tuning and control of pumps, fans, compressors, and conveyers.

There is another genre of motors and controls referred to as brushless permanent magnet torque motors. These are very high torque motors that have no drive 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. In all, this measure is taken as applicable to 30% of the commercial and manufacturing sectors.

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 $.86/ kWh/yr. For the average building considered here that cost would be $15,964 site.

Average Annual Expected Savings

It is assumed here that an application of drive control can save about 10% of the total building energy. In the average building considered here this measure can save 18,535 kWh/yr.

Expected Useful Life

This measure is essentially a built in measures and is assumed to have a useful life of 15 years.

Energy Star Transformers (C-14)

This measure saves energy by reducing energy losses associated with stepping down from high service voltages to typical service application voltages. In larger buildings and plants 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 is illustrated in the figure below.

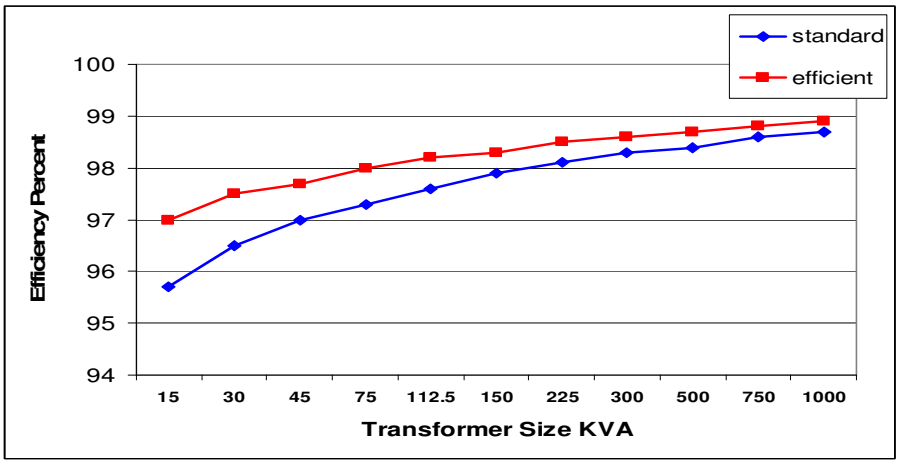


Figure 37. Transformer Efficiency specification NEMA TP-1

Figure 37 shows the efficiency improvement to be gained by using the more efficient Energy Star labeled transformer. While the efficiency gain is only about 1% 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. In all, this measure is taken as applicable to 30% of the commercial and manufacturing sectors.

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 with an incremental cost of $850, $.085/kwh/yr. For the average facility considered here, $75.

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. For this average transformer operating at 60% of load we estimate savings of 10,000kWh/yr. For the average facility considered here, savings are assumed to be ½% of energy, 927 kWh/yr.

Expected Useful Life

This measure is essentially a built in measures and is assumed to have a useful life of 18 years.

Efficient AC/DC Power (C-15)

A modern office environment has a multitude of electronic appliances, most of which are powered by a small transformer AC/DC converter. Standard transformer based converters are about 30-40% efficient. More efficient designs called switching power supplies operate with an efficiency of about 90%. The energy savings for this measure proceed from switching to the more efficient power supplies.

Measure Applicability

This measure is applicable in 100% 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. For the average building considered here, that cost would be $207/site.

Average Annual Expected Savings

Electronics and computers use 12% 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% would save at least 1.5% of the total building energy or 2,780 kWh/yr for the average commercial building considered here.

Expected Useful Life

This measure is assumed to have a useful life of 5 years

Efficient Network Management (C-16)

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

Measure Applicability

This measure is technically applicable in 100% of the commercial sector, but it is assumed that only 10% 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. For the average building considered here, that cost would be $426/site.

Average Annual Expected Savings

Approximately 12% of commercial energy is for electronics and computers. It is assumed here that, at an applicable site, 2% of energy can be saved by efficient network power management or 3,707 kWh/yr in the average building considered here.

Expected Useful Life

This is a transient measure dependent on the current system configuration. It is assumed to have a useful life of only 2 years.

New and Retrofit Efficient Lighting (C-17, C-18)

Lighting efficiency is the major commercial efficiency measure. Lighting accounts for 35% of commercial energy, and lighting also accounts for significant cooling energy that is saved when lighting is more efficient. There are literally hundreds of combinations of more efficient lighting elements that can replace less efficient elements. This efficient lighting measure goes beyond the light sources only and includes lighting controls, bi-level switching and occupancy sensors. Taken together it is common to find efficient lighting that can reduce lighting energy by 30% from the minimum code required levels (ASHRAE 90.1, 2001). In fact, the 2006 energy legislation offers preferred tax treatment to lighting configurations that can reduce lighting energy by 30%.

Measure Applicability

This measure is applicable in 100% of the new commercial buildings and in 85% of the existing commercial sector.

Incremental Cost

The incremental cost for this technology is essentially the cost of the efficient lighting components. These costs will be will be very diverse and site specific. Based on NWPCC estimates, and averaging the full range of conditions, efficient lighting costs about $.26/ kWh/yr. For the average building considered here that cost would be $4,875/site. For a retrofit application the cost is increased by 25% to $6,094/site in-order to allow for installation constraints.

Average Annual Expected Savings

A comprehensive lighting retrofit or new building lighting can save about 30% of the 35% lighting end use, in all 10% of building energy. In the commercial building considered here, the average annual expected savings is 18,535 kWh/yr.

Expected Useful Life

The useful life of the wide variety of lighting equipment varies widely from one light source or ballast to another. However, these elements are the replaceable elements in an overall system that is assumed to have a useful life of 18 years.

LED Exit Signs (C-19)

Typical existing exit signs are incandescent exit signs. This measure is designed to replace these typical exit signs with an Energy Star Light Emitting Diode (LED) Exit Sign which is more efficient than the incandescent versions.

Measure Applicability

In principal, measure is applicable in the entire commercial sector, and there are no physical constraints to replacing existing exit signs, but to account for already installed LED exit signs the applicability is assumed to be 85% of the commercial sector.

Incremental Cost

The incremental cost of an Energy Star LED Exit Sign over an incandescent exit sign is $45. For the average building considered in this analysis, six exit signs are assumed, for a full site cost of $270.

Average Annual Expected Savings

The average annual expected saving for this replacement is 245 kWh/year.[91] In the average building considered in this analysis, there are assumed to be 6 exit signs, for a full site savings of 1,470 kWh/yr.

Expected Useful Life

LED exit signs are very long-lived light sources. Accordingly, the useful life is taken as 10 years.[92]

LED Traffic Lights[93] (C-20)

LED traffic lights save energy because LED light sources are a much more efficient and long lived light source than the incandescent bulbs they replace. They save energy but they also save in terms of bulb replacement costs. LED traffic lights have a variety of configurations. Each color (red, Green, or yellow), each size (8 inch, or 12 inch) and each type (thru lane, left turn bay, right turn bay, and don't walk large or small) has different incremental cost, savings and effective useful life values.

[91] C&RD Database
[92] C&RD Database
[93] All values for LED Traffic Lights is available in the C&RD Database

Measure Applicability

Measure applicability was not estimated due to lack of data on the traffic lights in DEC-SC service territory. But for this analysis, it is assumed that there are 0.2 retrofittable intersections for every commercial building.

Incremental Cost

Depending on the color, size and type, the incremental cost ranges from $110 to $225. For this analysis we consider LED traffic light replacements in groups of 10, approximately the number of lamp replacements necessary to refit an intersection. For this analysis we will assume the average replaced light costs $200 and that the full intersection with 10 replacement lights costs $2,000. This cost compares favorably with the $1,850 cost derived from NWPCC data. These incremental costs do not assume an installation cost. It is assumed that the installation is done by the agency controlling the lights, and that it is more than paid for by the ongoing maintenance savings.

Average Annual Expected Savings

Depending on the color, size and type, the savings range from 111 kWh/year to 808 kWh/year. For this analysis we consider LED traffic light replacements in groups of 10, approximately the number of lamp replacements necessary to refit an intersection. For this analysis we will assume the average replaced light saves 500 kWh/yr and that the full intersection with 10 replacement lights saves 5,000 kWh/yr.

Expected Useful Life

Depending on the color, size and type, the expected useful life ranges from 3 – 16 years. For this analysis we will use 10 years.

Perimeter Daylighting (C-21)

This measure saves energy by reducing energy to lighting that is in or adjacent to day lit spaces. 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. In all this measure is taken as applicable to 30% of the commercial sector.

Incremental Cost

The incremental cost for this technology will be very diverse. Based on NWPCC estimates, perimeter daylighting costs about $0.85/ kWh/yr. For the average building considered here that cost would be $4,723/site.

Average Annual Expected Savings

It is assumed here that a full application of perimeter daylighting can save about 3% of the total building energy. In the average building considered here this measure can save 5,561 kWh/yr.

Expected Useful Life

This measure is essentially a built in measures and is assumed to have a useful life of 18 years.

Low Flow Fixtures (C-22)

This technology consists of a new showerhead rated at 2.0 gpm at 80 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 cautions 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. For this analysis the applicability is taken as 10% of the commercial sector.

Incremental Cost

The incremental cost for this measure is taken as $1,000 reflecting the installation of 10-20 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 10-20 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 DEC-SC 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 very from program to program depending strongly on the choice of showerhead. Savings can also diminish with "take back" in the event that the new showering experience is longer than the original. Actual savings observed in the comprehensive cases

include these take back effects, and are in the range of 650 kWh/yr to 950 kWh/yr. The savings from a showerhead and aerator change alone are assumed to be 500 kWh/yr.

Expected Useful Life

The life time of this equipment is the key to its cost effectiveness. If an adequate, even pleasant, shower can be provided through lifetime warranted equipment, then the practical lifetime of the equipment is the length of time until the equipment is replaced in the course of renovation. For these purposes that lifetime is taken as 10 years.[94] Normally showerheads will last longer but with renovations and changes in ownership a 10 year EUL is a good planning number.

Solar Water Heaters (C-23)

The water heating end use in commercial buildings is a smaller end use than in residences. In the DEC-SC 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% 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% 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. For this study the incremental cost will be $6,000.

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 DEC-SC service area, leads to average annual savings for a system sized and designed to be in the cost effective range to be 2,500 kWh/yr.

[94] DEER Database, 2005

Expected Useful Life

Solar water heating systems are essentially plumbing fixtures that are certified products (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. This study will take 25 years as the useful life.

Heat Pump Water Heaters (C-24)

The water heating end use in commercial buildings is a smaller end use than in residences. In the DEC-SC service area large commercial water heating will be done by gas, and it will not be a very good candidate for this measure. But the smaller commercial water heating applications will be residential scale in usage, and often these smaller applications will be electrically heated. These are the candidate applications for this measure. In the case of electrically heated water, the annual water heating energy is about 4,800 kWh/yr. The heat pump water heater is essentially a small heat pump drawing heat from the air by cooling and de-humidifying it and injecting this heat into a storage tank. Physically, this measure consists of a small self contained heat pump and a water storage tank and associated pumps and controls.

Measure Applicability

This measure is applicable to large commercial buildings with reasonably low hot water use, and the system is sized as if it were residential. This measure is taken as applicable 25% of the commercial sector.

Incremental Cost

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

Average Annual Expected Savings

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

Expected Useful Life

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

Energy Star Hot Food Holding Cabinet (C-25)

This measure saves energy by keeping prepared food warm more efficiently; they are 60% more efficient than standard models. These models have better insulation, and may have magnetic door gaskets, auto-door closers, or Dutch doors.

Measure Applicability

This measure is applicable in portions of the restaurant hospitality and education sectors, and the applicability is estimated here to be 7% of the commercial sector.

Incremental Cost

For the average building considered here that cost would be $1,100/site.

Average Annual Expected Savings

It is assumed here that this measure will save 3% at a suitable site or 4,100 kWh/yr[95] in terms of the average building considered here. The DEER Database confirms this value with a value of 4,029.

Expected Useful Life

This measure is assumed to have a useful life of 15 years.

Energy Star Electric Steam Cooker (C-26)

This measure saves energy by cooking food more efficiently. It also saves water and cooling energy.

Measure Applicability

This measure is applicable in portions of the restaurant hospitality and education sectors. The applicability is estimated here to be 7% of the commercial sector.

Incremental Cost

For the average steam cooker considered here, the incremental cost would be $5,000/site.

Average Annual Expected Savings

It is assumed here that this measure will save1.5% at a suitable site or 2,200 kWh/yr in terms of the average building considered here.

Expected Useful Life

This measure is assumed to have a useful life of 15 years. DEER lists a slightly more conservative value of 12 years.

Pre-Rinse Spray Wash (C-27)

This measure applies to the commercial sector and provides a low pressure nozzle for pre-washing dishes. Using a low pressure nozzle saves water and heating energy in commercial kitchen settings.

Measure Applicability

This measure is applicable in portions of the restaurant hospitality and education sectors. The applicability is estimated here to be 7% of the commercial sector.

[95] Energy Star Website: http://www.energystar.gov/index.cfm?c=hfhc.pr_hfhc

Incremental Cost

Based on NWPCC estimates, the pre-rinse spray wash costs about $0.03/ kWh/yr. For the average building considered here that cost would be $235/site.

Average Annual Expected Savings

It is assumed here that this measure will save 5% at a suitable site or 9,268 kWh/yr in terms of the average building considered here.

Expected Useful Life

This measure is assumed to have a useful life of 15 years.

Restaurant Commissioning Audit (C-28)

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. In this analysis this measure is taken as applicable in 30% of the commercial sector.

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 here assumed to be $1,300, $.0738/kWh/yr.

Average Annual Expected Savings

It is assumed here this measure can reduce the energy use in an applicable facility by 10%, or 18,535 kWh/yr for the average building considered in this analysis.

Expected Useful Life

This measure will have a relatively short life; here it is assumed to be 5 years.

Grocery Refrigeration Tune-Up and Improvement(C-29)

This measure consists of cleaning heat exchangers and assuring proper airflow at the freezer cases and condenser coil. 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. The applicability is estimated here to be 4% of the commercial sector.

Incremental Cost

Based on NWPCC estimates, the grocery refrigeration tune up costs about $0.19/ kWh/yr. For the average building considered here that cost would be $3,513/site.

Average Annual Expected Savings

It is assumed here that this measure will save 10% at a suitable site or 18,535 kWh/yr in terms of the average building considered here.

Expected Useful Life

This measure is assumed to have a useful life of 5 years.

Refrigeration Casework Improvements (C-30)

This measure refers to improvements to refrigeration casework that can lower the refrigeration load. These include high quality insulated glass doors on the refrigeration case or other transparent refrigeration case covers that limit mixing of the warmer store air with the refrigerated air.

Casework improvements also include attention to two refrigeration case auxiliaries that emit heat into the refrigerated space. The first is the anti sweat heater made part of the clear refrigeration door to melt frost that could accumulate on the door and obscure the view of the contents. These heaters are commonly on all the time when they are only needed during high humidity episodes with humidity greater than 55%. 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 the 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 8760 hours/yr of 50Watts or about 450 kWh/yr per case.

Measure Applicability

This measure is applicable in portions of the grocery sector and in some restaurants. The applicability is estimated here to be 4 percent of the commercial sector.

Incremental Cost

Based on NWPCC estimates, an average refrigeration case upgrade costs about $0.33/ kWh/yr. For the average building considered here that cost would be $3,058/site.

Average Annual Expected Savings

It is assumed here that this measure will save 5 percent at a suitable site or 9,268 kWh/yr in terms of the average building considered here.

Expected Useful Life

This measure is assumed to have a useful life of 10 years.

VendingMiser® (C-31)

The VendingMiser® is a controller placed on vending machines which powers down a vending machine during low use times while maintaining product quality. It cycles the machine to maintain temperature and uses occupancy sensors to control the lighting on the vending machine.

Measure Applicability

This measure is assumed to be applicable in 25% of the commercial sector.

Incremental Cost

The incremental cost for a VendingMiser® unit is $179 and installation costs are expected to be $35.50 in labor for a total incremental cost of $215.[96]

Average Annual Expected Savings

Measure savings range from a low value of 800–1,200 kWh/yr, depending on the vending machine. Large machines with an illuminated front save 1,200 kWh/yr, and small machines or machines without an illuminated front save 800 kWh/yr. For planning purposes, we will assume 1,000 kWh/yr.

Expected Useful Life

The expected useful life for this measure is 10 years.[97]

Sources

DEER: 2004-05 Database for Energy Efficient Resources (DEER) Version 2.01 October 26, 2005 developed by the California Public Utility Commission and the California Energy Commission.

C&RD: Northwest Power and Conservation Council's Conservation Resource Comments Database, which is continually updated as new information becomes available.

[96] DEER
[97] DEER

APPENDIX E. SEGMENTATION AND CIS SAMPLING PLAN

In order to accurately understand the nature of loads and DSM opportunities, we start by disaggregating the DEC 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.

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

1. Aggregate customer loads (kW and kWh) to the site level (Site_ID) using data that identified Service_ID to Site_ID mapping
2. Group customers into Residential (rate schedules R, E, and A) and Non-Residential (rate schedules G, O, and I) based on the first character of the rate schedule.
3. Residential customers were then grouped into housing type and vintage.
    a. Housing type based on Residence_Type field.
        i. Single Family includes houses and manufactured homes.
        ii. Multi Family includes 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 (2004 and after)
        ii. Existing stock (prior to 2004)
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.

Customer Class Based on Rate Schedule (first character of schedule in parentheses)

Residential (R, E and A)		Non-Residential (G, O and I)
Single Family New Construction	Single Family Existing	Manufacturing and Non-Manufacturing Segments Based on NAIC (SIC)
Multi Family New Construction	Multi Family 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
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 a large number (over 30,000) of 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 2006 (to allow sufficient billing history) was drawn by segment for modeling purposes as follows:

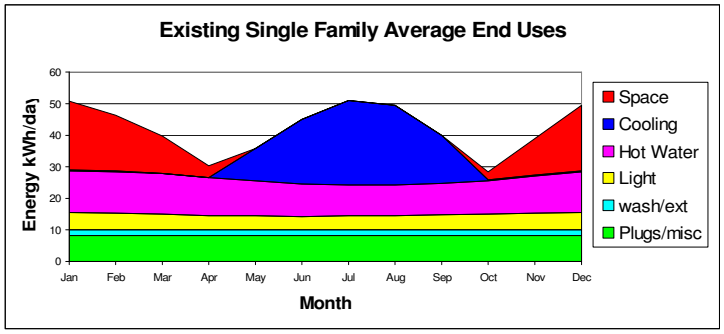
1. Randomly select 1,200 customer sites for each segment. This level of sampling is thought to provide sufficient power to allow analysis by weather zone (Mountains versus Piedmont).
2. Although not a separate segment, the sample also includes Energy Star homes to allow for a comparison of energy usage profiles with standard construction.
3. All manufacturing customers are included in the sample to allow for various groupings to be explored without having to request another round of data.
4. Any customer with exceptionally large load (> 5 MW) that was not included in the random sample was manually selected. Nearly 70 customer sites were included in the over-sample of exceptionally large customers.

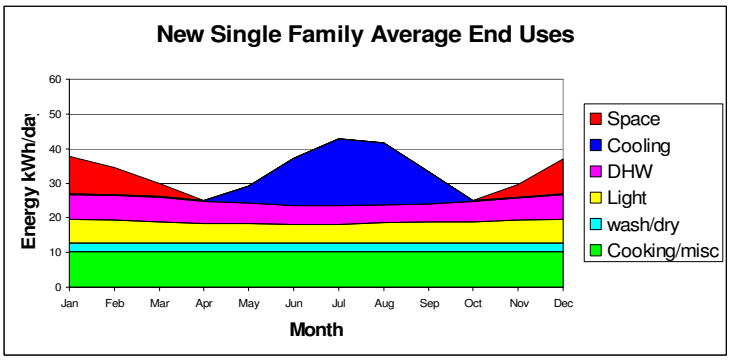
Monthly billing data for sample premises served as the basis for our energy modeling and analysis by market segment.

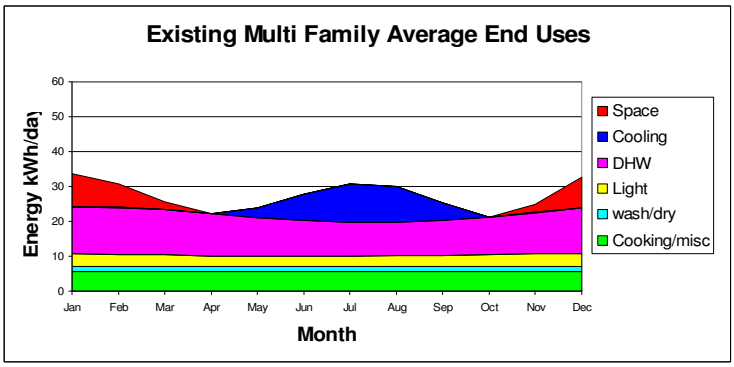
APPENDIX F. SEGMENT LOAD CHARTS

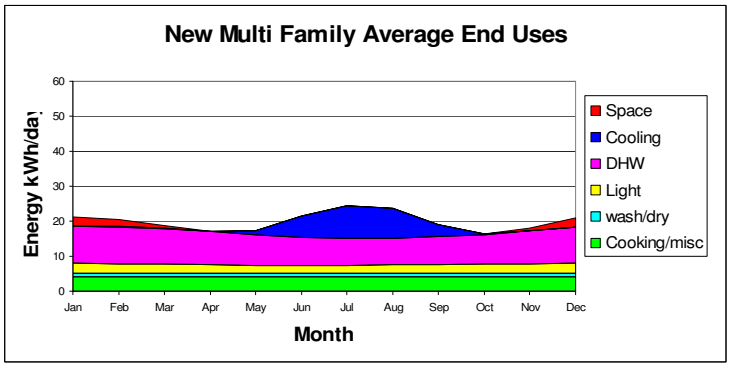
Residential

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



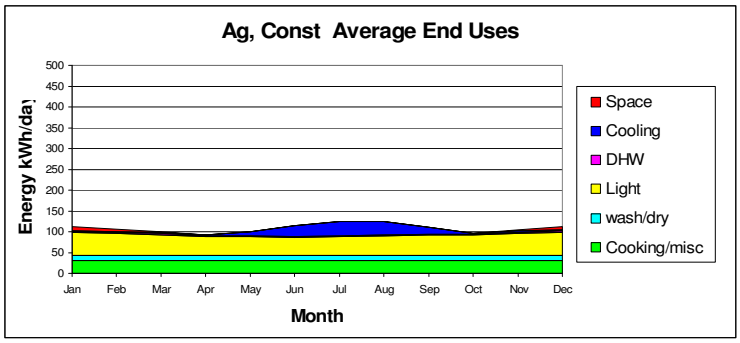


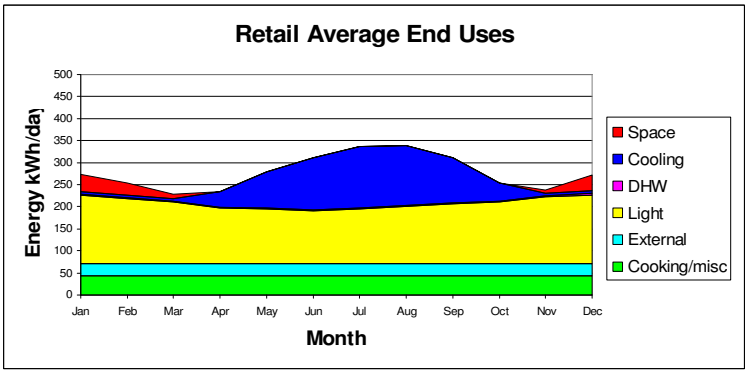


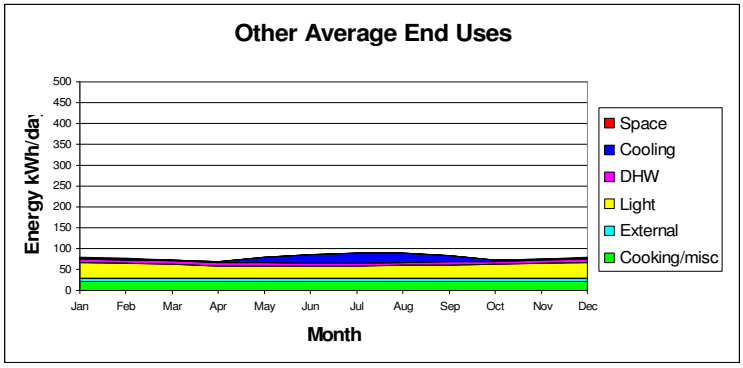


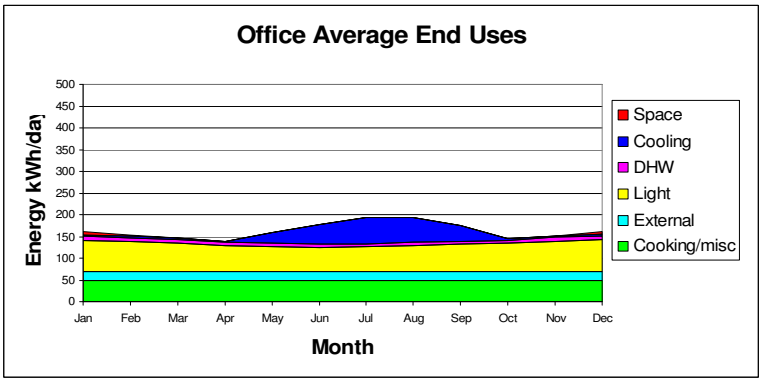
Non-Residential

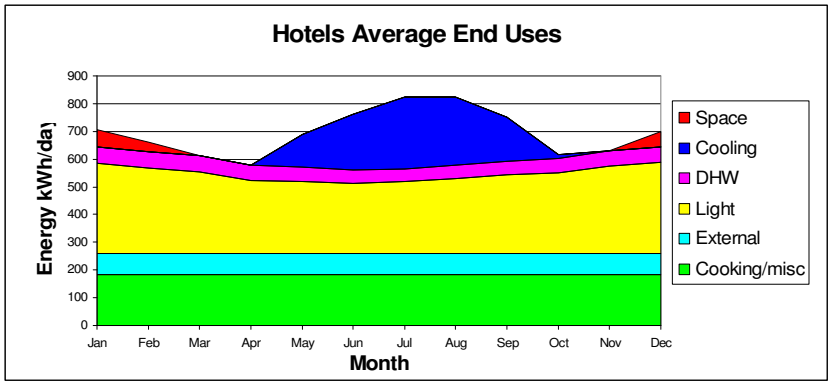
The following four charts show monthly usage by end-use for each of the non-residential segments.

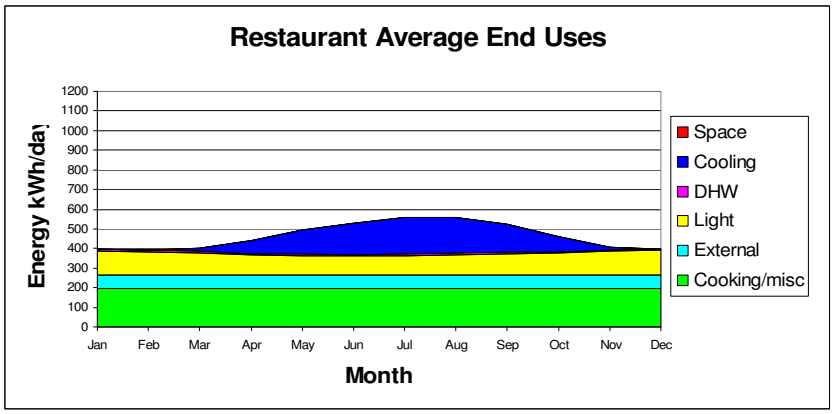


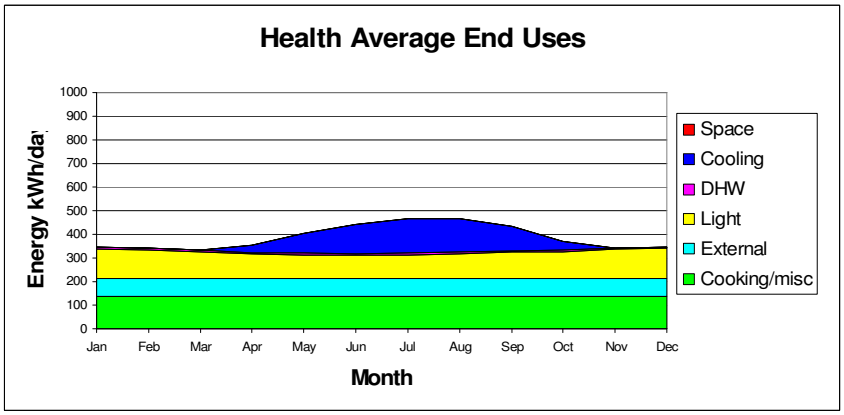


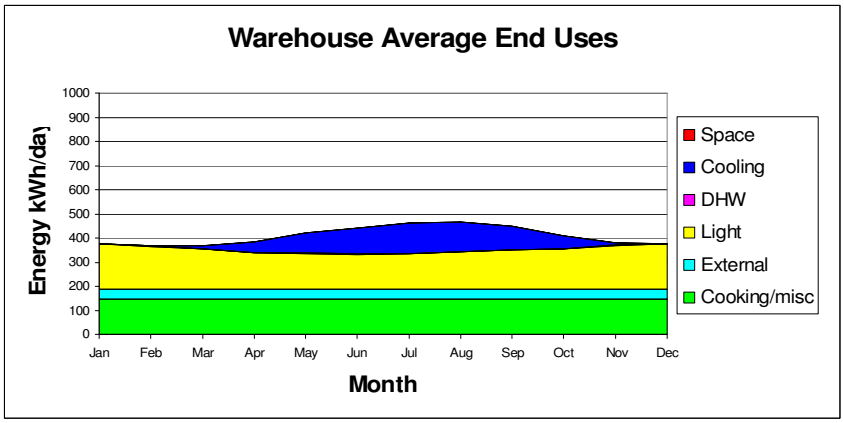


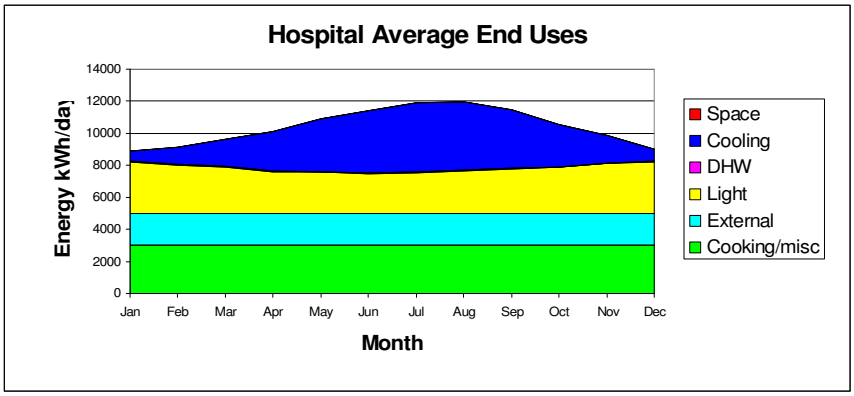


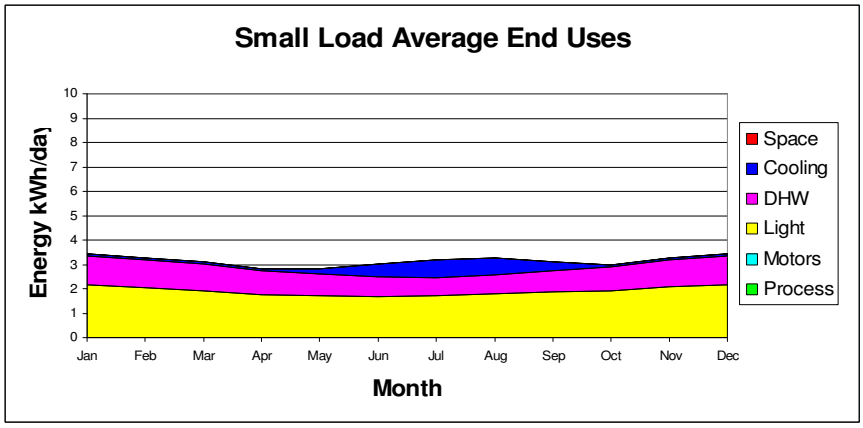

Hotels Average End Uses
Energy kWh/day
900
800
700
600
500
400
300
200
100
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Space
Cooling
DHW
Light
External
Cooking/misc

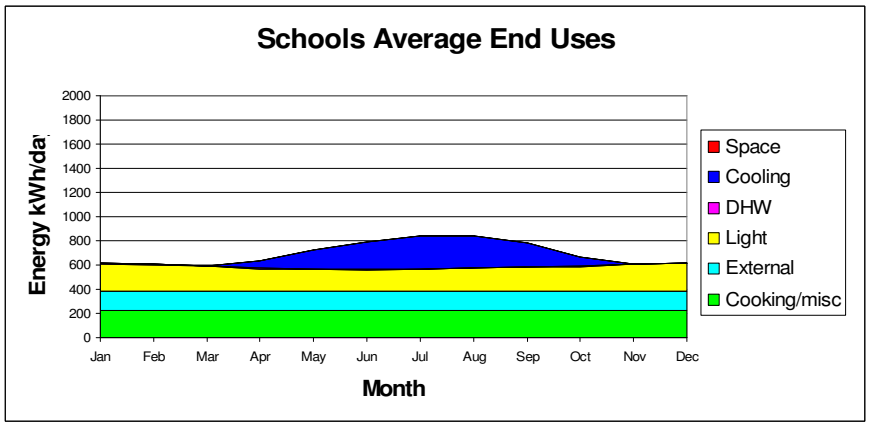

Restaurant Average End Uses
Energy kWh/day
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Space
Cooling
DHW
Light
External
Cooking/misc

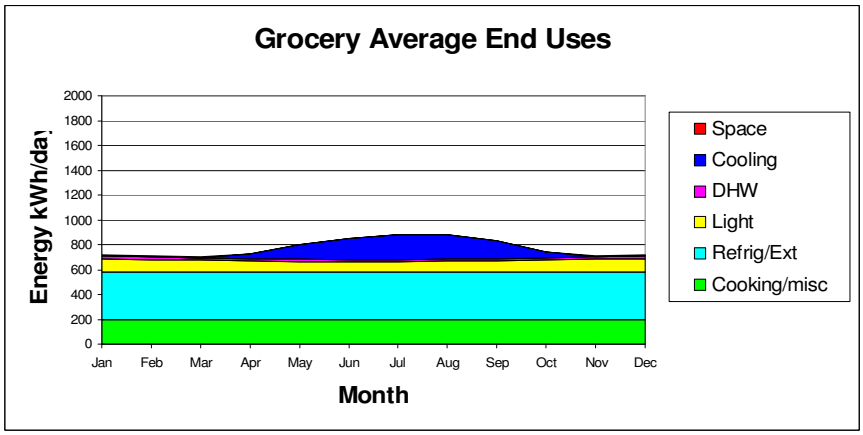

Health Average End Uses
Energy kWh/day
1000
900
800
700
600
500
400
300
200
100
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Space
Cooling
DHW
Light
External
Cooking/misc

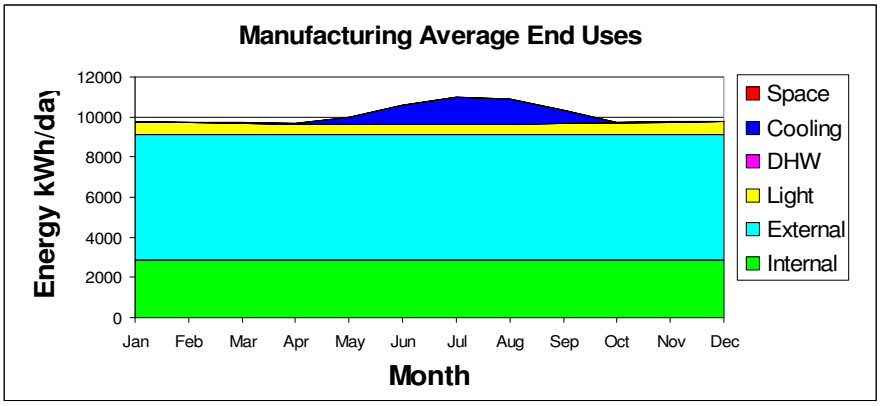

Warehouse Average End Uses
Energy kWh/day
1000
900
800
700
600
500
400
300
200
100
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Space
Cooling
DHW
Light
External
Cooking/misc


Hospital 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
Space
Cooling
DHW
Light
External
Cooking/misc


Small Load Average End Uses
Energy kWh/day
10
9
8
7
6
5
4
3
2
1
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Space
Cooling
DHW
Light
Motors
Process


Schools Average End Uses
Energy kWh/day
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Space
Cooling
DHW
Light
External
Cooking/misc


Grocery Average End Uses
Energy kWh/day
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Space
Cooling
DHW
Light
Refrig/Ext
Cooking/misc


Manufacturing Average End Uses
Energy kWh/day
12000
10000
8000
6000
4000
2000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Space
Cooling
DHW
Light
External
Internal

APPENDIX G. EMERGING PROGRAMS AND TECHNOLOGIES

Results of research into sixteen possible candidates for technical development and program research are shown in the table below, and then discussed in turn.[98] Four of the technologies were dropped because they were pre-screened by E-Source: Reduced Wattage Fluorescent Lamps, Power Reducers, Transient Voltage Surge Suppressors, and Voltage Controllers. Two of the technologies were found to be market ready: Intelligent Hotel Bathroom Lights and Cool-Colored Roofs. These technologies are ready to be moved into program measure lists. Four were found to be either unpromising or less appropriate: Programmable Thermostats, Solar Absorption Cooling, Induction Cooking, and the Turbochef Rapid Cooker. Reasons are given in the discussions below. Seven are recommended as candidates for Duke technical development and program research. The major four recommendations, in order are: Oil-Free Chiller Compressor, High-Intensity Fluorescent Lighting Systems, Smart Walk-In Freezer Defroster Controllers, and Intelligent Hotel Bathroom (Motion Sensor) Lighting. Three additional recommended technologies are the Evaporative Condenser Air Conditioner, Drain Heat Recover Water Heater, and Vehicles.

With the exception of the two technologies show as "ready," these measures are not ready for inclusion in current energy efficiency efforts. They are not modeled since they are not yet standard technologies, market ready, and some have significant drawbacks to be worked out through technical development and pilot studies. The two "ready" technologies, Intelligent Hotel Bathroom (Motion Sensor) Lighting and Cool Roofs are included in program measure packages.

Table 75. Technology Table

1	No	Programmable Thermostats
2	Future	Solar Absorption Cooling
3	No	Drain Heat Recover y Water Heaters
4	Yes	Oil Free Chiller Compressor
5	Yes	Evaporative Condenser AC
6	Yes	Smart Walk-In Freezer Defrost Controllers
7	No	Reduced Wattage Fluorescent Lamps
8	Yes	High-Intensity Fluorescent Systems
9	Ready Now	Intelligent Hotel Bathroom Lights
10	No	Power Reducers
11	No	Induction Cooking
12	No	Transient Voltage Surge suppressors
13	No	Voltage Controllers
14	No	Turbochef Rapid Cooker
15	Ready Now	Cool-Colored Roofs
16	Yes	Electric & Plug-In Electic Hybrid Vehicles

98 These technologies were listed by E-Source at the Spring 2007 AESP Conference, plus suggested additional technologies. In some cases we have listed specific vendors in this section of the report. These references are provided as a source for additional information on technologies and program development and are not meant to imply a recommendation of engagement with any particular company.

Technology 1. Programmable Thermostats

Programmable thermostats have a strong potential for residential and commercial energy savings. Unfortunately, they have not yet reached expected performance standards. The majority of studies have shown savings of only about 2 percent as opposed to the industry projected 15 percent potential savings. This is due primarily to non-use of the programmable features of these thermostats. The introduction of this technology has not yet become readily accepted by the general population and survey reports find these devices operating as standard thermostats.

The difficulty in use/interface with these thermostats is generally accepted as the primary cause for technical failure. Most households surveyed indicated they simply could not figure out how to make them work. Several anecdotal quotes show that these problems are not only found among the technically challenged, but professional programmers also have found them unworkable. Due to these challenges the Energy Star program has decided to drop their certification of all programmable thermostats in January 2009.

Even though this technology has not had much success in the residential sector, the general consensus among process evaluators is that there is still real potential in these thermostats. This is determined by the fact that MOST people would like to see the savings on their monthly energy bill, IF they could understand the technology. Therefore there are two recommended program developments that should assist the implementation of these savings. They both involve product redesign, one for technically savvy individuals and one for general population use.

(1) **Computer-aided Programmable Thermostat.** This type of thermostat has the largest short-term impact for residential energy conservation. It is targeted for computer-savvy and internet accessible markets. It is billed as a "discount home automation" device. Its basic idea is a thermostat that comes with a small "cruzer" style USB storage device for transferring thermostat settings from the home computer to the thermostat. The users plug in the memory storage device to their computer, log in to an online interface, choose the settings they would like for their home automation system and then simply plug them into their thermostat for easy download. Due to the streamlined and easy-to-read interface online, this design thermostat will yield immediate results for consumers. As a home automation device, this product would have a significant market share, especially if it can be put online and championed by the Energy Star program in 2009. This product could be designed regionally, manufactured overseas and implemented aggressively to a well-informed target audience for rapid and effective realized savings of 10 percent or more per unit.

(2) **Easy-to-Use Programmable Thermostat.** The primary challenge associated with current programmable thermostats is their cryptic user interfaces. Traditionally, thermostats have been hidden away in dark hallways and designed to be as small and inconspicuous as possible. This philosophy has carried onto the newer programmable thermostats with very tiny readout windows of black letters on green luminescence backgrounds. The obvious solution to this challenge is the development of large touch-screen thermostats that actually use a display screen with graphic interface capabilities. These types of thermostats will be much more costly than the typical programmable thermostat but their appearance, ease of interface and user-friendly design features will make them much more enjoyable to use. Also, having a touch-screen of this kind will allow programming instructions to be incorporated within the programming routine so that they will never be lost or forgotten. While the expected cost of this type of thermostat will be significantly higher, the real expected savings (10 percent in warmer climates and greater in colder ones) justify the cost. This is especially true when considering the costs of other weatherization efforts that bring 10 percent or less savings, (i.e. heat pump installation).

There is a significant market reward in the development of a successful product in this market, especially as the Energy Star program is removing its certification. A clear leader in programmable thermostat design will be poised to enjoy significant returns on their investments. This series of products should be seen as a marketable opportunity by Duke Energy which can also happen to yield wide-scale energy savings within its service territory.

However, the programmable thermostat problem is a universal problem, and Duke's most logical response would be to participate in industry working groups rather than independent technology development. For this reason, we recommend that any attention to this technology be focused on the national effort, rather than internal product development in a pilot project.

This technology has been included only in the Controls, Lights and Signs delivery channel in the Prescriptive Program (Program No. 3) for small hotels and motels because staff can insure the devices are set properly each day.

Technology 2. Solar Absorption Chillers

Solar absorption chillers for commercial air conditioning utilize the sun's energy to heat water for the refrigeration cycle of a lithium-bromide cooler. The amount of energy saved for this process is significant, though lithium-bromide systems are considerably less efficient than the current industry standard chillers. Due to the high costs and lower efficiency ratings of this technology, these devices are not currently marketable in the United States. The initial research for this technology was first developed during the mid 1970's. During that time it was determined that this technology was too expensive to compete with current methods and it was shelved. In the late 1990's this technology was again reviewed as a potential peak-load reduction strategy in California. The final results of this study determined that it could be an effective component of a peak-load reduction program.

To date, there are no solar absorption chillers readily available on the commercial market. In 2006 BROAD, a Chinese air-conditioner manufacturer, donated the first commercialized solar absorption cooling system in the United States to Carnegie-Mellon University. There, the Center for Building Performances and Diagnostics will be using the chiller for heating and cooling of their buildings as well as continuing research on "environmentally sound building cooling practices".

Based on the currently available research results and cost data, this could be considered for a demonstration research program once it becomes more readily available.

Technology 3. Drain Water Heat Recovery (DWHR)

Drain Water Heat Recovery (DWHR) is a method of capturing the heat from warm waste water (i.e. shower or dishwasher) and using it to pre-heat the incoming water to a hot water heater. This relatively simple technology has been proven to recover 30-50 percent of the hot water energy lost per shower.

Current market-available units designed for residential DWHR are composed of a copper drain-pipe replacement, installed by a certified plumber, with a tightly wound copper tube wrapped around the outside of the drain. As

water flows from the hot water heater to the shower, and then down the drain pipe, suction draws cold incoming water through the copper coil wrapped around the drain pipe. A large amount of heat is captured from the drain water due to the heat conduction of copper and the large amount of surface area shared between the two pipes.

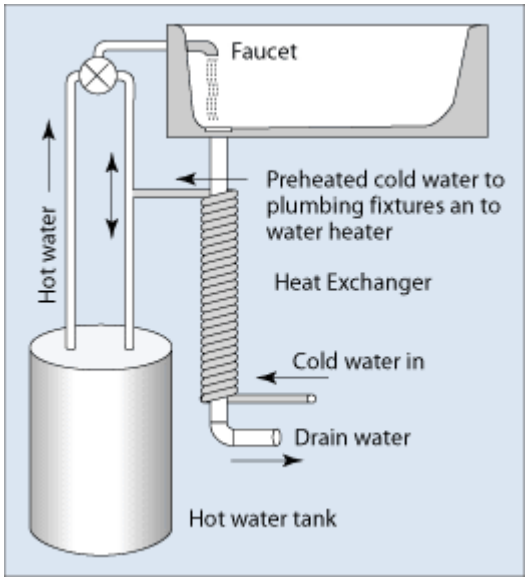


Figure 38. Typical Drain Water Heat Recovery System (Source: U.S. Dept. of Energy)

There are significant benefits to this technology for any sector that uses hot water. In addition to energy and monetary savings, for the residential sector, this technology also increases the effective water heater capacity by 2-3 times. This may lead to higher water use (longer showers) but will in turn increase the energy savings of the household while increasing home living standards. For new construction residential this technology allows for a smaller water heater which, in turn, provides significant inherent energy savings. While most research for this product has been performed to analyze the monetary benefits to residential retrofits with electric-powered water heaters, a significant benefit may be had for commercial applications, (i.e. restaurants, gymnasiums, laundry facilities, food processing and dairies). Gas water heating will increase the payback period to the longer end of the spectrum, approximately 6 years for the average household.

Recommended efforts to forward this technology start with local code agencies being trained to accept DWHR technology as an acceptable measure for high efficiency building standards. Mailing inserts to residences describing the product and local vendors able to provide this service/installation will naturally lead to the use of this technology in the residential market. A target flyer showing the potential monetary savings for targeted businesses will lead to further inquiries which can then be directed to local vendors. Since this technology is market ready, it is a candidate for program research.

However, most commercial water heating is powered by natural gas rather than electricity, so the program research should be undertaken by a gas utility or a state bureau.

Technology 4. Oil-Free Chiller Compressors

Oil-free chiller compressors utilize high-efficiency magnetic bearings to "levitate" the compressor drive shaft to greatly reduce friction and increase compressor efficiency. This product is readily available in the market and is a proven technology through many field installations. Offering up to 47 percent increases in energy efficiency over standard new chiller compressors of similar cooling capacities, this technology offers a relatively short payback period of only 1.8-3.8 years. Increased use in warmer climates shortens payback periods significantly. For older commercial buildings with aging cooling systems energy savings of upwards to 70 percent have been measured.

Target commercial applications are those that require a cooling load of 60 tons or greater. Typical target platforms for commercial new construction and commercial retrofit are schools, hospitals, office buildings, industrial facilities and hotels.

Currently in California, plans are being made to incorporate this technology into the Title 24 codes and standards. It is generally understood that an aggressive promotion of this technology throughout the state of California could produce 2,000 GWH/Year of new electrical savings for each year through 2012. A possible platform for Duke Power to assist market impact would be a widely promoted pilot program for an older commercial building retrofit, preferably a school or hospital. This is a promising candidate for technology development and program research.

Technology 5. Evaporative Condenser Air Conditioner

Evaporative Condenser Air Conditioners are a potential high-efficiency cooling solution for the residential market. Typical unit sizes are 3-7 tons cooling capacity. These condensers use the process of evaporation for cooling but are not to be confused with evaporative coolers, also called "swamp coolers". Instead of using a stagnant pool of water to provide a cooling mechanism, the cooling fluid is pumped through external coils which are regularly sprayed with water. As the sprayed water evaporates away from the coils, the fluid inside the coils becomes cool. This water can then be used to cool the home. Pilot projects in California and Nevada using this technology have shown energy savings of up to 51 percent over typical household air conditioners.

This technology is market available for residential use but is not yet a proven technology. Significant questions still persist regarding the long-term reliability of this technology. The evaporation of water from the external coils leaves behind a mineral scale deposit on the coil's external surfaces. Over time this scale can reduce the heat conductivity of the coils. While typical air-cooled conditioners are known to degrade by up to 20 percent over 8-10 years, it is unknown how evaporative condenser efficiencies will perform over time. Some recent changes in the technology have been made to address this issue, but a regular maintenance schedule (annual cleaning) is generally required for these coolers. All energy efficiency calculations for this technology must also take into consideration the amount of water used in this process. Up to 70 gallons of water are consumed in a typical 8-hour period of operation for a 5-ton cooling system. Finally, there is some question as to the viability of this technology in the humid south. Actual installations in the south Florida area have proven these concerns to be unfounded.

Payback periods for this technology in California and Nevada pilot programs were shown to be between 5-7 years. While this is a long payback period, this technology is still a viable option, especially for residential retrofit where current AC units are 8 years old or older. Recent efforts by private vendors to combine this technology with heat-pump technology are promising. It is suggested that Duke Power implement a modest pilot project to explore the viability of this technology in the Carolinas. These devices are not expected to work as well in the Carolinas, where savings may be less but still significant.

Technology 6. "Smart" Walk-in Freezer Defrost Controllers

The "smart" walk-in freezer defrost controller is a device that monitors the typical daily usage of a commercial walk-in freezer and develops an energy saving defrost cycle personalized to that freezer's operation. Installation of this technology has been found to reduced the number of defrost cycles of a typical freezer by up to 30 percent. Field tests have shown annual energy savings of 2 GWH to 37.5 GWH per freezer based on size and usage. Due to the widespread usage of these types of freezers in grocery, warehouse and restaurant applications the potential savings of this technology are robust.

Purchase and installation costs for this equipment are $400 to $600 with annual energy cost savings of $160 to $3000 based on freezer size and usage.

While this technology has made large strides in market penetration in recent years, it still has experienced some drawbacks. The most significant has been the inexperience of maintenance personnel who, in not understanding the technology, override the controller at the first need of a service call. Otherwise, this technology stands as a valuable tool for future energy conservation designs and should be pursued in a pilot program within the Duke service territory. Due to limited commercial availability, a recommended vendor for this technology is provided in this report. For further information regarding program development, contact Jim Kitchen, Senior Product Manager at Heatcraft Refrigeration Products LLC at jimkitchen@heatcraftrpd.com. This is a reasonable candidate for ongoing program research.

Technology 7. Reduced Wattage Fluorescent Lamps

Pre-screened by E-Source. Not a good prospect.

Technology 8. High-Intensity Fluorescent (HIF) Lighting Systems

High-intensity fluorescent (HIF) lighting systems for large bay commercial applications have experienced a dramatic decline in unit costs (65%) over the last 10 years. Commercial vendors providing HIF lighting units have increased from 10 in 2000 to over 50 in 2007. Typical unit energy savings for this technology are measured at 40 percent when compared with the industry standard 400W metal hydride lamps. This translates to an annual energy savings of 650 KWH to 2,140 KWH per fixture. Additionally, aisle-occupancy sensors (motion detectors) for individual aisle lighting can be included with unit installations, increasing unit efficiency in some applications by an additional 25 percent. An ancillary benefit to this technology is the reduction in heat load on HVAC equipment.

Each 400W Metal Hydride lamp operates at temperatures of over 1,200°F while HIF lamps operate at temperatures of only 100°F.

This is a proven technology with many commercial installations to date. Design increases in light output as well as improvements in the emitted color spectrum have now overcome many of the early challenges associated with this technology. Consequently, several investor-owned utilities have developed incentive plans for the retrofitting of high-bay commercial buildings with new HIF lights. One of the most successful is Tacoma Power who advertises an incentive of 33 percent of total installation cost or 1/3 of first-year energy savings costs calculated at $.12 per KWH (whichever is less). With incentives such as these, typical payback periods are reduced from 2-4 years to 1-3 years, depending on usage.

Attempts are being made in California to incorporate this technology under the Title 24 energy efficiency building codes. It is generally believed within the CPUC that this technology, coupled with oil-free chiller compressor technology could yield the entire state's projected efficiency target goals through 2012. Attempts should be made to broaden market penetration in the Duke Power service territory via a mailing insert advertising an incentive program, and working with state building code developers for increased efficiency standards. This is an excellent candidate for ongoing program research.

Technology 9. Intelligent Bathroom (Motion Sensor) Lighting

Intelligent bathroom lighting is a motion sensor control that turns off the bathroom lights after a preset period of room inactivity. Currently stipulated into the California Title 24 energy efficiency building code, this technology has a proven track record and yields approximately 50 percent lighting energy efficiency across all pilot studies. Target platforms for this technology are large commercial residential buildings such as elderly assisted-living facilities, dormitories and hotels. Typical study payback periods for this technology are 2.5 years, with an annual energy savings of 150 KWH per hotel room installation. For large hotels of 200+ rooms this is a significant energy savings.

This technology is a viable solution on a purely technical basis; however, due to the cultural sensitivity of the bathroom experience, this solution has become seen as uncomfortable and even draconian by the general public. This is, for the most part, due to personal experience in areas where municipal building codes require a 30-minute shutoff delay. For some activities, and depending on sensor location, this is insufficient for the bathroom during bathing and grooming.

Pilot studies performed for the California Lighting Technology Center have shown that approximately 10 percent of hotel rooms produce the large majority of lighting energy waste. Only a small percent of the hotel guests leave the bathroom lights on. Due to this factor it has been shown that extending the shut-off delay from 30 minutes to 60 minutes has only an incremental reduction in overall program energy savings, with large gains in public acceptance of this technology. Therefore, it is recommended that this technology be promoted within the Duke Power service

territory only with the required 60 minute shutoff delay. Since this technology is ready, it is included in program measure lists.

Technology 10. Power Reducers

Pre-Screened by E-Source. Not a good prospect.

Technology 11. Induction Cooking

Induction Cooking is a new concept in high-efficiency cooking for restaurants, hotels and some high-end homes. This technology is a radical departure from current stove-top cooking methods. To generate a heat source for cooking, a magnetic field is created at the stove top. Then, ferromagnetic cookware made of iron or stainless steel are placed on the stove top. As the magnetic field induces electric currents within the cookware, heat begins to build up within and the food is cooked. Due to the direct transfer of electrical energy to heat within the cookware this is a high-efficiency method of cooking. Also, since this is effectively a transformer device, with the stovetop acting as the primary coil and the cooking utensil forming the secondary coil, a negligible amount of load is drawn by the system until the pot is placed directly on the cooking surface, regardless if this unit is left on.

Esthetically, this is an elegant system of cooking with porcelain cooking surfaces that are actually heated by the cookware instead of vice versa. Due to the direct transfer of heat energy, heat loss to the living space is greatly reduced, which also reduces cooling load during warm seasons. Currently there are no pilot program results available for the study of direct energy savings from this technology. There are no indications of payback periods for this technology. It is likely that payback periods will be excessively long as most commercial cooking applications use gas ranges and the induction cooking method, though more efficient, uses electricity. Unit costs are currently very high, making this an unlikely energy efficiency program component. Finally, this method uses magnetic radiation as the energy transfer device. This inherently produces uneasiness within the general public, considering the recent scare revolving around implied childhood leukemia risks associated with living near high-voltage power lines.

Technology 12. Transient Voltage Surge Suppressors

Pre-screened by E-Source. Not a good prospect.

Technology 13. Voltage Controllers

Pre-screened by E-Source. Not a good prospect.

Technology 14. Turbochef® Rapid Cooker

The Turbochef® Rapid Cooker is a niche technology that has considerable energy savings when compared to typical conduction ovens. Turbochef® is a registered trademark of Turbochef Technologies, Inc. Winning an exclusive contract with Subway Sandwiches this is a proven technology for commercial applications that require

rapid cooking/toasting, continuous use, load sizes greater than typical toaster ovens and where microwave ovens will not produce the desired results. Due to the limited market potential of this product it is not recommended as an energy efficiency program component at this time.

Technology 15. Cool Roofs

Cool Roofs is a market ready technology with Energy Star labeling. These panels are reflectorized and so no longer have to be light in color. There is no cost differential and the shingles are graded for measure life similar in the same increments as standard composite shingles. Since his technology is ready, it is included in Program 15, Energy Star Cool Roofs.

Technology 16. Electric and Plug In Electric Hybrid Vehicles

Growing public awareness within the United States to the facts of global warming has shifted the attitudes towards alternatively fueled vehicles. This process has necessitated investigation by electric utilities to the trend impacts and potential benefits that a large fleet of electric and plug-in hybrid vehicles may have within their service territory. In addition, the recent and expected future developments of battery technology, coupled with a continued and growing insecurity regarding the availability of cheap gasoline may radically shift the cost-effectiveness of these vehicles in the near-term. To address the potential market benefits/impacts of these vehicles, three hypothetical vehicles evaluated:

(1) **Full Sedan Electric Vehicle.** This vehicle is in the form of the unsuccessful EV-1 vehicle. It was chosen due to its comfort, speed, distance and carrying capacity. Typically this vehicle will be used for work commute and shorter distance errands. It has a limited range of 110 miles per battery charge and its battery pack will require a charge time of 5 or more hours. Current battery costs are prohibitive for all but those who seek this vehicle for status or ideology.

(2) **Mini-Compact Electric Vehicle.** This vehicle is the bare-bones minimum economy for production and operation. It is a two-seat, three-wheeled vehicle with a maximum speed of 55 miles per hour, a maximum range of 80 miles per charge and a charge time of approximately 4 hours. This vehicle is a commute-only vehicle with some very limited errand capability. The advantage of the three wheeled vehicle is in its federal classification as a motorcycle, without the need for expensive crash-testing and other federal safety regulations. Its small size and relatively few comforts allows for a smaller battery pack and greatly reduced purchasing costs.

(3) **Plug-in Hybrid Sedan.** This vehicle is in the form of a Toyota Prius Hybrid that has been converted to plug-in capability. The conversion package increases the initial cost of the vehicle but its subsequent increase in fuel efficiency offsets the cost, making it an attractive choice. It has full sedan carrying capacity and comforts.

Vehicle Availability

Currently none of these vehicles are available for purchase from vehicle manufacturers within the United States. Due to its cost-effectiveness on the long-term the Plug-in Hybrid Sedan technology has become marketable with a conversion package purchase and installation available from a vendor for around $2,500. This total cost is approximate to the purchase cost from a manufacturer when the Plug-in hybrid vehicles make it to market

(expected Nov 2009 at earliest). Due to the voiding of vehicle warranty, the uncertainty of battery life under plug-in hybrid operations and the removal of the spare tire for package installation, the Prius conversion option is severely limited in its current marketing potential.

The Full Sedan Electric Vehicle is not currently available on the market with long-term projections for purchase availability over 5 years. The Mini-compact Electric Vehicle is also not available for market purchase. Conversations with a private EV designer have determined the cost model for the Mini-compact vehicle. The purchase model assumed a sponsoring entity to secure reduced cost financing for the large pre-order of the vehicles by interested consumers. This has also allowed for a reduced down payment and lower interest rate in the cost calculations.

Table 76. Vehicle Specifications

Vehicle Specifications			
Vehicle	**Battery Capacity**	**Seating Capacity**	**Distance/Charge**
Sedan EV	30 kWh	5	110
Mini Compact EV	15kWh	2	80
Plug-In Hybrid	10kWh	5	Unlimited

Vehicle Impacts

Determination of CO2 savings is a primary concern. Using data provided by the EIA and Duke Energy the effect of shifting the fuel use of an average vehicle from gasoline (high CO2 emissions) to the Duke Energy electric grid (low CO2 emissions) was readily determined (Full Sedan Electric Vehicle). Comparison of vehicle fuel efficiencies between the Plug-in Hybrid and the normal gasoline-powered sedan, with the offset energy provided by the electric grid allowed for the determination of the Plug-in Hybrid's CO2 profile. Comparable operating efficiencies between the Full Sedan Electric Vehicle and the Mini-compact Electric Vehicle determined the projected CO2 profile for the Mini-compact. For the use of this study all driving habits were considered to be the same between vehicles, though it is certain that the Mini-compact will have significantly less usage than the Plug-in Hybrid.

The greatest projected CO2 savings were realized by the Mini-compact Electric Vehicle with the Full Sedan Electric Vehicle and the Plug-in Hybrid each producing comparable amounts of CO2. Note that the CO2 production of a single gasoline powered vehicle (average vehicle type and operations in South Atlantic region) only generates 6 tons of CO2 per year. This is not a significant amount with respect to current CO2 reduction strategies currently being employed by Duke Energy. It does show, however, that the long-term trend of electrification of the transportation will eventually generate sizeable CO2 reductions in the United States.

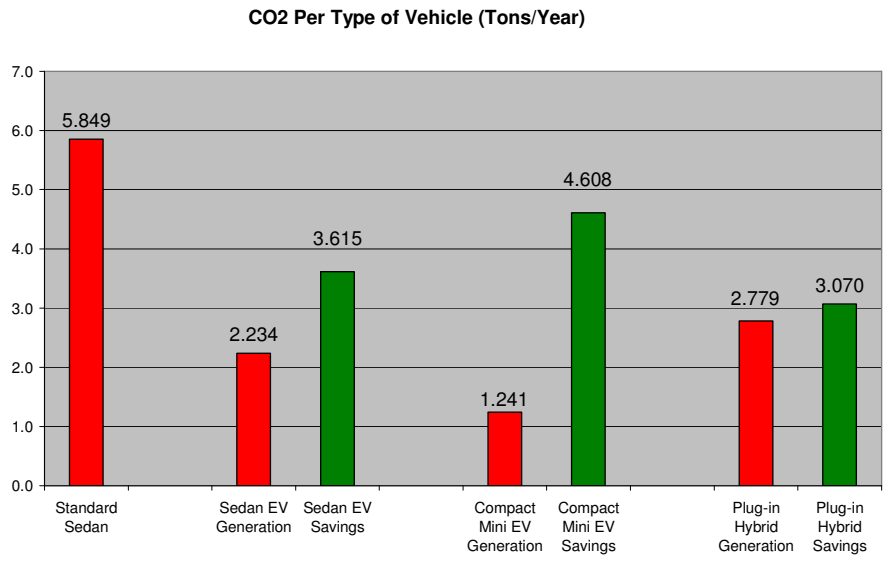


Figure 39. Comparison CO2 Values for Each Vehicle Type

Another concern was the effect that this shift will create for the electric grid. From the utility's perspective there are both positives and negatives realized for a large fleet of electrically powered vehicles. The most easily recognized positive is the increase in electricity sales that these vehicles will require.

Table 77. Annual Electricity Sales by Vehicle Type

Annual Electricity Sales/Vehicle	
Vehicle	**Annual Sales (kWh)**
Sedan EV	3,680
Mini Compact EV	2,050
Plug-In Hybrid	2,690

This also provides a potential for an increase in valuable off-peak demand to the grid. Unfortunately, the summer peak load for Duke Power coincides with the returning of the average commuter from work and turning on the home lighting and air conditioning. This means that steps will need to be taken to ensure that the charging process of these vehicle batteries takes place several hours after the commuter arrives home from work. This is not typical behavior for these vehicles as most owners will want to immediately charge their vehicles for convenience and potential emergency transportation needs. To leverage a shift in behavior some timer mechanism will need to be developed with an associated off-peak rate reduction incentive to those who will agree to charge their vehicles in the late evening or early morning hours.

Vehicle Costs

Determination of costs of each vehicle assumed a 6-year life of typical vehicle operation and maintenance schedules in the South Atlantic region. The projected cost of purchase, finance and operation of each type of vehicle assumes a gasoline price staying at 2007 prices for the next 6 years. All purchase options, with exception to the Compact Mini EV, assumed a $5000 down payment and a 7 percent financing over 48 months. The Compact

Mini EV was assumed to be purchased via a customer buy-in program of a large purchase order from an overseas manufacturer. For the purpose of this simulation, a $2000 down payment was required and 3 percent financing was made available to program participants. Due to uncertainty of availability, Federal, State and program incentives are not included for these vehicles. Currently there are no federal incentives for the purchase of the Toyota Prius since this vehicle has now become popular. It is likely, however, that there will be significant tax and rebate incentives available on the Federal and State levels for full EV and Plug-in Hybrid vehicles. There is currently a plug-in hybrid conversion tax rebate available in South Carolina. As these products approach market-ready a program incentive by Duke Energy will also assist in shifting these cost curves more favorably toward the alternatively fuelled vehicles. Surprisingly, it is clear that the Plug-in Hybrid vehicle is approaching typical standard sedan costs.

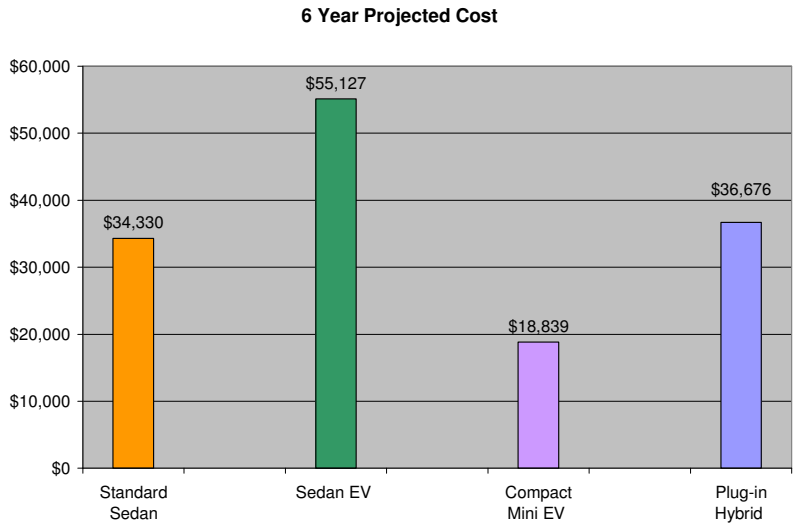


Figure 40. Six-Year Projected Costs of Purchase and Operation

The growing public awareness and acceptance of the urgency of CO2 reduction is a significant factor in determining market acceptance for these vehicles. In addition, the current costing of the plug-in hybrid vehicle shows that any real advance in battery technology or increase in fuel costs (or both!) will make the plug-in hybrid less expensive than a standard gasoline powered sedan, when fuel costs over time are considered. More attention needs to be made to determine how Duke Energy will be able to take advantage of this situation. Besides the technical and behavior challenges associated with load peaking, there is also the very significant benefit to the grid operations that several thousand of these vehicles may provide in the form of load smoothing and ancillary service, as well as possible emergency supply[99].

This is a technology to follow and, within the next five years move from program development to program design.

[99] This concept, known as Vehicle-to-Grid (V2G) Technology has been championed recently by PG&E. They currently have several concept vehicles and full-time staffers employed in education and outreach programs to increase awareness and future sales of these Plug-in Hybrid Vehicles. For more information see: http://www.acpropulsion.com/technology/v2g.htm

Testimony of Donald Gilligan on Behalf of ED, CCL, SACE and SELC
Docket No. 2007-358-E

Exhibit C

"New York Energy $mart[SM] Program Evaluation and Status Report"
Year Ending December 31, 2006 – Final Report March 2007
New York State Energy Research And Development Authority

New York Energy $mart℠ Program Evaluation and Status Report

Year Ending December 31, 2006

Report to the System Benefits Charge Advisory Group

Final Report
March 2007

New York State
Energy Research and
Development Authority

Table of Contents

EXECUTIVE SUMMARY ES-1
Program Administration ES-2
New York Energy $mart[SM] Budget and Spending Status ES-2
Portfolio Level Findings ES-5
Cost Effectiveness of Programs ES-7
Macroeconomic Impact Analysis ES-7
Evaluation Approaches ES-8
Commercial/Industrial Programs ES-9
Residential and Low-Income Programs ES-10
Research and Development Programs ES-12
Evaluation Review and Recommendations ES-13

1 INTRODUCTION AND PUBLIC POLICY CONTEXT **1-1**
1.1 Introduction 1-1
1.2 Public Policy Context 1-2
1.3 Design and Conduct of the New York Energy $mart[SM] Program 1-3
1.4 Organization of the Report 1-4

2 PORTFOLIO-LEVEL REPORTING **2-1**
2.1 Budget and Spending Status 2-1
2.2 Portfolio Level Findings 2-13
2.3 Portfolio Process Evaluation 2-24

3 COMMERCIAL/INDUSTRIAL PROGRAMS **3-1**
3.1 Overview of Commercial/Industrial Programs 3-1
3.2 Commercial/Industrial Evaluation Activities 3-3
3.3 Key Commercial/Industrial Evaluation Findings 3-4
3.4 Peak Load Management Program 3-8
3.5 Enhanced Commercial and Industrial Performance Program 3-10
3.6 New York Energy $mart[SM] Business Partners 3-14
3.7 New York Energy $mart[SM] Loan Fund and Financing Program 3-21
3.8 Energy Smart Focus Program 3-24
3.9 High Performance New Buildings Program 3-26
3.10 FlexTech Technical Assistance Program 3-31

4 RESIDENTIAL AND LOW-INCOME PROGRAMS **4-1**
4.1 Overview of the Residential and Low-Income Programs 4-1
4.2 Residential and Low-Income Evaluation Activities 4-3
4.3 Residential and Low-Income Evaluation Findings 4-3
4.4 Single Family Home Performance Program 4-8
4.5 Multifamily Building Performance Program 4-14
4.6 Market Support Program 4-19
4.7 Communities and Education Program 4-23
4.8 EmPower New York[SM] 4-26
4.9 Buying Strategies and Energy Awareness Program 4-31

5 RESEARCH AND DEVELOPMENT PROGRAMS 5-1
5.1 Overview of the R&D Programs 5-1
5.2 R&D Program Evaluation Activities 5-3
5.3 R&D Program Evaluation Findings 5-4
5.4 Public Benefit Power Transmission and Distribution Research 5-7
5.5 Clean Energy Infrastructure 5-10
5.6 Power Systems Product Development 5-15
5.7 DG-CHP Demonstration 5-22
5.8 Demand Response and Innovative Rate Research 5-27
5.9 Electric Transportation 5-29
5.10 Environmental Monitoring, Evaluation, and Protection 5-31
5.11 Industrial Research, Development, and Demonstration 5-35
5.12 Municipal Water and Wastewater Efficiency 5-36
5.13 Next Generation and Emerging Technologies 5-39

Tables

Table ES-1. New York Energy $mart^{SM} Program Budget ($ million) ES-3
Table ES-2. Financial Status of New York Energy $mart^{SM} Program ($ million) ES-4
Table ES-3. New York Energy $mart^{SM} Program Goals and Progress through December 31, 2006 ... ES-5
Table ES-4. Cumulative Program Benefits from Installed Measures ES-6
Table ES-5. Benefit Cost Ratios for the New York Energy $mart^{SM} Portfolio ES-7
Table ES-6. Summary of Macroeconomic Impacts of the New York Energy $mart^{SM} Program (Constant 2006$) ES-8
Table 2-1. New York Energy $mart^{SM} Program Budget ($ in million) 2-2
Table 2-2. Financial Status of New York Energy $mart^{SM} Program ($ million) 2-4
Table 2-3. Commercial and Industrial Programs – Financial Status ($ million) 2-5
Table 2-4. Residential and Low-Income Programs - Financial Status ($ million) 2-8
Table 2-5. Research & Development Programs – Financial Status ($ million) 2-11
Table 2-6. New York Energy $mart^{SM} Goals and Progress through December 31, 2006 2-14
Table 2-7. Reported and Adjusted Cumulative Annual Energy, Demand, and Fuel Savings through December 2006 2-16
Table 2-8. Summary of Macroeconomic Impacts of the New York Energy $mart^{SM} Program (Constant 2006$) 2-20
Table 2-9. Summary of Benefits ($ million) 2-23
Table 2-10. Summary of Costs Through 2006 ($ million) 2-23
Table 2-11. Non-energy Impacts as a Percent of Bill Savings ($ million) 2-23
Table 2-12. Benefit Cost Ratios for the New York Energy $mart^{SM} Portfolio 2-24
Table 2-13. Solicitations Released Through Year-End 2006[1] 2-24
Table 3-1. 2006 C/I Program Evaluation Activities 3-3
Table 3-2. C/I Program Electricity Savings through December 31, 2006 and Progress toward One-Year Goal 3-5
Table 3-3. C/I Program Peak Demand Savings through December 31, 2006 and Progress toward One-Year Goal 3-6
Table 3-4. C/I Program Fuel Savings through December 31, 2006 3-7
Table 3-5. Peak Load Management Program – Near-Term Goals and Achievements 3-9
Table 3-6. PLMP – Key Market Indicators and Program Cumulative Progress 3-9
Table 3-7. PLMP Cumulative Annual Energy and Peak Demand Savings (through December 2006) .. 3-10

Table 3-8. Enhanced Commercial and Industrial Performance Program – Near-Term Goals and Achievements 3-11
Table 3-9. Enhanced Commercial and Industrial Performance Program – Key Program Outputs....3-12
Table 3-10. Enhanced Commercial and Industrial Performance Program – Key Market Indicators and Program Cumulative Progress 3-12
Table 3-11. ECIPP Cumulative Annual Energy and Peak Demand Savings (Through Dec. 2006)....3-13
Table 3-12. ECIPP NEI Results 3-14
Table 3-13. New York Energy $mart^{SM} Business Partners Program – Near-Term Goals and Achievements 3-15
Table 3-14. New York Energy $mart^{SM} Business Partners Program – Key Program Outputs 3-17
Table 3-15. New York Energy $martSM Business Partners Program – Key Market Indicators and Program Cumulative Progress 3-18
Table 3-16. New York Energy $mart^{SM} Business Partners Cumulative Annual Energy and Peak Demand Savings (Through December 2006) 3-20
Table 3-17. Business Partners NEI Results 3-21
Table 3-18. New York Energy $mart^{SM} Loan Fund and Financing Program – Near-Term Goals and Achievements for Commercial/Industrial Projects 3-22
Table 3-19. Loan Fund and Financing Program – Key Program Outputs for Commercial/Industrial Projects 3-22
Table 3-20. Loan Fund and Financing Program Key Program – Key Market Indicators and Program Cumulative Progress 3-23
Table 3-21. Loan Fund Cumulative Annual Energy and Peak Demand Savings (Through December 2006) 3-24
Table 3-22. Energy Smart Focus Program – Near-Term Goals and Achievements 3-25
Table 3-23. High Performance New Buildings Program – Near-Term Goals and Achievements 3-26
Table 3-24. High Performance New Buildings Program – Key Program Outputs 3-27
Table 3-25. High Performance New Buildings Program – Key Market Indicators and Program Cumulative Progress 3-27
Table 3-26. High Performance New Buildings Cumulative Annual Energy and Peak Demand Savings (through December 2006) 3-29
Table 3-27. FlexTech Program – Near-Term Goals and Achievements 3-32
Table 3-28. FlexTech Program – Key Program Outputs 3-33
Table 3-29. FlexTech Program – Key Market Indicators and Program Cumulative Progress 3-33
Table 3-30. FlexTech Program Cumulative Annual Energy and Peak Demand Savings (through December 2006) 3-35
Table 4-1. 2006 Residential and Low-Income Program Evaluation Activities 4-3
Table 4-2. Residential and Low-Income Program Electricity Savings through December 31, 2006 and Progress toward One-Year Goals 4-5
Table 4-3. Residential and Low-Income Program Peak Demand Reductions through Dec. 31, 2006 4-6
Table 4-4. Residential and Low-Income Program Fuel Savings through December 31, 2006 and Progress toward One-Year Goals 4-6
Table 4-5. Number of Low-Income Customers Served by Program and Utility Area 4-8
Table 4-6. Single Family Home Performance Program – Near-Term Goals and Achievements 4-10
Table 4-7. Single Family Home Performance Program – Key Program Outputs 4-11
Table 4-8. Single Family Home Performance Program – Key Market Indicators and Program Cumulative Progress 4-11
Table 4-9. Single Family Home Performance Program Cumulative Annual Energy and Peak Demand Savings (Through December 2006) 4-14
Table 4-10. Single Family Home Performance NEI Results 4-14
Table 4-11. Multifamily Building Performance Program – Near-Term Goals and Achievements 4-16

Table 4-12. Multifamily Building Performance Program – Key Market Indicators and Program Cumulative Progress 4-16
Table 4-13. Multifamily Building Performance Program Cumulative Annual Energy and Peak Demand Savings (Through December 2006)....4-18
Table 4-14. Multifamily Building Performance NEI Results 4-18
Table 4-15. Market Support Program – Near-Term Goals and Achievements....4-20
Table 4-16. Market Support Program – Key Program Outputs 4-20
Table 4-17. Market Support Program – Key Market Indicators and Program Cumulative Progress 4-21
Table 4-18. Market Support Program Cumulative Annual Energy and Peak Demand Savings (Through December 2006 unless noted) 4-23
Table 4-19. Market Support Program NEI Results....4-23
Table 4-20. Communities and Education Program – Near-Term Goals and Achievements 4-25
Table 4-21. Communities and Education Program – Key Program Outputs....4-26
Table 4-22. Non-SBC Funds Leveraged....4-27
Table 4-23. EmPower New York^{SM} Program – Near-Term Goals and Achievements....4-28
Table 4-24. EmPower New York^{SM} Program – Key Market Indicators and Program Cumulative Progress (SBC-funded only) 4-28
Table 4-25. EmPower New York^{SM} Program Cumulative Annual Energy and Peak Demand Savings (Through December 2006) 4-30
Table 4-26. Buying Strategies and Energy Awareness Program – Near-Term Goals & Achievements....4-33
Table 4-27. Buying Strategies and Energy Awareness Program – Key Program Outputs 4-34
Table 4-28. Buying Strategies and Energy Awareness Program – Key Market Indicators and Program Cumulative Progress....4-34
Table 5-1. 2006 R&D Program Evaluation Activities....5-3
Table 5-2. R&D Program Electricity Savings through December 31, 2006 and Progress toward One-Year Goals....5-5
Table 5-3. R&D Program Peak Demand Reductions through December 31, 2006 and Progress toward One-Year Goals....5-6
Table 5-4. R&D Program Fuel Savings through December 31, 2006 and Progress toward One-Year Goals 5-6
Table 5-5. Public Benefit Power Transmission and Distribution Research Program Goals achieved from July 1, 2006 through September 30, 2006....5-8
Table 5-6. Anticipated Near-Term Accomplishments....5-10
Table 5-7. Clean Energy Infrastructure Program Goals achieved from July 1, 2006 through December 31, 2006 5-12
Table 5-8. Clean Energy Infrastructure – Key Program Outputs....5-13
Table 5-9. Clean Energy Infrastructure – Key Market Indicators and Program Cumulative Progress...5-13
Table 5-10. Clean Energy Infrastructure Program Cumulative Annual Clean Generation (through December 2006)....5-14
Table 5-11. Power Systems Product Development Program Goals achieved from July 1, 2006 through December 31, 2006....5-16
Table 5-12. Power Systems Product Development Program – Key Program Outputs....5-16
Table 5-13. Power Systems Product Development Program – Key Outcomes 5-17
Table 5-14. Number of Field and Lab Tests Initiated and Completed....5-19
Table 5-15. Number of Articles by Technology Area 5-19
Table 5-16. Number of Projects with Commercialization Progress....5-20
Table 5-17. Number of projects with Economic Benefits....5-21
Table 5-18. DG-CHP Demonstration Program – Near-Term Goals and Achievements 5-22
Table 5-19. DG-CHP Demonstration Program – Key Program Outputs....5-23

Table 5-20. DG-CHP Demonstration Program – Key Market Indicators and Program Cumulative Progress 5-23
Table 5-21. Location of NYSERDA CHP Projects by NY Independent System Operator Zone 5-26
Table 5-22. CHP Cumulative Annual Energy and Peak Demand Savings (Through December 2006) . 5-27
Table 5-23. Demand Response and Innovative Rate Research Program Goals achieved from July 1, 2006 through December 31, 2006 5-28
Table 5-24. Demand Response and Innovative Rate Research Program Cumulative Annual Energy and Peak Demand Savings (Through December 2006) 5-29
Table 5-25. Electric Transportation Program Goals achieved from July 1, 2006 through December 31, 2006 5-30
Table 5-26. Long-Term Success Indicators 5-31
Table 5-27. Environmental Monitoring, Evaluation, and Protection Program Goals achieved from July 1, 2006 through December 31, 2006 5-32
Table 5-28. Industrial Research, Development and Demonstration Program – Near-Term Goals and Achievements 5-35
Table 5-29. Industrial Research, Development and Demonstration Program – Key Program Outputs .. 5-36
Table 5-30. Municipal Water and Wastewater Efficiency Program Goals achieved from July 1, 2006 through December 31, 2006 5-37
Table 5-31. Project and Funding Status 5-38
Table 5-32. Next Generation and Emerging Technologies Program – Near-Term Goals and Achievements 5-40
Table 5-33. Next Generation and Emerging Technologies Program – Number of Projects with Selected Outcomes (Through Year-End 2006) 5-43
Table 5-34. Other Program Outcomes: Number of Projects with Attribute 5-43
Table 5-35. Next Generation and Emerging Technologies Program – New Products Developed Since 1998 5-44
Table 5-36. Project Outcomes by Technology Type (Cumulative Through 2006) 5-45

Figures

Figure 2-1. New York Energy $mart^{SM} Ratepayer Contributions by Utility Service Area 2-3
Figure 2-2. New York Energy $mart^{SM} Ratepayer Contributions by Sector 2-3
Figure 2-3. New York Energy $mart^{SM} Program Funding History and Activity December 1998 through December 2006 2-5
Figure 2-4 C/I Funds Spent by Utility Service Area 2-6
Figure 2-5 C/I Funds Spent by Sector 2-7
Figure 2-6 Residential Funds Spent by Utility Service Area 2-9
Figure 2-7 Residential Funds Spent by Housing Type 2-9
Figure 2-8. Low-Income Funds Spent by Utility Service Area 2-10
Figure 2-9. Low-Income Funds Spent by Housing Type 2-10
Figure 2-10 R&D Funds Spent by Utility Service Area 2-12
Figure 2-11 R&D Funds Spent by Technology 2-12
Figure 2-12. 2006 Update – Net Employment Impacts by Year 2-21
Figure 4-1. Percent of Appliance Models on Display at Partner Stores that are ENERGY STAR Compliant 4-22
Figure 4-2. Referrals to EmPower by Source 4-29
Figure 5-1. Power System Program Funds Encumbered through 2005 5-18
Figure 5-2. Conference Presentations 5-20

Figure 5-3. Peak KW Reduction by Prime Mover for Encumbered Projects (through 2006) 5-24
Figure 5-4. Peak KW Reduction by Utility Service Area for Encumbered Projects (Through 2006) 5-24
Figure 5-5. Citations of Journal Articles from EMEP Projects 5-33
Figure 5-6. Projects Distributed by Project Type..... 5-41
Figure 5-7. Distribution of Funding by Project Type 5-42
Figure 5-8. Encumbered Funding by Sector (through 2006) 5-42

Executive Summary

This report presents evaluation results for the **New York Energy $mart**[SM] public benefits program (Program) for activities completed through year-end 2006.[1] The report was prepared jointly by staff of the New York State Energy Research and Development Authority (NYSERDA) and a team of third-party evaluation assistance and specialty contractors acting under the terms and conditions of a Memorandum of Understanding (MOU)[2] between NYSERDA, the New York State Department of Public Service (DPS), and the New York State Public Service Commission (PSC). This report was reviewed before being finalized by the System Benefits Charge Advisory Group[3] (Advisory Group), which serves as the Independent Program Evaluator in accordance with the MOU. The report is tendered to the PSC by the Advisory Group in fulfillment of its responsibilities under the terms of the MOU.

On December 21, 2005, the PSC ordered[4] New York's public benefits program funding extended for five years, from July 1, 2006 through June 31, 2011 and increased funding from approximately $150 million to $175 million annually ($896 million over the five-year period). The continuation and expansion of the Program is designed to help maintain momentum for the State's efforts to develop competitive markets for energy efficiency; demand management (including peak load reduction); outreach and education services; research, development, and demonstration; low-income services; and to provide direct economic and environmental benefits to New Yorkers. The extended program will continue to address market barriers to the competitive procurement of these services. By mid-2011, SBC funds will have provided over $1.85 billion to support a full range of programs to help the State meet its energy challenges.[5]

The report builds on the evaluation framework and model used to guide prior evaluation efforts, described below under Evaluation Approaches, and constitutes the most comprehensive assessment to date of the **New York Energy $mart**[SM] Program. The content and format of this report has changed from previous annual reports. In an effort to comprehensively monitor program performance, NYSERDA expanded the scope of its quarterly reporting and streamlined its annual reporting to avoid redundancy. While this

---

[1] Previous annual reports dated September 2000, January 2002, May 2003, May 2004, May 2005, and May 2006 presented cumulative results from the Program's inception on July 1, 1998. The most recent annual and quarterly reports are available on NYSERDA's website at www.nyserda.org and by request.

[2] Memorandum of Understanding between the New York State Public Service Commission, New York State Department of Public Service, and New York State Energy Research and Development Authority, March 11, 1998, revised December 6, 2001.

[3] The Advisory Group consists of 24 individuals representing varied interests, including utilities, business and environmental groups, energy services companies, community organizations, professional and trade associations, and national energy efficiency and energy research and development (R&D) organizations

[4] Case 05-M-0090, In the Matter of the System Benefits Charge III, Order Continuing the System Benefits Charge (SBC) and the SBC-Funded Public Benefit Programs, issued and effective December 21, 2005.

[5] In addition to NYSERDA's **New York Energy $mart**[SM] Program, funded through the SBC, the New York Power Authority (NYPA) and Long Island Power Authority (LIPA) each offer complementary public benefits programs of their own. The three authorities coordinate program design and service delivery wherever practicable to maximize the use of public funds for the programs and to ensure a coordinated statewide effort to meet public policy goals. The results of the NYPA and LIPA programs are not included in this report.

report documents program progress through the quarter ending December 31, 2006[6], NYSERDA has provided program descriptions, and expanded program accomplishments and progress for the full year, to enable the reader to compare annual results to the previous reports. Individual evaluation contractor reports to NYSERDA that detail the activities undertaken to develop this report are available upon request. Future quarterly reports will document work completed within the reporting period.

Program Administration

NYSERDA has instituted numerous policies to ensure that the Program is administered in an open, fair, and equitable manner. Ninety-seven percent (97%) of projects are competitively selected. The remaining 3% of projects involve contracts less than $25,000 each, unsolicited proposals that are deemed to support the Program's goals, and sole-source contracts with unique, specially-skilled contractors.

Contract awards are recommended to NYSERDA management for consideration and approval by expert panels that review all competitive proposals. The panels consist of technical experts, and external members are drawn from government and industry. Panels are required to have more external reviewers than internal NYSERDA reviewers. The panels provide feedback on the contents and composition of each program solicitation to ensure that solicitations reach the widest possible audience of potential proposers. All solicitations are published in the New York State *Contract Reporter.*

The evaluation function is overseen by NYSERDA and conducted by a team of independent evaluation contractors. All contractors were selected through competitive solicitation with a member of the Advisory Group and DPS serving on each review panel. The Advisory Group and DPS help allocate the evaluation budget, identify evaluation activities to be conducted, and establish timelines for evaluation activities. Evaluation analyses and reports are reviewed by the Advisory Group and DPS before being finalized and submitted to the PSC for approval. The Advisory Group is independent of NYSERDA; its members are selected by DPS and NYSERDA, it corresponds directly with the PSC, and members of the group participate in selection of evaluation contractors, receive evaluation reports, when requested, directly from evaluation contractors, and have independent access to those contractors.

New York Energy $mart^{SM} Budget and Spending Status

As shown in Table ES-1, the Program has a thirteen-year budget of approximately $1.87 billion. The budget is primarily allocated among four major program areas:

- Commercial/Industrial initiatives account for the largest share, 34% of the thirteen-year **New York Energy $mart^{SM}** Program budget, or $635.9 million.
- Research and Development, including environmental monitoring and evaluation, accounts for 21% of the thirteen-year budget, or $392.8 million.
- Residential initiatives account for 16.2% of the thirteen-year budget, or $302.1 million.
- Funding for Low-Income initiatives accounts for 17% of the total thirteen-year budget, or $318.6 million over this time period.

[6] The report for the quarter ending September 30, 2006 is available on NYSERDA's website.

In addition to these major program areas, the thirteen-year Program also funds an environmental disclosure program ($1.9 million), program administration ($128.2 million), program evaluation ($34.4 million), and includes a cost recovery fee ($25.4 million), a mandatory payment into the general fund assessed by New York State for state support functions. Table ES-2 shows the financial status of the programs as of December 31, 2006.

Table ES-1. New York Energy $mart[SM] Program Budget ($ million)

	Budget			% of Program Area Budget	% of Total Budget
	SBC I & SBC II[1,2]	SBC III[3]	Total Budget		
Program Areas					
Commercial and Industrial	359.2	276.7	635.9	37.8%	34.0%
Residential	167.1	135.0	302.1	18.0%	16.2%
Low Income	128.4	190.2	318.6	19.0%	17.0%
Research and Development	210.8	182.0	392.8	23.4%	21.0%
General Awareness[4] (Marketing)	16.0	15.0	31.0	1.8%	1.7%
Program Areas Total	**$881.5**	**$798.9**	**$1,680.4**	**100.0%**	**89.8%**
Other Costs					
Program Administration	65.5	62.7	128.2	-	6.9%
Metrics and Evaluation	16.5	17.9	34.4	-	1.8%
Environmental Disclosure	1.9	0	1.9	-	0.1%
NYS Cost Recovery Fee[5]	9.0	16.4	25.4	-	1.4%
Other Costs Total	**$ 92.9**	**$97.1**	**$189.9**	**-**	**10.2%**
Total New York Energy $mart[SM]	**$ 974.3**	**$ 896.0**	**$1,870.3**	**-**	**100.0%**

[1] Included with SBC II funding an additional $12.6 million from interest and unspent utility funds (distribution: Residential: $11.5 million; Program Administration: $0.88 million; and Metrics & Evaluation: $0.25 million).
[2] SBC I: July 1, 1998 through June 30, 2001; SBC II: July 1, 2001 through June 30, 2006.

[3] SBC III: July 1, 2006 through June 30, 2011.

[4] General Awareness previously included in Residential Program Area.

[5] The New York State Cost Recovery Fee is assessed for services to public authorities. The fee is determined by the New York State Division of Budget and imposed and collected by the Department of Taxation and Finance.

Totals may not sum due to rounding.

Source: NYSERDA

Table ES-2. Financial Status of New York Energy $mart[SM] Program ($ million)

	Total 13-Year Budget	Funds Spent			Encumbered Funds[4]	Committed Funds[5]
		SBC I & SBC II [1,2]	SBC III[3]	Total Spent % of Budget Spent	% of Budget Encumbered	% of Budget Committed
Program Areas						
Commercial and Industrial	635.9	247.1	18.3	265.5 41.8%	368.3 57.9%	399.5 62.8%
Residential	302.1	165.4	12.1	177.6 58.8%	196.6 65.1%	206.3 68.3%
Low-Income	318.6	86.6	15.3	101.9 32.0%	139.3 43.7%	145.6 45.7%
Research and Development	392.8	105.9	11.7	117.6 29.9%	177.8 45.3%	201.5 51.3%
General Awareness[6] (Marketing)	31.0	15.9	0.8	16.7 53.9%	19.3 62.3%	19.3 62.3%
Program Areas Total	**$1,680.4**	**$620.9**	**$58.3**	**$679.2** **40.4%**	**$898.5** **53.6%**	**$972.3** **57.9%**
Other Costs						
Program Administration	128.2	59.8	5.8	65.6 51.2%	65.6 51.2%	65.6 51.2%
Metrics and Evaluation	34.4	14.5	1.0	15.5 45.1%	17.5 50.9%	22.5 65.4%
Environmental Disclosure	1.9	0.8	0.1	0.9 47.4%	1.1 57.9%	1.1 57.9%
NYS Cost Recovery Fee[7]	25.4	9.2	1.2	10.4 40.9%	10.4 40.9%	10.4 40.9%
Other Costs Total	**$189.9**	**$84.3**	**$8.1**	**$92.4** **48.7%**	**$94.6** **49.8%**	**$99.6** **52.4%**
Total New York Energy Smart[SM]	**$1,870.3**	**$705.2**	**$66.4**	**$771.6** **41.3%**	**$993.3** **53.1%**	**1,071.9** **57.3%**

[1] Included with SBC II funding is $12.6 million from interest and unspent utility funds (distribution: Residential: $11.5 million; Program Administration: $0.88 million; and Metrics & Evaluation: $0.25 million) approved by DPS staff as part of SBCII reconciliation request.

[2] SBC I: July 1, 1998 through June 30, 2001; SBC II: July 1, 2001 through June 30, 2006.

[3] SBC III: July 1, 2006 through June 30, 2011.

[4] Encumbered funds associated with signed contracts and purchase orders.

[5] Committed funds associated with encumbered funds and pending contracts.

[6] General Awareness previously included in Residential Progarm Area.

[7] The New York State Cost Recovery Fee is assessed for services to public authorities. The fee is determined by the New York State Division of Budget and imposed and collected by the Department of Taxation and Finance.

Totals may not sum due to rounding.

Source: NYSERDA

Portfolio Level Findings

Progress Toward Goals

This section presents the cumulative progress of the **New York Energy $mart^{SM}** Program toward meeting the four overarching public policy goals set forth and recently revised by the PSC.[7] Overall, the Program is making good progress toward achieving its long term goals. The stated goals and progress made through December 31, 2006 are shown in Table ES-3. Substantial additional program-specific and sector-level accomplishments have been documented in NYSERDA and independent evaluation contractor reports and are contributing to the development of sustainable progress toward these important overarching public policy goals.

Table ES-3. New York Energy $mart^{SM} Program Goals and Progress through December 31, 2006

Public Policy Goal	Progress as of December 31, 2006
Improve New York's energy system reliability and security by reducing energy demand and increasing energy efficiency, supporting innovative transmission and distribution technologies that have broad application, and enabling fuel diversity, including renewable resources.	The **New York Energy $mart^{SM}** Program has improved system-wide reliability and peak demand reduction, enabling 618 MW of callable load reduction and installing efficiency measures that permanently reduce peak demand by another 495 MW.
	The **New York Energy $mart^{SM}** Program has led to the installation of energy efficiency measures saving more than 2,360 GWh per year.
	The **New York Energy $mart^{SM}** Program has led to the installation of wind and photovoltaic technologies which provide more than 100 GWh of clean electricity generation per year.
	With funding from **New York Energy $mart^{SM}**, the U.S. Department of Energy and private sources, the world's first in-grid underground superconducting cable was installed and began operations on July 20, 2006 in the National Grid utility system. Superconducting cables can carry three to five times more power than conventional cables of the same size and can meet increasing power demands in urban areas by retrofitting old underground cables, eliminating the need to acquire new rights-of-way.
Reduce the energy cost burden of New Yorkers by offering energy users, particularly the State's lowest income households, services that moderate the effects of energy price increases and volatility and provide access to cost-effective energy efficiency options.	The **New York Energy $mart^{SM}** Program has saved participating customers nearly $340 million in annual energy costs in 2006.
	Approximately 60,000 eligible New York low-income customers received direct assistance through the **New York Energy $mart^{SM}** programs, resulting in $220/year in average customer energy bill savings for this under served population.
	Approximately 2,200 small business customers have been served through the Smart Equipment Choices Program.
	Approximately 3,000 multi-family units will participate in time-sensitive electricity rate pilot projects.
	The **New York Energy $mart^{SM}** portfolio has achieved a benefit-cost ratio of 2.4 under the most conservative Total Market Effects Test scenario.

[7] Case 94-E-0952 *et al.*, In the Matter of Competitive Opportunities Regarding Electric Service, *Staff Proposal for the Extension of the System Benefits Charge (SBC) and the SBC-funded Public Benefits Program*, August 30, 2005.

Mitigate the environmental and health impacts of energy use by increasing energy efficiency, encouraging the development of support services for renewable energy resources, and optimizing the energy performance of buildings and products.	The annual reduction of emissions resulting from **New York Energy $mart**SM Programs' energy savings is 2,060 tons of nitrogen oxide (NOX), 3,800 tons of sulfur dioxide (SO_2), and 1.6 million tons of carbon dioxide (CO_2).
	Between 2002 and 2006, the number of PV and small wind installers participating in the **New York Energy $mart**SM Program has increased from 30 to 102. The Program has supported more than 1,680 attendees at PV and small wind training events, and helped 27 installers in the PV program become certified by the North American Board of Certified Energy Practitioners (NABCEP).
	The **New York Energy $mart**SM Program has helped optimize energy performance in approximately 650 new commercial buildings, more than 8,500 new homes, and more than 13,800 existing homes. Additionally, more than 8,500 energy efficiency projects have been completed in commercial/industrial buildings.
Create economic opportunity and promote economic well-being by supporting emerging energy technologies, fostering competition, improving productivity, stimulating the growth of New York energy businesses, and helping to meet future energy needs through efficiency and innovation.	Averaged over a 19-year analysis period, the **New York Energy $mart**SM Program creates and sustains on average more than 8,600 jobs, increases labor income by $182 million per year, increases total output by $456 million per year, and increases value added by $211 million per year.
	The **New York Energy $mart**SM Program activities were instrumental in EPA revising its ENERGY STAR computer specifications to incorporate 80 PLUS® criteria for active power efficiency thresholds.[8]
	Under the Environmental Product development program, total product sales grew from $13 million in 2004 to $28 million in 2005.

Summary of Program Benefits

Table ES-4 provides a summary of quantifiable benefits achieved by the **New York Energy $mart**SM portfolio of programs for the past three years.

Table ES-4. Cumulative Program Benefits from Installed Measures

Benefits	Through Year-End 2004	Through Year-End 2005	Through Year-End 2006
Electricity Savings from Energy Efficiency and On-Site Generation (Annual GWh)	1,400	1,950	2,360
Peak Demand Reduction (MW)	860	1,040	1,113
Permanent Measures (MW)	325	445	495
Curtailable	535	595	618
Annual Energy Bill Savings to Participating Customers ($ Million)	$195	$275	$340
Net savings for gas and oil (Annual MMBtu)	2,600,000	4,000,000	4,049,000
Renewable Energy Generation (Annual GWh)	102	103	105
Jobs Created and Retained per Year[1]	2,500	3,100	3,700
NO_x Emissions Reductions (Annual Tons)	1,280	1,750	2,060

[8] 80 PLUS is a national upstream buy-down program that encourages market transformation groups and computer manufacturers to get more energy-efficient power supplies into PCs and desktop-derived servers.

Benefits	Through Year-End 2004	Through Year-End 2005	Through Year-End 2006
SO_2 Emissions Reductions (Annual Tons)	2,320	3,170	3,800
CO_2 Emissions Reductions (Annual Tons)	1,000,000	1,400,000	1,600,000
Equivalent number of cars removed from NY roadways.	200,000	275,000	320,000

[1] Figures in this row represent the average number of jobs created and retained through year end. Results from 2004 and 2005 have been restated based on new analysis conducted in 2006.

Cost Effectiveness of Programs

For deployment and market transformation programs for which energy and demand savings are estimated, an economic benefit/cost analysis is used that monetizes savings and compares them to costs. Benefit/cost results for the deployment programs are summarized below and presented in more detail in Section 2. For R&D programs, such as next-generation technologies, distributed generation, new product development, and strategic reliability technologies, the economic benefit/cost methodology is inappropriate because these programs are designed to accomplish a range of objectives, many of which cannot be monetized in the early program years.

Benefit cost ratios for deployment programs are shown in Table ES-5. Two different tests were used to calculate B/C ratios:

1. Total Market Effects Test (TMET) compares quantifiable life-cycle benefits from program participants and spillover effects against both NYSERDA and customer costs incurred in achieving those benefits.

2. Program-Efficiency Test (PET) compares the same quantifiable life-cycle benefits against only NYSERDA's costs. This test can also be called the program administrator test.

Scenario 1 includes only resource benefits. Scenario 2 adds non-energy impacts to Scenario 1. Scenario 3 adds market price effects to Scenario 2. Scenario 4 adds macroeconomic impacts to Scenario 3.

Table ES-5. Benefit Cost Ratios for the New York Energy $mart^{SM} Portfolio

	Resource Benefits (Scenario 1)	Plus Non-Energy Impacts (Scenario 2)	Plus Price Effects (Scenario 3)	Plus Macroeconomic Impacts (Scenario 4)
Total Market Effects Test[1]	2.4	3.1	3.2	3.3
Program Efficiency Test	8.8	11.4	11.9	12.4

[1] The method of estimating measure costs for retrofit/early replacement programs was modified in this year's analysis resulting in higher measure costs, and therefore, lower benefit cost ratios for the total resource cost test.

Macroeconomic Impact Analysis

Previous economic evaluations of the **New York Energy $mart^{SM}** Programs focused on tracking program costs and identifying direct benefits to program participants reported as energy bill savings.

However, expenditures made by NYSERDA and program participants have substantial macroeconomic impacts that go far beyond direct benefits. Purchases of goods and services through the Program initiate a ripple effect as spending and re-spending influence various sectors of New York's economy and, in turn, affect the level and distribution of employment and income in the State. A macroeconomic impact analysis[9] of the programs was previously conducted and reported in detail in previous annual reports. The analysis was updated for this report and the results are presented in Table ES-6. Averaged over a 19-year analysis period, the Program is expected to create and sustain on average more than 8,600 jobs, increase labor income by $321 million per year, increase total output by $456 million per year, and increase value added by $211 million per year. To date, the Program has created and or sustained 3,700 jobs.

Table ES-6. Summary of Macroeconomic Impacts of the New York Energy $mart^{SM} Program (Constant 2006$)

Economic Variable	Program Implementation Years (1999-2012)	Years Following Program Implementation (2013-2027)	Annual Average over 29-year Analysis Period (1999-2027)
	2006 Update	**2006 Update**	**2006 Update**
Net Job Growth	7,807	9,362	8,612
Labor Income	$361 Million	$283 Million	$321 Million
Total Output	$573 Million	$346 Million	$456 Million
Value Added	$271 Million	$154 Million	$211 Million

Evaluation Approaches

The findings in this report are compiled based on the cumulative work of NYSERDA and its evaluation contractor teams over the past several years; however, they also incorporate findings from recent evaluations conducted this year as follows:

- Measurement and Verification (M&V) work on Peak Load Management, Enhanced Commercial/Industrial Performance Program (ECIPP), FlexTech Technical Assistance, and EmPower New York.

- Market Characterization, Assessment and Causality (MCAC) work on Enhanced Commercial/Industrial Performance Program, Small Commercial Lighting, High Performance New Buildings (New Construction Program – NCP), FlexTech Technical Assistance, and Market Support (residential ENERGY STAR focused).

- Process Evaluation work on High Performance New Buildings, EmPower New York, and a portfolio-level evaluation review.

- Program Theory and Logic work on the **New York Energy $mart^{SM}** Loan Fund and Financing Program, **New York Energy $mart^{SM}** Focus, High Performance New Buildings, FlexTech Technical Assistance, all Residential and Low-Income programs, Public Benefit Power Transmission

[9] The input-output model used the IMPLAN Pro software system (Version 2.0) developed by the Minnesota IMPLAN Group

and Distribution Research, Electric Transportation, Industrial Process and Productivity Improvement, and Next Generation and Emerging Technologies.

- A peer-review assessment of the Distributed Generation/Combined Heat and Power and Environmental Monitoring, Evaluation and Protection programs.

Commercial/Industrial Programs

Commercial/Industrial (C/I) Programs identify opportunities to improve energy efficiency and load management and try to effect changes in energy decision making by building owners and operators. The C/I Programs have been streamlined to target diverse market actors, including architects and engineers who work primarily with large buildings and projects, and contractors and distributors whose primary focus is small buildings. C/I Programs address the efficient use of electricity, petroleum, and natural gas and seek to provide customers with comprehensive, attractive incentives and financing packages. Programs in the C/I area are discussed in detail in Section 3.

Commercial/Industrial Program Findings

Significant progress is being made as the C/I portfolio transitions to the new, streamlined set of programs. Several near-term goals were set for the first year of the third **New York Energy $mart**SM Program funding cycle. These goals established levels to reach, by June 30, 2007, for energy and peak demand savings as well as several other key metrics of program success. Overall, the C/I portfolio is performing well in terms of the energy savings and peak demand reduction goals. In the first six months of the one-year measurement period, the C/I portfolio has exceeded its goal for energy savings (123%) and nearly reached the half-way point (47%) for the peak demand reduction goal.

As reported in Section 2, overall, NYSERDA's M&V and MCAC contractor teams have found that savings for the C/I sector should be adjusted as follows:

- Electricity savings were adjusted downward by 4%.
- Peak demand savings were adjusted downward by 5%.
- Other fuel savings were adjusted upward by 14%.

These adjustments include changes in program-reported savings due to database reviews and field work to measure and verify savings, as well as survey research and other activities to quantify freeridership and spillover. For most of the largest energy-saving programs (including ECIPP, High Performance New Buildings, and FlexTech Technical Assistance) spillover outweighs any freeridership that is occurring.

Across the programs, twelve additional near-term goals were added, besides energy savings such as the number of customers receiving assistance, funds leveraged, allies participating, and percentage of target markets affected by programs. Overall, the programs are also performing well with respect to these other goals. Progress on more than half of the goals is at 50% or greater. In fact, two of the goals have already been exceeded. Specifically, the Business Partners Program has exceeded its goal to sign up 300 business partners (737 partners to date), and the Loan Fund and Financing Program has exceeded its goal to leverage $12 million in loans ($12.7 million to date). The results of each program's progress toward its stated goals are shown in table format in the subsequent sections.

Other key findings from evaluation research include the following:

- Participant surveys found that NYSERDA programs are being cited more often as an important factor in the decision to install energy efficiency measures and equipment in C/I facilities. Respondents are citing NYSERDA unaided, making these findings especially significant.

- End-use customers continue to gain more experience, education, and trust in energy efficiency measures, equipment, and services. Historically, these were lacking among end-use customers and were often cited as reasons for not taking action on energy-efficient purchases or services.

- Even customers who have not participated directly in NYSERDA program offerings have shown increasing levels of familiarity with energy-efficient measures and equipment.

- Surveys indicate high levels of awareness of **New York Energy $mart^{SM}** C/I Programs, with 88% of end-use customers and 81% of contractors reporting awareness of at least one program offering.

- Respondents were more familiar with NYSERDA programs in general, and were less aware of specific program offerings. This indicates that NYSERDA is achieving a greater degree of brand recognition than are the numerous individual program names.

- Survey results indicate that NYSERDA is becoming a trusted source for information and support in the adoption of energy-efficient practices. Respondents report that NYSERDA brings credibility to the various services offered through its programs and contractors.

- C/I customers who participated in **New York Energy $mart^{SM}** programs expressed high satisfaction levels of 80%-90% with project results. This suggests that they are likely to continue working with NYSERDA in the marketplace to improve efficiency.

Process evaluation surveys and interviews indicate that the NCP compares favorably to other new construction programs on most process elements examined. Findings also suggest the NCP could increase savings "per building" and market transformation by placing greater emphasis on its whole building and LEED® certification components.

Residential and Low-Income Programs

Residential energy efficiency programs influence decisions regarding energy use by homeowners, renters, and participants in the residential energy services and new construction markets. The programs also work with the multifamily building industry to improve the efficient use of electricity, petroleum, and natural gas. Residential programs are described in Section 4.

Low-Income programs reduce the energy burden[10] on low-income households by improving the efficiency of energy use and providing energy management and aggregated energy procurement services. Initiatives in this program have also been streamlined and include: providing technical support for and installing a variety of energy-efficient electric end-use measures in low-income housing; paying a portion of the incremental cost of energy efficiency measures and electric heat conversions in publicly assisted housing; helping low-income households aggregate energy purchases; incorporating energy-efficient equipment and design specifications into State and federally assisted housing; and educating customers about the benefits of energy efficiency. Programs in the Low-Income Program area are also discussed in detail in Section 4.

[10] Energy burden is the percentage of household income used to pay for energy.

Residential and Low-Income Program Evaluation Findings

Significant progress is being made as the Residential and Low-Income portfolio transitions to the new streamlined set of programs. Several near-term goals were set for the first year of the third **New York Energy $mart**[SM] Program funding cycle. These goals established levels to reach, by June 30, 2007, for energy and peak demand savings as well as several other key metrics of program success. Overall, in the first six months of the one-year measurement period, the Residential and Low-Income portfolio has achieved 12% of its goal for energy savings, and 24% of its goal for other fuel savings. There is no goal for peak demand reduction in this sector.

As reported in Section 2, overall, NYSERDA's M&V and MCAC contractor teams have found that savings for the Residential and Low-Income sector should be adjusted as follows:

- Electricity savings were adjusted upward by 4%.
- Peak demand savings were adjusted upward by 4%.
- Other fuel savings were adjusted upward by 8%.

These adjustments include changes in program-reported savings due to database reviews and field work to measure and verify savings, as well as survey research and other activities to quantify freeridership, naturally occurring adoption, spillover, and market effects.

Across the programs, 23 additional near-term goals were set for other key metrics besides energy savings such as the number of customers receiving assistance, funds leveraged, allies participating, and outreach activities completed. Overall, the programs are making good progress with respect to these other goals. Eleven out of the 23 goals are approximately 50% or more achieved. In fact, two of the goals have already been reached or exceeded. Specifically, the Market Support Program goal to sign up four new manufacturing partners has been exceeded (40 new partners to date), and the Buying Strategies and Energy Awareness Program goal to reach 3,000 low-income individuals via seminars and workshops has been exceeded (more than 7,600 individuals reached to date). The results of each program's progress toward its stated goals are shown in table format in the subsequent sections.

Most of the new evaluation work on the Residential and Low-Income programs has consisted of updating and creating program logic models. Therefore, other key findings from secondary data and studies of participants, non-participants and other market actors shown below are largely repeated from previous major evaluation efforts:

- The ENERGY STAR label is the overarching symbol for NYSERDA's Residential Programs. New Yorkers' recognition of the ENERGY STAR label has increased steadily, from 34% in 1999 to 77% in 2005. The proportion of consumers in New York who show high understanding of the label has also increased from 35% in 1999 to 87% in 2005. In 2005, 63% of New York consumers saw television ads related to ENERGY STAR, evidence linking increased awareness and understanding directly to NYSERDA's efforts.
- The percentage of ENERGY STAR-qualified models out of all models on display in partner stores increased from 14% in 1999 to 35% in 2005 for refrigerators, from 10% to 82% for dishwashers, from 16% to 39% for clothes washers, and from 26% to 61% for room air conditioners.
- NYSERDA's program efforts from 1999 to 2005 have helped increase the market share of ENERGY STAR refrigerators among NYSERDA partners from 28% to 47%; from 48% to 76% for

dishwashers; from 24% to 41% for clothes washers; and from 45% to 76% for room air conditioners. The proportion of new single-family homes sold that are ENERGY STAR-labeled has increased from 0.3% in 2001 to 11.1% in 2006. The proportion of the home improvement market installing efficiency measures through the Home Performance with ENERGY STAR Program has increased from 0.2%-0.3% in 2001 to 2.1%-3.3% in 2005.

- NYSERDA continues to be effective in recruiting partners in appropriate markets, and in providing them with tools—such as training and marketing—to help them persuade consumers to adopt more efficient products and behaviors. Association with NYSERDA's programs and with energy efficiency has helped many of these partners differentiate their businesses from competitors.

- Nearly all parties involved in these programs, including builders, contractors, and consumers indicate a high degree of satisfaction with the programs. This year's process evaluation surveys and interviews indicate that the results of the EmPower pilot program were largely positive for the six participants. The contractors are pleased with the increased speed with which they can complete jobs by avoiding the pre-approval process under the EmPower pilot program, and believe the measures selected for direct installation without pre-approval are the appropriate ones.

- An important evaluation finding for the Assisted Multifamily Program is that 6.1% of eligible units had efficiency measures installed through the program, and an additional 8.8% had participated in the audit offered by the program. This sums to almost 15% of the eligible population of the low-income multifamily market that had participated in some aspect of the program. This is as of the end of 2005.

Research and Development Programs

NYSERDA's R&D activities are organized into five primary program areas: energy resources, transportation and power systems, environment, industry, and buildings. Projects in each of these program areas address technologies and mechanisms that affect the energy supply and meet the needs of end users. As a result, crosscutting areas such an environmental protection, waste management, energy product development, and renewable energy technologies are addressed in several programs. Programs in the R&D Program area are discussed in detail in Section 5.

Research and Development Program Evaluation Findings

Significant progress is being made as the Research & Development portfolio transitions to the new set of program offerings. As reported in Section 2, overall, NYSERDA's M&V and MCAC contractor teams have found that savings for the R&D sector should be adjusted as follows:

- Electricity savings were adjusted upward by 2%.

- Peak demand savings were adjusted downward by 29%.[11]

- Other fuel savings were adjusted downward by 5%.

[11] The Demand Response and Innovative Rate Research Program does not require that enabled demand reductions be maintained. This large downward adjustment for the R&D programs is due to M&V results indicating the portion of enabled demand reduction that has been maintained.

These adjustments include changes in program-reported savings due to database reviews and field work to measure and verify savings, as well as survey research and other activities to quantify freeridership and spillover. Most of the adjustment, however, is due to the measurement and verification work since any freeridership that exists is outweighed by spillover on all but one program.

Across the programs, numerous additional near-term goals were set, besides energy savings, such as: the number of solicitations, studies, and projects; the number of workshops; the number of companies doing business in New York; new products developed and launched; and other important knowledge creation, information dissemination, and commercialization progress metrics. Overall, the programs are also performing well with respect to these other goals. Results of each program's progress toward its stated goals are shown in table format in the subsequent sections.

Key areas of progress in the past six months include the following:

- Contracts are being negotiated with four firms intending to manufacture clean energy products in New York.
- The Power Systems Product Development Program awarded five contracts for product development.
- Performance data on 21 DG/CHP projects is now available on the Internet, allowing performance monitoring and promoting technology transfer.
- Thirteen publications (including research reports and peer-reviewed journal articles) resulted from the Environmental Monitoring, Evaluation and Protection Program activities.
- Four Technical Assistance projects were completed for water and wastewater facilities.
- Seven solicitations were issued for the Next Generation and Emerging Technologies Program, and the new Public Benefit Power Transmission and Distribution Research Program identified priority research areas and will soon release its first solicitation in the first quarter of 2007.

Evaluation Review and Recommendations

Study Purpose

For the past two years of evaluation, NYSERDA had undertaken a study of the efficiency and effectiveness of its evaluation design, planning, and implementation. The purpose of the study was to assess the results of the evaluation work from the perspective of its execution and outcomes in the context of how it was envisioned and planned. Questions to be addressed included:

- Was the evaluation process effectively created?
- Did it have the outcomes intended (including building evaluation capacity, greater integration of evaluation into program processes, and meeting stakeholder requirements)?
- Was the evaluation model an effective one and should it be changed or revised?

In addition to addressing these questions, this review provides feedback to NYSERDA and the SBC Advisory Group as they work with contractors in the next phase of evaluation work. The study also

provides insights for the larger evaluation community interested in assessing the most appropriate ways to evaluate such comprehensive, market-oriented programs like the **New York Energy $mart^{SM}** portfolio.

Methodology

To address all of these research issues, the process evaluation team has undertaken two cycles of data collection. The first occurred in 2005 and included 30 interviews with NYSERDA's senior management, the Energy Analysis evaluation team, and program staffs. The interviews addressed the history of the evaluation effort, its implementation, and responses to the evaluation work done to date. The second round of data collection, leading to the results summarized in this report, occurred in 2006. Twenty-nine individual and four group interviews were conducted with NYSERDA's Energy Analysis evaluation team and program staff members, as well as with the specialty evaluation contractors and members of the SBC Advisory Group that oversees the independent evaluation effort.

Three cycles of independent, third-party monitoring and evaluation reporting on **New York Energy $mart^{SM}** programs have been completed during the period assessed (these three evaluation cycles concluded in 2004, 2005 and 2006), with each cycle resulting in recommendations for improvements in the programs. The interviewers asked NYSERDA staff to reflect on these cycles and the types of evaluation efforts conducted in each, and asked program staffs to assess the degree to which they had taken action in response to the recommendations of evaluators. The review of recommendations also asked staff members to identify the reasons for their actions or inaction. A total of 174 recommendations were reviewed for the first two evaluation cycles, and 93 were reviewed for the third cycle.

Finally, to place the results of the evaluation review in context of wider practices for using evaluation in large organizations, the process evaluation team conducted a review of the literature across a wide range of fields. The goal was to provide an overview of how other energy efficiency entities and other large organizations use evaluation findings in planning, program design, and program implementation.

Summary of Results

These results are viewed in terms of NYSERDA's unique approach to evaluation. With a budget ranging from less than 0.5% to 2% for evaluation during the SBC funding cycles, NYSERDA implemented an evaluation model using teams of specialty contractors to conduct crosscutting evaluations of multiple programs. NYSERDA's evaluation structure was intended to provide independent evaluation at many levels, with the goal of aggregation to the portfolio level. This focus on the portfolio level as the ultimate evaluation objective is driven by the reporting requirements of the PSC.

While the first year of the evaluation was especially challenging for program staffs, the Energy Analysis evaluation team, and the specialty evaluation contractors, significant improvement was reported over the three years. By year three, increased evaluation capacity was seen in the improved knowledge and skills of the Energy Analysis evaluation team, and in program staffs' more positive views of evaluation's use in program planning and implementation, as well as in greater communication with the Energy Analysis evaluation team. Further evidence of increased evaluation capacity is seen in the SBC Advisory Group's reported greater clarity of its role in the evaluation, and in the specialty contractors' reports of greater knowledge of the programs and processes.

Use of the evaluation findings has also increased over the three years, with both program staff and the Energy Analysis evaluation team reporting increased awareness of evaluation in program planning and solicitation processes. While some program staff indicate they do not use the evaluation findings, others report using the findings to change programs, improve data collection or recording, prepare public presentations, and for program marketing. Reported consideration of, or action on the recommendations

resulting from the evaluations has also increased. In the earlier evaluation cycles, some action was reported on less than 50% of the recommendations; in the most recent cycle, this number had risen to 67%. While action on 100% of the recommendations is not expected, this increase may be due in part to: improvements on the part of the contractors (recommendations that reflect better knowledge of programs and are more realistic in context); program staffs' increased involvement in setting the research agenda and thus producing recommendations more closely related to timely programmatic issues; and/or some positive response bias as program staff, in this second round of interviews, perceived it important to indicate action was being taken. Also, it is important to note that NYSERDA staff have been quick to address many issues identified in the various evaluation contractor team reports – often before the draft reports were even finalized. The Public Service Commission, Department of Public Service staff, and the SBC Advisory Group are also key users of the evaluation findings.

Reporting processes, initially characterized as disjointed and time-consuming (specifically in preparation of the annual report), have improved over the three evaluation cycles. The SBC Advisory Group expressed high levels of satisfaction with both the evaluation process and its outcomes, including reports.

Based on the findings of this review, there is clear indication that NYSERDA has achieved many of its goals for the evaluation effort and there has been definite improvement in both process and outcomes from year one of the assessment period to year three. However, there are still pockets of resistance among program staff members, including lingering views of the evaluation process as not meeting their needs or not adequately measuring their programs under consideration. Unrealistic expectations on the part of program staff, as well as conflicting, multiple objectives with a highly constrained evaluation budget likely contribute to this resistance. Also, there is inconsistent support among managers for evaluation and unclear expectations among some staff members regarding the recommendations they receive from the evaluation reports. All of these factors indicate that there is still room to continue the improvements already seen over the last three years by continued effort to foster a culture that recognizes the value and relevance of evaluation for program planning and implementation. The recommendations below are intended to address some of the residual effects of the first three years of the current evaluation model (especially from the first year) and to assist NYSERDA in continuing its path of improving the process and outcomes of the evaluation.

Recommendations

- Consider development of a theory and logic model for the evaluation. Program staff, as well as specialty and oversight evaluation contractors, identified the need for a clearly articulated evaluation plan. The literature review also points to the necessity of a clearly articulated vision for process and outcomes. As part of the March 2006 Amended SBC Operating Plan, a vision was articulated, but a specific plan has not been developed, rather it is to be developed with the evaluation contractors. Development of a well-defined plan for process and outcomes will reduce uncertainty about evaluation expectations for all stakeholders and make transparent the balance between evaluation for program improvement and evaluation for stakeholder accountability in developing the goals and tasks. In this process, the following should be addressed:

    - Define the portfolio evaluation goals

    - Define the portfolio tasks and approach

    - Define tasks at the program and sector levels

- Once a theory and logic model has been developed for the evaluation, the resulting plan should be clearly communicated at all levels of the organization. General communication of an evaluation plan

could greatly reduce the uncertainty and discomfort felt by all involved in the effort. Key elements of the plan to be communicated include:

- Expectations of the Energy Analysis evaluation team, program staff, and contractors in the model

- Expectations for how recommendations from the evaluation are to be used

- As part of the overall evaluation plan, a discussion of potential products resulting from the evaluation should occur. This process should involve program staff and other stakeholders in identifying all audiences for the evaluation findings, resulting in a plan for dissemination approaches to meet the range of audiences identified. Communication of evaluation results has so far focused largely on meeting stakeholder requirements and the products have successfully met these requirements. There are many other audiences for the evaluation results, including potential program participants, the general public, and other energy professionals.

As part of a review of roles, NYSERDA should continue to examine the skills needed for their model of evaluation and ensure that Energy Analysis evaluation team members have the skills and direction to serve the roles defined for them. NYSERDA has continued to build evaluation knowledge and skills in the Energy Analysis evaluation team and program staff report that they are more often working with the team early in their program planning and solicitation processes. Some additional skills and knowledge are needed to ensure that capacity building continues within the Energy Analysis team and that the team members can then continue to help build capacity throughout the organization.

1

Introduction and Public Policy Context

1.1 Introduction

This report provides an update of the progress made to date implementing the **New York Energy $mart**[SM] Public Benefits Program (Program). Progress is reported for Program activities completed through December 31, 2006.[1] The report was prepared jointly by New York State Energy Research and Development Authority (NYSERDA) staff and a team of third-party evaluation assistance and specialty contractors, in accordance with the Memorandum of Understanding (MOU)[2] between NYSERDA, the New York State Department of Public Service (DPS), and the New York State Public Service Commission (PSC). This report was prepared on behalf of the System Benefits Charge Advisory Group[3] (Advisory Group), which serves as the Independent Program Evaluator as per the MOU. The Advisory Group was provided a draft report and met via teleconference to discuss the draft and review the findings of the evaluation contractors. Evaluation assistance and specialty contractors presented their work and research findings to the Advisory Group. Feedback and comments received on the draft report were incorporated into this final report. The SBC Advisory Group submits this report to the PSC in fulfillment of its responsibilities under the terms of the MOU.

The Advisory Group and DPS were actively involved in selecting the evaluation contractors who were retained through NYSERDA's competitive solicitation process and in developing the scopes of work for the evaluation activities, including apportioning the evaluation budget among the contractors and identifying the programs to be included in the evaluation. All evaluation contract awards were made through NYSERDA's competitive solicitation process whereby proposals were submitted in response to a Request for Proposals (RFP) that was developed and reviewed by a Technical Evaluation Panel (TEP). The Advisory Group and DPS were represented on all TEPs that were convened to review proposals and recommend contract awards. Advisory Group members had the opportunity to review and comment on individual evaluation contractor work plans and meet with the members of each contractor's team as they deemed necessary and appropriate. This report builds upon the evaluation framework and model used to

[1] Previous annual reports were issued in September 2000, January 2002, May 2003, May 2004, May 2005, and May 2006. Each report presents cumulative results from the Program's inception on July 1, 1998. The most recent report is available at www.nyserda.org and by request.

[2] Memorandum of Understanding between the New York State Public Service Commission, New York State Department of Public Service, and New York State Energy Research and Development Authority, March 11, 1998, revised December 6, 2001.

[3] The Advisory Group consists of 24 individuals representing varied interests, including utilities, business and environmental groups, energy service companies, community organizations, professional and trade associations, and national energy efficiency and energy research and development (R&D) organizations.

guide prior evaluation efforts and reports results for work completed from the program's inception through December 31, 2006.

1.2 Public Policy Context

The System Benefits Charge (SBC) Program administered by NYSERDA as the **New York Energy $mart**SM Program, was initiated in 1998 by order of the PSC[4] and has included three funding cycles.[5] The **New York Energy $mart**SM Program (Program) portfolio consists of numerous initiatives promoting energy efficiency, including both permanent efficiency reductions as well as peak demand management, facilitating renewable energy infrastructure development, providing energy services to low income New Yorkers, and conducting research, development, and demonstration of promising new products and technologies. The Program provides a myriad of services, and includes the dissemination of information to increase consumer energy awareness, marketing of programs and services, provision of financial incentives to spur customer and market investment in energy efficiency and demand management, development and testing of new products, commercializing new technologies, and gathering data and information.

The **New York Energy $mart**SM Program is currently in its third funding cycle, each of which is described below.

First Funding Cycle (1998 – 2001)

- June 1998 through June 2001. During this three-year period, NYSERDA's administration of the Program was begun with emphasis on designing programs, conducting outreach, and offering technical and financial assistance to customers and market allies to fully deploy programs. Programs were offered to all customers paying the SBC. During this period, NYSERDA administered approximately $58 million a year in SBC funding.

Second Funding Cycle (2001 – 2006)

- July 2001 through December 2002. During this five-year period, NYSERDA was provided approximately $147 million per year to continue and expand upon its current program offerings. Also during this period, the **New York Energy $mart**SM Program's implementation activities were greatly accelerated as committed program funding more than doubled in the first 18-month period, going from less than $300 million to more than $600 million. The rapid increase in program funding commitments was a direct result of program design, outreach, and marketing efforts introduced by NYSERDA during the first three years of the Program. NYSERDA's early efforts were designed to create a market capacity and capability to deliver energy efficiency and related services. Once created, Program activities could be readily accelerated, as partnerships were created with market allies, marketing and general awareness campaigns had succeeded in stimulating demand for services, and the market infrastructure was in place to deliver such services.

---

[4] Case 94-E-1052, *et al.*, In the Matter of Competitive Opportunities Regarding Electric Service, Opinion 98-3, issued January 30, 1998.

[5] The most recent cycle was initiated with the New York State Public Service Commission in Case 05-M-0900, In the Matter of the System Benefits Charge III, *Order Continuing the System Benefits Charge (SBC) and the SBC-funded Public Benefit Programs*, issued and effective December 21, 2005.

- January 2003 through December 2004. As the **New York Energy $mart^{SM}** Program evolved, NYSERDA selectively modified its funding commitments across the many programs offered. For example, funding modifications were required because some energy efficiency product markets, such as residential room air conditioners, were being transformed, and product incentive offerings as a result, could be reduced. Also, because the market and demand for energy efficiency services in New York is extensive, the Program needed to accept fewer service applications to preserve funds through the funding period ending June 2006, when the second funding cycle for the **New York Energy $mart^{SM}** Program ended.

- January 2005 through June 2006. NYSERDA continued to assess gaps and opportunities with respect to energy efficiency, low-income services, and R&D programs as a means to assist policy makers in deciding the future of funding for energy-related public benefits programs in the State.

Third Funding Cycle (2006 –2011)

- July 2006 through June 2011. The PSC extended the **New York Energy $mart^{SM}** Program for another five years, increasing funding from approximately $150 million to $175 million annually (with NYSERDA administering approximately $173.2 million annually and the balance provided to certain utilities for their utility-run programs). The continuation and expansion of the Program is designed to help maintain momentum for the State's efforts to develop competitive markets for energy efficiency; demand management (including peak load reduction); outreach and education services; research, development, and demonstration; low-income services; and to provide direct economic and environmental benefits to New Yorkers. The extended program will continue to address market barriers to the competitive procurement of these services.

1.3 Design and Conduct of the New York Energy $mart^{SM} Program

In order to successfully pursue these diverse activities, NYSERDA employs differing strategies. Representative strategies are presented in broad outline below. Many programs use a combination of these strategies. Discussions of individual activities are presented throughout this evaluation report.

- Market transformation programs promote energy efficiency by developing markets and permanently changing energy-related decisions by consumers, retailers, and manufacturers. Creating an energy efficiency "ethic" is critical if New Yorkers are to improve energy efficiency without sacrificing energy services – making decisions based on life-cycle economic benefits and costs, and sustainable environmental stewardship. Market transformation programs also promote the development of the energy-efficiency supply infrastructure through training, certification, marketing and other means.

- Energy efficiency programs identify energy savings opportunities and install energy-efficient products and technologies in single and multifamily homes, commercial buildings, and industrial plants.

- Load-management programs allow energy users to shift and reduce energy use from on-peak to off-peak periods – thereby reducing customers' energy use and bills, and improving the reliability of the electric system.[6]

- Low-income services make energy more affordable for low-income households by installing energy efficiency improvements and by disseminating energy information to homeowners, building owners and operators, and contractors.

- Research, Development and Demonstration (RD&D) programs develop alternative energy resources and technologies, deploy distributed generation and combined heat and power systems, develop and test new technologies and products, and collect and evaluate data for use in environmental analysis and in support of policy decision making. RD&D programs emphasize innovation and support projects and activities that provide opportunities for breakthroughs that might significantly improve existing technologies, products, and markets.

Different methods and protocols must be applied in evaluating each of the program offerings because their purposes and services are designed to meet different goals. Among the methods and protocols used and reported herein are measurement and verification (M&V); program theory and logic modeling; process evaluation; market characterization, assessment, and causality; benefit-cost and value-cost analyses; and, macroeconomic impact analysis.

1.4 Organization of the Report

This annual report describes how the **New York Energy $mart**[SM] Program is contributing to meeting its public policy goals.

This report is divided into the following sections:

Executive Summary

Section 1 - Introduction and Public Policy Context

Section 2 – Portfolio-Level Reporting

Section 3 – Commercial and Industrial Programs

Section 4 – Residential and Low-Income Programs

Section 5 - Research and Development Programs

[6] Reducing peak demand by shifting and reducing energy use from on-peak to off-peak periods increases energy productivity but may not reduce energy use or improve energy efficiency. If the electric load is shifted to an off-peak period and the same overall amount of energy is used, costs to consumers may be less, thus improving energy productivity, but the total quantity of energy used will be unchanged.

2

Portfolio-Level Reporting

The **New York Energy $mart**[SM] Program is a portfolio of numerous program initiatives that have individually and collectively helped the State make strides toward achieving its energy policy goals. This section presents findings and results for the portfolio of **New York Energy $mart**[SM] programs. The evaluations of individual program initiatives are presented separately in Sections 3, 4 and 5.

2.1 Budget and Spending Status

This financial overview of the **New York Energy $mart Program**[SM] presents budget and funding status from 1998 through December 31, 2006. The thirteen year budget is approximately $1.87 billion, of which $1.68 billion is allocated to four major program areas – Commercial/Industrial, Residential, Low-Income, and Research and Development (R&D) – and a general awareness campaign. The budgets for these program areas are presented in Table 2-1 along with the costs for program administration, program evaluation, the Environment Disclosure Program[1], and the New York State Cost Recovery Fee[2]. Figure 2-1 and Figure 2-2 present graphic representations of ratepayer System Benefits Charge (SBC) contributions.

[1] This program provides electricity commodity suppliers with data for informing customers about the fuel mix and associated environmental impacts of their electricity sources.

[2] The New York State Cost Recovery Fee is assessed for services to public authorities. The fee is determined by the New York State Division of Budget and imposed and collected by the Department of Taxation and Finance.

Table 2-1. New York Energy $mart[SM] Program Budget ($ million)

	Budget			% of Program Area Budget	% of Total Budget
	SBC I & SBC II [1,2]	SBC III [3]	Total Budget		
Program Areas					
Commercial/Industrial	359.2	276.7	635.9	37.8%	34.0%
Residential	167.1	135.0	302.1	18.0%	16.2%
Low-Income	128.4	190.2	318.6	19.0%	17.0%
Research and Development	210.8	182.0	392.8	23.4%	21.0%
General Awareness[4] (Marketing)	16.0	15.0	31.0	1.8%	1.7%
Program Areas Total	**$881.5**	**$798.9**	**$1,680.4**	**100.0%**	**89.8%**
Other Costs					
Program Administration	65.5	62.7	128.2	-	6.9%
Metrics and Evaluation	16.5	17.9	34.4	-	1.8%
Environmental Disclosure	1.9	0	1.9	-	0.1%
NYS Cost Recovery Fee[5]	9.0	16.4	25.4	-	1.4%
Other Costs Total	**$ 92.9**	**$97.1**	**$189.9**	**-**	**10.2%**
Total New York Energy $mart[SM]	**$ 974.3**	**$ 896.0**	**$1,870.3**	**-**	**100.0%**

[1] Included with SBC II funding an additional $12.6 million from interest and unspent utility funds (distribution: Residential: $11.5 million; Program Administration: $0.88 million; and Metrics & Evaluation: $0.25 million).

[2] SBC I: July 1, 1998 through June 30, 2001; SBC II: July 1, 2001 through June 30, 2006.

[3] SBC III: July 1, 2006 through June 30, 2011.

[4] General Awareness previously included in Residential Program Area.

[5] The New York State Cost Recovery Fee is assessed for services to public authorities. The fee is determined by the New York State Division of Budget and imposed and collected by the Department of Taxation and Finance.

Totals may not sum exactly due to rounding.

Source: NYSERDA

Figure 2-1. New York Energy $mart^{SM} Ratepayer Contributions by Utility[3] Service Area

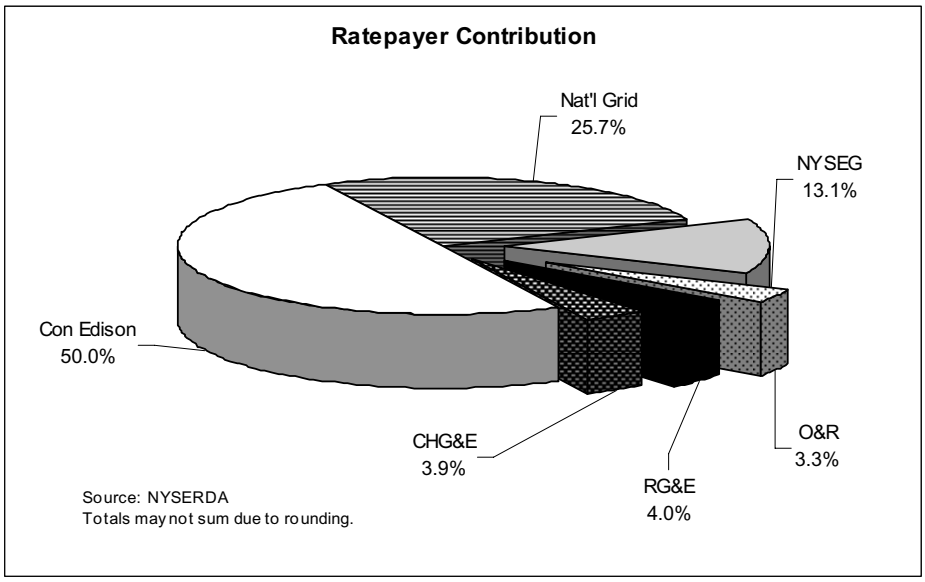
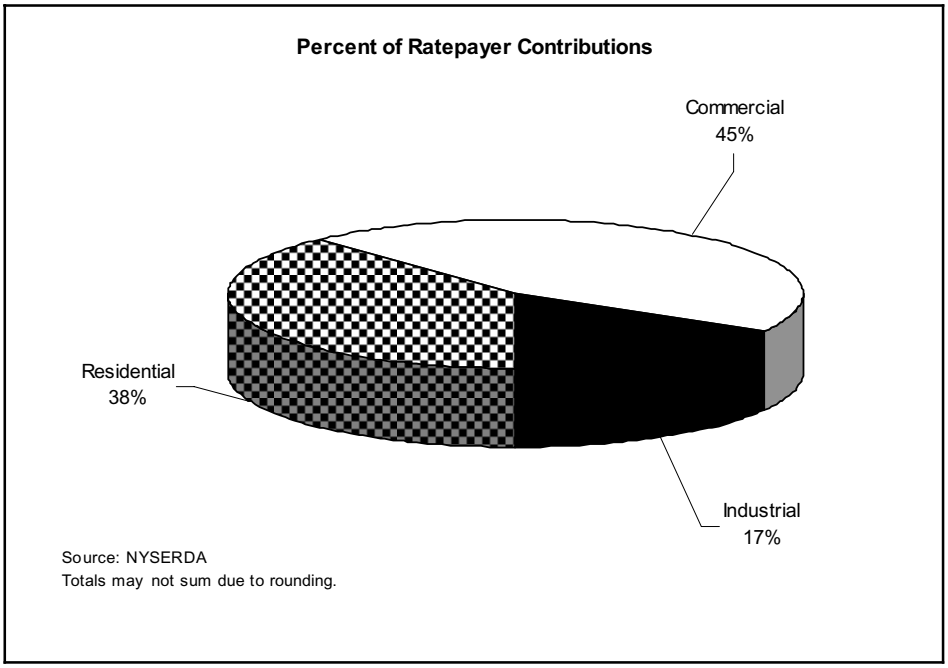


Figure 2-2. New York Energy $mart^{SM} Ratepayer Contributions by Sector



[3] The utility service areas: Central Hudson Gas and Electric, Inc. (CHG&E), Consolidated Edison Company of New York, Inc. (Con Edison), National Grid (Nat'l Grid), New York State Electric and Gas Corporation (NYSEG), Orange and Rockland Utilities, Inc. (O&R), Rochester Gas and Electric Corporation (RG&E).

2.1.1 Financial Status and Funding Allocation

The funding status of **New York Energy $mart^{SM}** through year-end 2006 is shown in Table 2-2. The percentage of funds spent relative to the thirteen-year budget for each program area is: Commercial/ Industrial 41.8%; Residential 58.8%; Low-Income 32.0%; and R&D 29.9%. Figure 2-3 provides historical information on program funding and spending.

Table 2-2. Financial Status of New York Energy $mart^{SM} Program ($ million)

	Total 13-Year Budget	Funds Spent			Encumbered Funds[4]	Committed Funds[5]
		SBC I & SBC II [1,2]	SBC III [3]	Total Spent and % of Budget	% of Budget Encumbered	% of Budget Committed
Program Areas						
Commercial/Industrial	635.9	247.1	18.3	265.5 41.8%	368.3 57.9%	399.5 62.8%
Residential[5]	302.1	165.4	12.1	177.6 58.8%	196.6 65.1%	206.3 68.3%
Low-Income	318.6	86.6	15.3	101.9 32.0%	139.3 43.7%	145.6 45.7%
Research and Development	392.8	105.9	11.7	117.6 29.9%	177.8 45.3%	201.5 51.3%
General Awareness[6] (Marketing)	31.0	15.9	0.8	16.7 53.9%	19.3 62.3%	19.3 62.3%
Program Areas Total	**$1,680.4**	**$620.9**	**$58.3**	**$679.2** **40.4%**	**$898.5** **53.6%**	**$972.3** **57.9%**
Other Costs						
Program Administration	128.2	59.8	5.8	65.6 51.2%	65.6 51.2%	65.6 51.2%
Metrics and Evaluation	34.4	14.5	1.0	15.5 45.1%	17.5 50.9%	22.5 65.4%
Environmental Disclosure	1.9	0.8	0.1	0.9 47.4%	1.1 57.9%	1.1 57.9%
NYS Cost Recovery Fee	25.4	9.2	1.2	10.4 40.9%	10.4 40.9%	10.4 40.9%
Other Costs Total	**$189.9**	**$84.3**	**$8.1**	**$92.4** **48.7%**	**$94.6** **49.8%**	**$99.6** **52.4%**
Total New York Energy Smart^{SM}	**$1,870.3**	**$705.2**	**$66.4**	**$771.6** **41.3%**	**$993.3** **53.1%**	**1,071.9** **57.3%**

[1] Included with SBC II funding an additional $12.6 million from interest and unspent utility funds (distribution: Residential: $11.5 million; Program Administration: $0.88 million; and Metrics & Evaluation: $0.25 million).

[2] SBC I: July 1, 1998 through June 30, 2001; SBC II: July 1, 2001 through June 30, 2006.

[3] SBC III: July 1, 2006 through June 30, 2011.

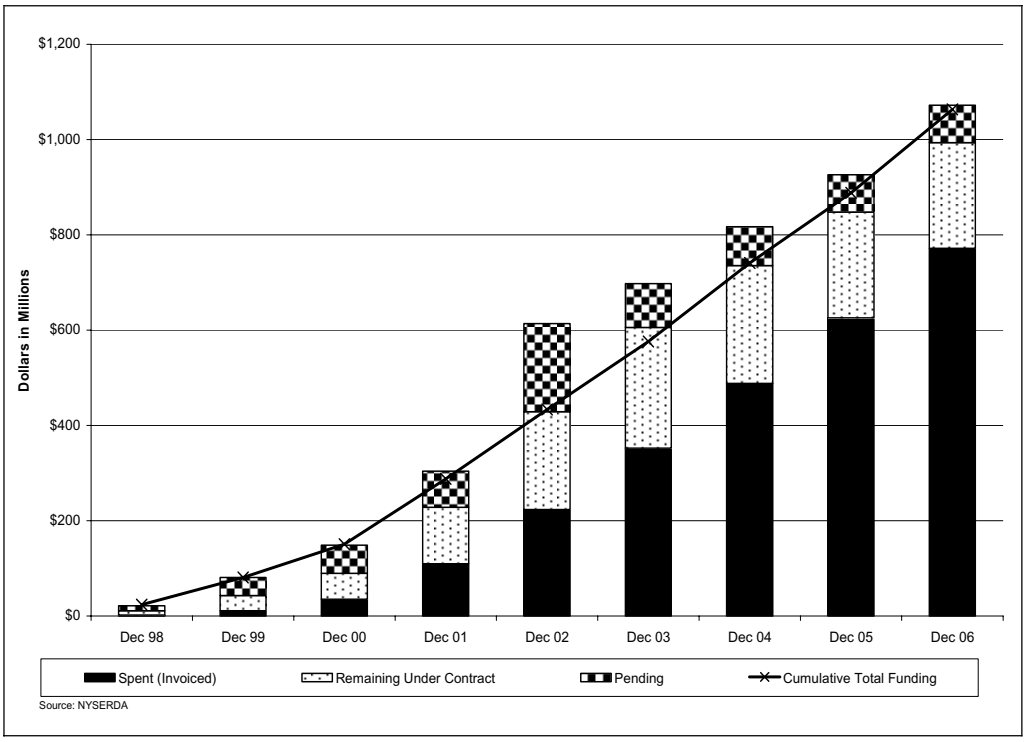
[4] Encumbered funds associated with signed contracts and purchase orders.

[5] Committed funds associated with encumbered funds and pending contracts.

[6] General Awareness previously included in Residential Progarm Area.

Totals may not sum exactly due to rounding. Source: NYSERDA

Figure 2-3. New York Energy $mart^{SM} Program Funding History and Activity December 1998 through December 2006



2.1.2 Program Areas

<u>Commercial/Industrial Program Area</u>

Table 2-3 presents detailed budget and funding information for the Commercial/Industrial programs. Figure 2-4 and Figure 2-5 show C/I program spending by utility service area and sector, respectively.

Table 2-3. Commercial/Industrial Programs – Financial Status ($ million)

Program	Budget			Funds Spent			Encumbered Funds[3] % of Budget Encumbered	Committed Funds[4] % of Budget Committed
	SBC I & SBC II [1]	SBC III [2]	Total Budget	SBC I & SBC II [1]	SBC III [2]	Total Funds Spent		
Peak Load Management	42.7	40.0	82.7	35.1	3.4	38.5 46.6%	55.3 66.9%	56.6 68.4%
Enhanced Commercial/ Industrial Performance	150.5	96.1	246.6	100.3	4.5	104.8 42.5%	146.1 59.2%	148.9 60.4%
New York Energy $mart^{SM} Business Partners	22.6	18.8	41.3	19.7	1.2	20.9 50.6%	24.5 59.3%	24.7% 59.8%
Loan Fund and Financing	10.5	10.5	21.0	12.3	1.5	13.8 65.7%	17.4 82.9%	17.4 82.9%
Energy Smart Focus	8.0	11.9	19.9	3.6	0.8	4.4 22.1%	5.1 25.6%	5.1 25.6%

High Performance New Buildings	80.8	70.0	150.8	53.1	5.7	58.8 39.0%	89.2 59.2%	114.4 75.9%
FlexTech Technical Assistance	37.0	29.5	66.5	20.4	1.1	21.5 32.3%	25.7 38.6%	27.4 41.2%
Other	7.1	0.0	7.1	2.6	0.1	2.7 38.0%	5.0 70.4%	5.0 70.4%
Total Commercial & Industrial	**359.2**	**276.7**	**635.9**	**247.1**	**18.3**	**265.5** **41.8%**	**368.3** **57.9%**	**399.5** **62.8%**

[1] SBC I: July 1, 1998 through June 30, 2001; SBC II: July 1, 2001 through June 30, 2006.

[2] SBC III: July 1, 2006 through June 30, 2011.

[3] Encumbered funds associated with signed contracts and purchase orders.

[4] Committed funds associated with encumbered funds and pending contracts.

Totals may not sum exactly due to rounding.

Source: NYSERDA

Figure 2-4. C/I Funds Spent by Utility Service Area

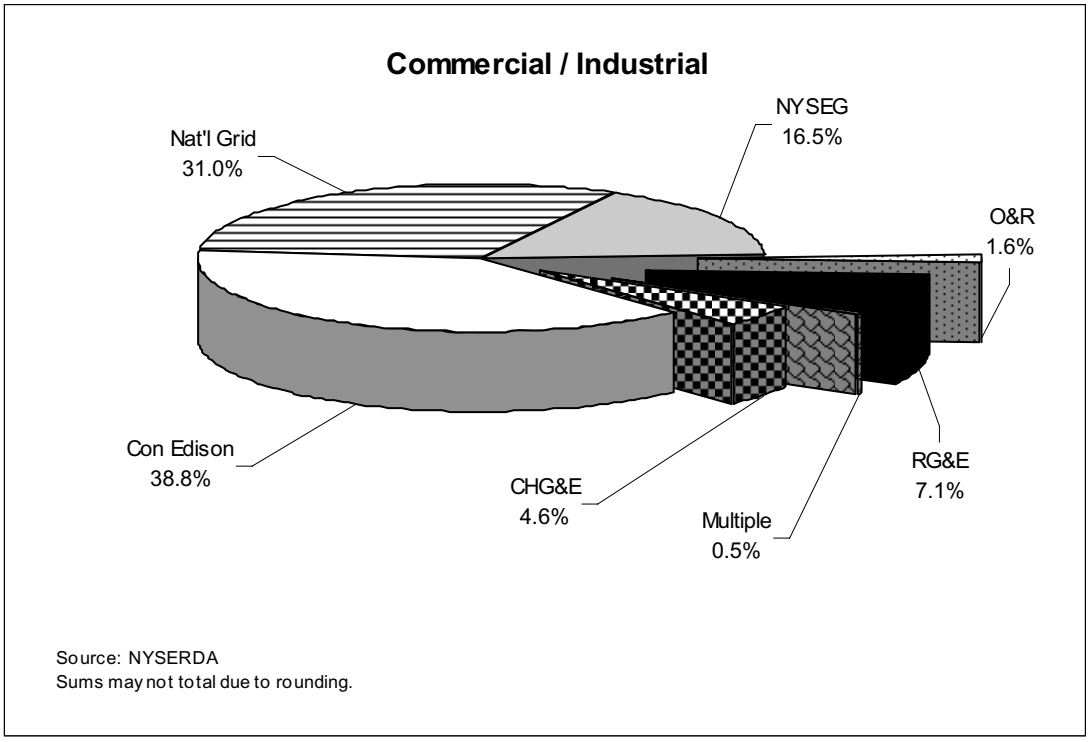
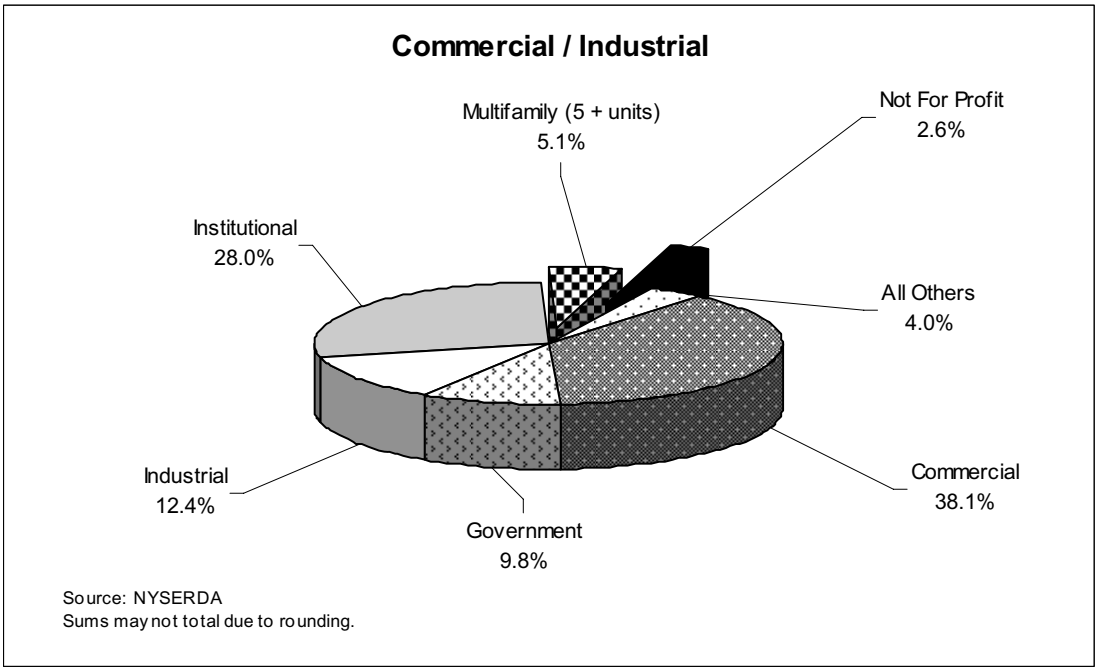


Figure 2-5. C/I Funds Spent by Sector



Residential and Low-Income Program Areas

Table 2-4 presents detailed budget and funding information for the Residential and Low-Income programs. Figure 2-6 and Figure 2-7 show Residential program spending by utility service area and housing type, respectively. Figure 2-8 and Figure 2-9 provide the same information for the Low-Income programs.

Table 2-4. Residential and Low-Income Programs - Financial Status ($ million)

Program	Budget			Funds Spent			Encumbered Funds[4]	Committed Funds[5]
	SBC I & SBC II [1, 2]	SBC III [3]	Total Budget	SBC I & SBC II [1, 2]	SBC III [3]	Total Funds Spent	% of Budget Encumbered	% of Budget Committed
Residential Programs								
Single Family Home Performance	49.3	58.3	107.6	47.4	4.7	52.1 48.4%	54.8 50.9%	56.1 52.1%
Multifamily Building Performance	17.8	20.0	37.8	18.3	2.6	20.9 55.3%	28.9 76.5%	30.8 81.5%
Market Support Residential	95.2	49.0	144.2	96.5	4.2	100.7 69.8%	107.9 74.8%	113.3 78.6%
Communities and Education	4.9	7.8	12.6	3.2	0.7	3.9 31.0%	5.0 39.7%	6.0 47.6%
Subtotal Residential	**167.1**	**135.0**	**302.1**	**165.4**	**12.1**	**177.6** **58.8%**	**196.6** **65.1%**	**206.3** **68.3%**
Low-Income Programs								
Single Family Home Performance	27.5	54.0	81.5	27.7	4.6	32.3 39.6%	34.5 42.3%	34.5 42.3%
Multifamily Building Performance	76.2	75.0	151.2	35.5	6.2	41.7 27.6%	76.1 50.3%	78.1 51.7%
EmPower New York	8.8	49.5	58.3	8.8	4.2	13.0 22.3%	13.4 23.0%	17.2 29.5%
Buying Strtegies & Energy Awareness	6.1	11.7	17.7	4.7	0.3	5.0 28.2%	5.4 30.5%	5.8 32.8%
Other	9.9	0.0	9.9	9.9	0.0	9.9 100.0%	9.9 100.0%	9.9 100.0%
Subtotal Low-Income	**128.4**	**190.2**	**318.6**	**86.6**	**15.3**	**101.9** **32.0%**	**139.3** **43.7%**	**145.6** **45.7%**
TOTAL Residential and Low Income	**295.5**	**325.2**	**620.7**	**252.0**	**27.5**	**279.5** **45.0%**	**336.0** **54.1%**	**351.9** **56.7%**

[1] Included with SBC II Residential funding an additional $11.5 million from interest and unspent utility funds.

[2] SBC I: July 1, 1998 through June 30, 2001; SBC II: July 1, 2001 through June 30, 2006.

[3] SBC III: July 1, 2006 through June 30, 2011.

[4] Encumbered funds associated with signed contracts and purchase orders.

[5] Committed funds associated with encumbered funds and pending contracts.

Totals may not sum exactly due to rounding.

Source: NYSERDA

Figure 2-6. Residential Funds Spent by Utility Service Area

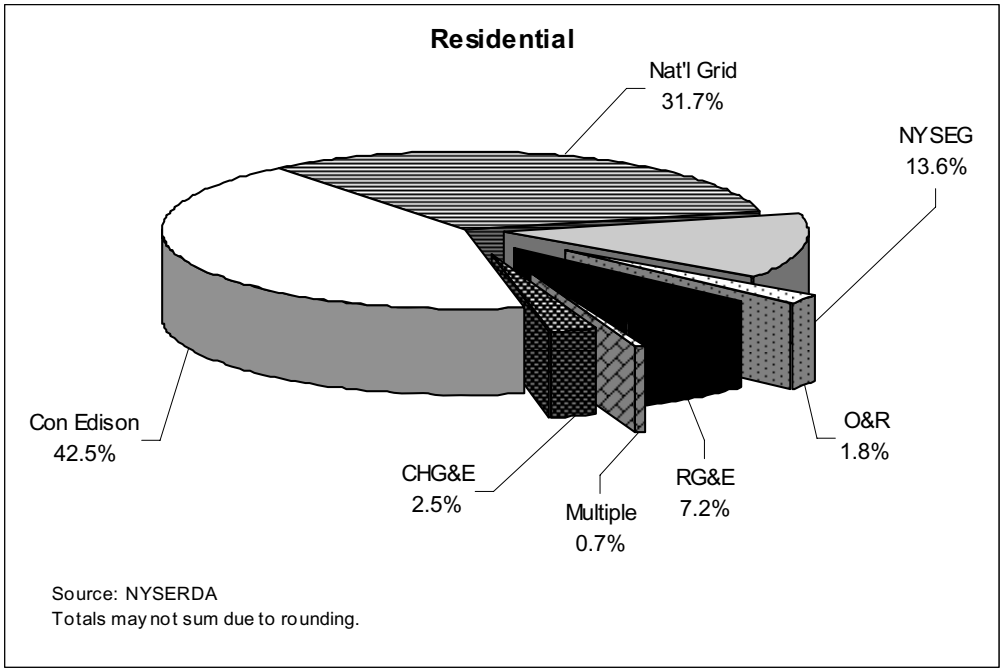


Figure 2-7. Residential Funds Spent by Housing Type

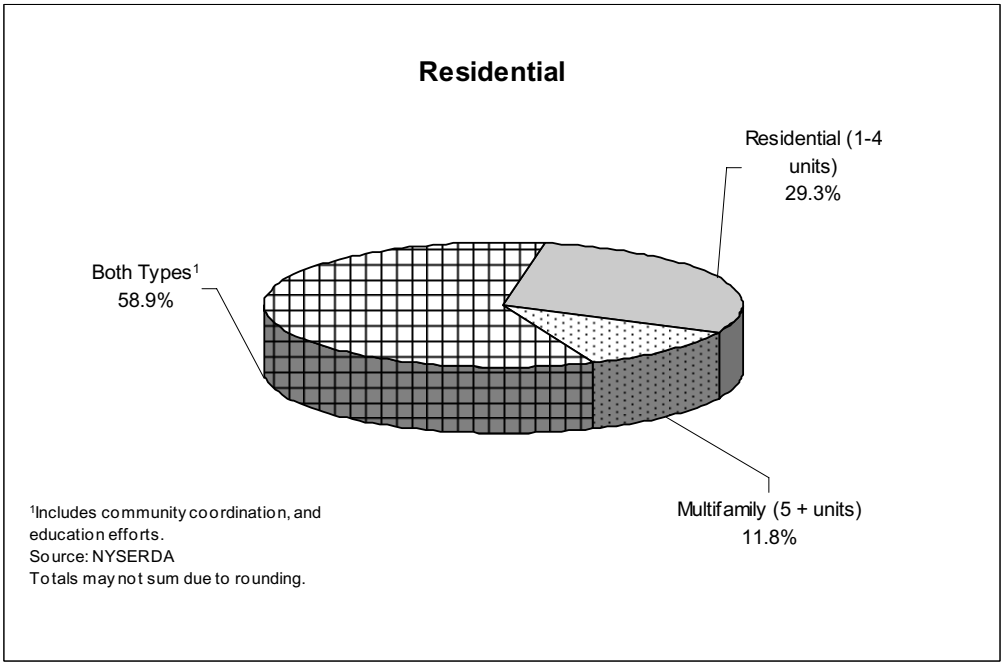


Figure 2-8. Low-Income Funds Spent by Utility Service Area

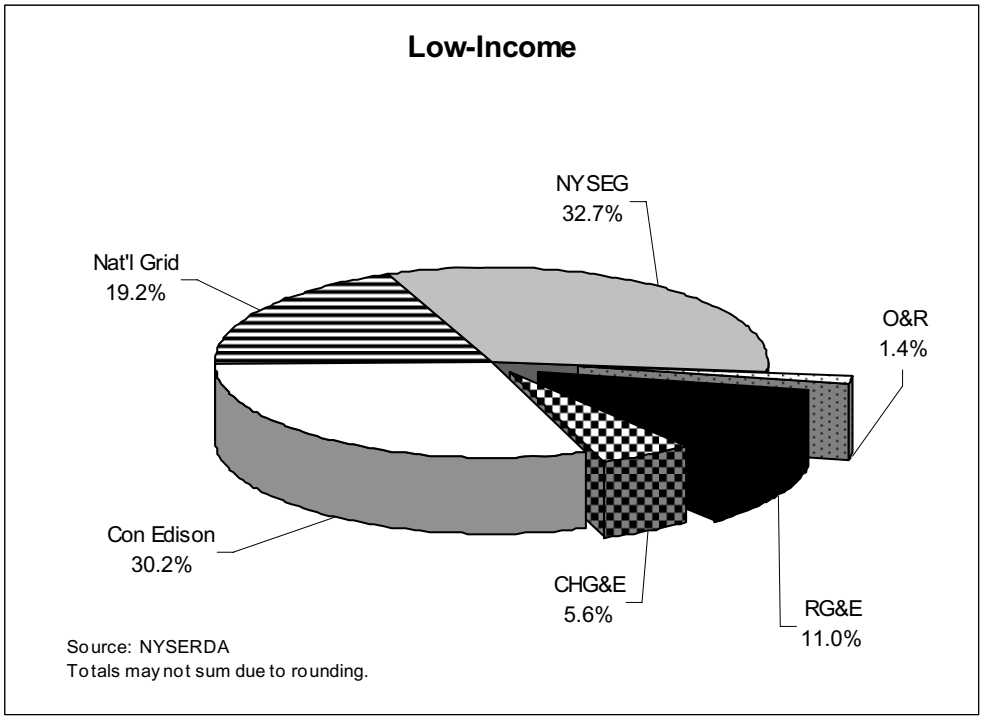
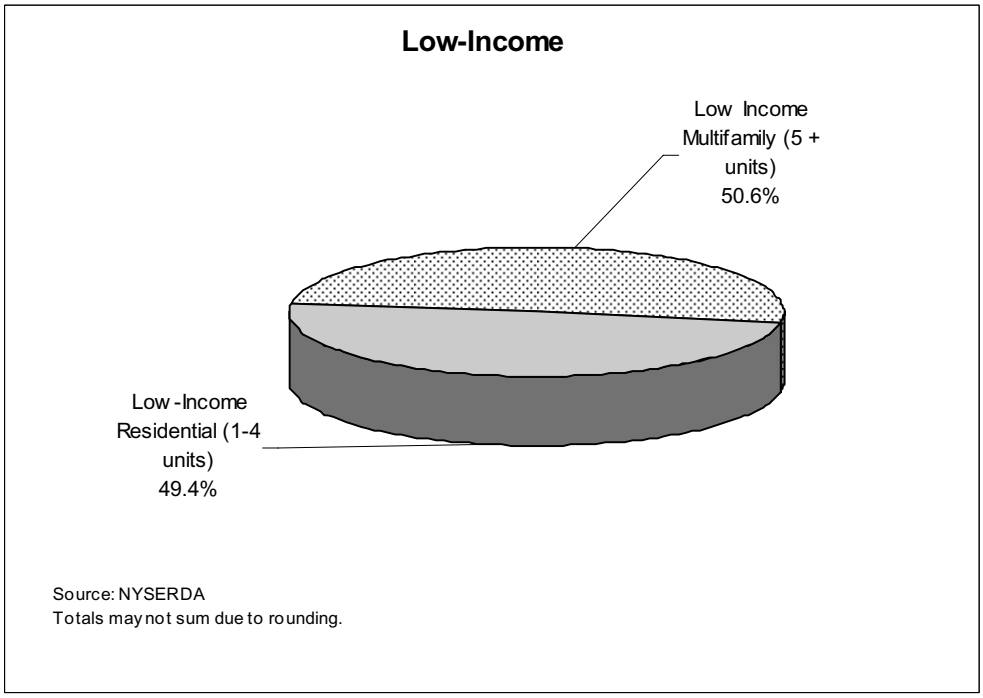


Figure 2-9. Low-Income Funds Spent by Housing Type



Research, Development and Demonstration Program Area

Table 2-5 presents detailed budget and funding information for the Research, Development and Demonstration (RD&D or R&D) programs. Figure 2-10 and Figure 2-11 show R&D Program spending by utility service area and technology.

Table 2-5. Research & Development Programs – Financial Status ($ million)

Program	Budget			Funds Spent			Encumbered Funds[3] % of Budget Encumbered	Committed Funds[4] % of Budget Committed
	SBC I & SBC II [1]	SBC III[2]	Total Budget	SBC I & SBC II[1]	SBC III [2]	Total Funds Spent % Funds Spent		
Public Benefit Power Transmission and Distribution	0.0	10.0	10.0	0.0	0.0	0.0	0.0	0.0
Clean Energy Infrastructure	43.7	33.8	77.5	19.0	4.6	23.6 30.5%	33.6 43.4%	38.0 49.0%
Distributed Energy Resources: Products and Demonstrations	74.1	72.5	146.6	31.9	4.1	36.1 24.6%	69.6 47.5%	84.0 57.3%
Demand Response and Innovative Research	0.0	10.0	10.0	0.0	0.0	0.0	0.0	0.0
Electric Transportation	0.0	5.0	5.0	0.0	0.0	0.0	0.4 8.0%	1.0 20.0%
Environmental, Monitoring, Evaluation, and Protection	21.5	17.5	39.0	17.7	1.0	18.7 47.9%	21.9 56.2%	24.3 62.3%
Industrial and Municipal Process Efficiency	0.0	15.0	15.0	0.0	0.0	0.0	0.2 1.3%	1.7 11.3%
Next Generation and Emerging Technologies	29.6	18.3	47.8	18.3	1.4	19.6 41.0%	22.8 47.7%	24.6 51.5%
Wholesale Renewable Energy Market	36.1	0.0	36.1	16.5	0.6	17.1 47.4%	23.6 65.4%	25.1 69.5%
Other	5.8	0.0	5.8	2.5	<0.1	2.5 43.1%	2.9 50.0%	2.9 50.0%
TOTAL Research & Development	**210.8**	**182.0**	**392.8**	**105.9**	**11.7**	**117.6 29.9%**	**175.1 44.6%**	**201.5 51.3%**

[1] SBC I: July 1, 1998 through June 30, 2001; SBC II: July 1, 2001 through June 30, 2006.

[2] SBC III: July 1, 2006 through June 30, 2011.

[3] Encumbered funds associated with signed contracts and purchase orders.

[4] Committed funds associated with encumbered funds and pending contracts.

Totals may not sum due to rounding.

Source: NYSERDA

Figure 2-10. R&D Funds Spent by Utility Service Area

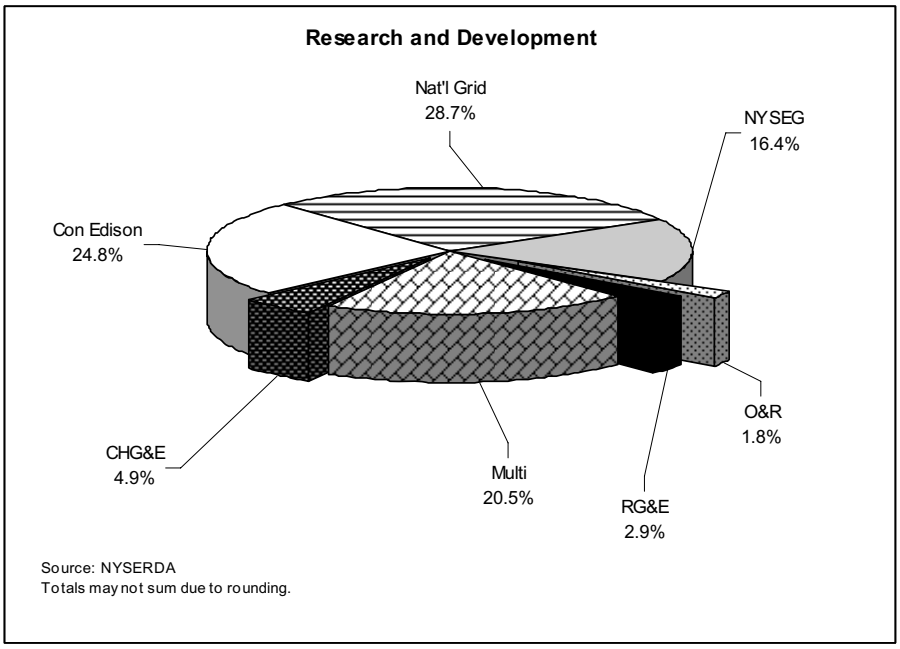
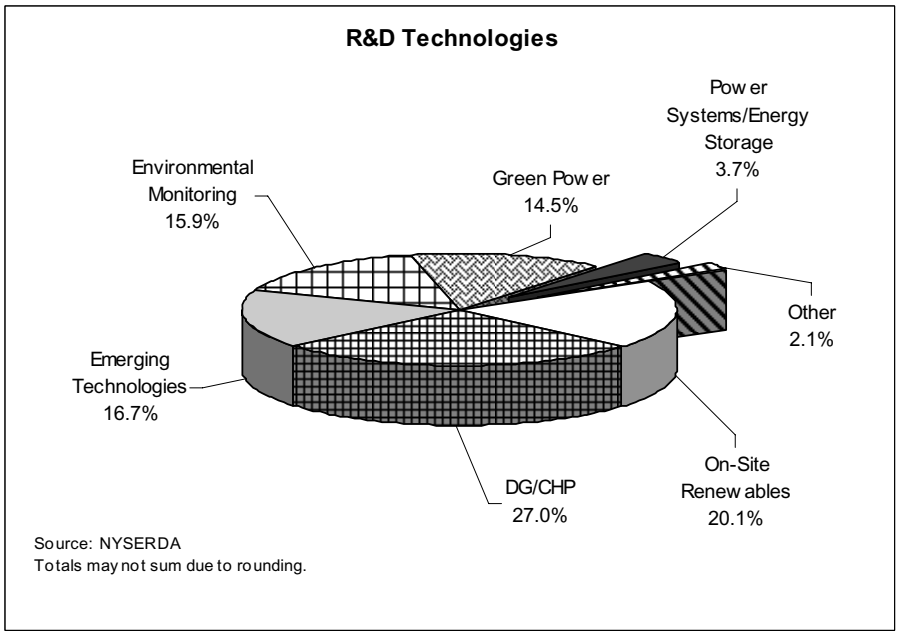


Figure 2-11. R&D Funds Spent by Technology



2.2 Portfolio Level Findings

This section discusses portfolio level findings related to progress toward overarching public policy goals, energy savings achievements, and economic analyses including macroeconomic impacts, market price effects, and overall cost-effectiveness. These findings are compiled based on the cumulative work of NYSERDA and its evaluation contractor teams over the past several years. Evaluation activities completed this year include:

- Measurement and Verification (M&V) work on FlexTech Technical Assistance, as well as database reviews for Peak Load Management, the Enhanced Commercial/Industrial Performance Program, the Small Commercial Lighting Program, High Performance New Buildings, Single Family Home Performance, EmPower New York, End Use Renewables, and DG/CHP.

- Market Characterization, Assessment and Causality (MCAC) work on Enhanced Commercial/Industrial Performance Program, High Performance New Buildings, and FlexTech Technical Assistance.

- Process Evaluation work on High Performance New Buildings, EmPower New York, and a portfolio-level evaluation review.

- Program Theory and Logic work on High Performance New Buildings, FlexTech Technical Assistance, all Residential and Low-Income programs (except Market Support, Buying Strategies and Energy Awareness), and Value/Cost analyses on DG/CHP and Environmental Monitoring, Evaluation and Protection.

- A peer review assessment of the Distributed Generation/Combined Heat and Power Program and the Environmental Monitoring, Evaluation and Protection Program.

NYSERDA expects to complete the following evaluation activities for inclusion in the next report (first quarter 2007):

- Measurement and Verification (M&V) work on Peak Load Management, Enhanced Commercial/Industrial Performance, the Small Commercial Lighting Program, Home Performance with ENERGY STAR, EmPower New York, and Enabling Technologies.

- Market Characterization, Assessment and Causality (MCAC) work on non-participant market effects/spillover, the Market Support Program (residential ENERGY STAR focused), and Non-Energy Impacts.

- Process Evaluation work on End Use Renewables, the Assisted Multifamily Program, and EmPower New York.

- Program Theory and Logic work on: the **New York Energy $mart**^{SM} Focus Program, Business Partners, and the **New York Energy $mart**^{SM} Loan Fund; General Awareness efforts, Market Support, and Low-Income Buying Strategies; and R&D programs including Public Benefit Power Transmission and Distribution and Next Generation and Enabling Technologies.

2.2.1 Progress Toward Goals

This section presents the cumulative progress of the **New York Energy $mart^{SM}** Program toward meeting the four overarching public policy goals set forth and recently revised by the PSC.[4] Overall, the Program is making good progress toward achieving the long term goals. The goals and progress through December 31, 2006 are shown in Table 2-6. Substantial additional program-specific and sector-level accomplishments have been documented within NYSERDA and independent evaluation contractor reports and are contributing to the development of sustainable progress being made toward these important overarching public policy goals.

Table 2-6. New York Energy $mart^{SM} Goals and Progress through December 31, 2006

Public Policy Goal	Progress as of December 31, 2006
Improve New York's energy system reliability and security by reducing energy demand and increasing energy efficiency, supporting innovative transmission and distribution technologies that have broad application, and enabling fuel diversity, including renewable resources.	The **New York Energy $mart^{SM}** Program has improved system-wide reliability and peak demand reduction, enabling 618 MW of callable load reduction and installing efficiency measures that permanently reduce peak demand by another 495 MW.
	The **New York Energy $mart^{SM}** Program has led to the installation of energy efficiency measures saving more than 2,360 GWh per year.
	The **New York Energy $mart^{SM}** Program has led to the installation of wind and photovoltaic technologies which provide more than 100 GWh of clean electricity generation per year.
	With funding from **New York Energy $mart^{SM}**, the U.S. Department of Energy and private sources, the world's first in-grid underground superconducting cable was installed and began operations on July 20, 2006 in the National Grid utility system. Superconducting cables can carry three to five times more power than conventional cables of the same size and can meet increasing power demands in urban areas by retrofitting old underground cables, eliminating the need to acquire new rights-of-way.
Reduce the energy cost burden of New Yorkers by offering energy users, particularly the State's lowest income households, services that moderate the effects of energy price increases and volatility and provide access to cost-effective energy efficiency options.	The **New York Energy $mart^{SM}** Program has saved participating customers nearly $340 million in annual energy costs.
	Approximately 60,000 eligible New York low-income customers received direct assistance through the **New York Energy $mart^{SM}** programs, resulting in $220/year in average customer energy bill savings for this under served population.
	Approximately 2,200 small business customers have been served through the Smart Equipment Choices Program.
	Approximately 3,000 multi-family units will participate in time-sensitive electricity rate pilot projects.
	The **New York Energy $mart^{SM}** portfolio has achieved a benefit-cost ratio of 2.4 under the most conservative Total Market Effects Test scenario.
Mitigate the environmental and health impacts of energy use by increasing energy efficiency, encouraging the development of support services for renewable energy resources, and optimizing the energy performance of buildings and products.	The annual reduction of emissions resulting from **New York Energy $mart^{SM}** Programs' energy savings is 2,060 tons of nitrogen oxide (NOX), 3,800 tons of sulfur dioxide (SO_2), and 1.6 million tons of carbon dioxide (CO_2).
	Between 2002 and 2006, the number of PV and small wind installers participating in the **New York Energy $mart^{SM}** Program has increased from 30 to 102. The Program has supported more than 1,680 attendees at PV and small wind training events, and helped 27 installers in the PV program become certified

[4] Case 94-E-0952 *et al.*, In the Matter of Competitive Opportunities Regarding Electric Service, *Staff Proposal for the Extension of the System Benefits Charge (SBC) and the SBC-funded Public Benefits Program*, August 30, 2005.

Public Policy Goal	Progress as of December 31, 2006
	by the North American Board of Certified Energy Practitioners (NABCEP).
	The **New York Energy $mart**SM Program has helped optimize energy performance in approximately 650 new commercial buildings, more than 8,500 new homes, and more than 13,800 existing homes. Additionally, more than 8,500 energy efficiency projects have been completed in commercial/industrial buildings.
Create economic opportunity and promote economic well-being by supporting emerging energy technologies, fostering competition, improving productivity, stimulating the growth of New York energy businesses, and helping to meet future energy needs through efficiency and innovation.	Averaged over a 19-year analysis period, the **New York Energy $mart**SM Program creates and sustains on average more than 8,600 jobs, increases labor income by $182 million per year, increases total output by $456 million per year, and increases value added by $211 million per year.
	The **New York Energy $mart**SM Program activities were instrumental in EPA revising its ENERGY STAR computer specifications to incorporate 80 PLUS® criteria for active power efficiency thresholds.[5]
	Under the Environmental Product development program, total product sales grew from $13 million in 2004 to $28 million in 2005.

2.2.2 Reported and Achieved Energy, Demand and Fuel Savings

The energy, peak demand, and fuel savings from the **New York Energy $mart**SM Program portfolio from 1998 through December 2006 are presented in Table 2-7. The table shows both program-reported savings and savings after adjustments were applied for field-verified realization rates, freeridership, and spillover. The purpose of the adjustments that are applied to the program-reported savings is as follows:

- Realization rates are developed by the Measurement and Verification contractor to account for differences in program reported savings and the performance of actual installations.
- Freeridership adjustments are developed by the MCAC contractor to subtract any program reported savings that would have happened in the absence of the program due to naturally-occurring adoption.
- Spillover adjustments, also developed by the MCAC contractor, add to program reported savings when participants or non-participants implement energy-saving measures due to the program's influence, but do not apply to participate in the program.

During 2006 the **New York Energy $mart**SM programs contributed 410 GWh in electricity savings, which represents a 17% increase in savings beyond those achieved by the end of 2005. Achieved permanent peak demand reduction increased by 77 MW or 7% from 2005. Achieved non-electric savings decreased by 150,000 MMBtu or 4%.

Also shown in Table 2-7 is the estimated overlap in savings across programs. Overlapping savings are expected – for example, overlap occurs when a customer first participates in the Technical Assistance (TA) Program to obtain a detailed energy audit of a facility and then participates in the Enhanced Commercial/Industrial Performance Program (ECIPP) to access incentives for the implementation of recommended measures. Database searches were performed to locate savings claimed for the same customer(s) for the same measure(s). When identified, overlap factors were developed to account for the same savings claimed under more than one program. Since both technical assistance and incentives for measures are equally vital to convincing customers to take action, and there was no reliable way of

[5] 80 PLUS is a national upstream buy-down program that encourages market transformation groups and computer manufacturers to get more energy-efficient power supplies into PCs and desktop-derived servers.

allocating the savings to one program or the other, the adjustments are made only at the sector level. In the case of the Distributed Generation/Combined Heat and Power (DG/CHP) Program, where R&D savings overlap with programs in the Commercial/Industrial sector, savings were removed from the portfolio and are shown in the table as "Cross-Sector Overlap Removed."

The reductions in energy use translate into:

- $340 million in annual energy bill savings (electric, oil and natural gas) in 2006 for New York consumers,
- 2,060 tons of annual nitrogen oxide (NO_x) emission reductions,
- 3,800 tons of annual sulfur dioxide (SO_2) emission reductions, and
- 1.6 million tons of annual carbon dioxide (CO_2) emission reductions which are equivalent to removing 320,000 automobiles from New York's roadways.

Table 2-7. Reported and Adjusted Cumulative Annual Energy, Demand, and Fuel Savings through December 2006[6]

Program	Energy Savings (GWh)			Peak Demand Reduction (MW)			Fuel Savings (MMBtu)[7]		
	Reported GWh	**Adjusted GWh**	***% of Reported***	**Reported MW**	**Adjusted MW**	***% of Reported***	**Reported MMBtu**	**Adjusted MMBtu**	***% of Reported***
Peak Load Management: Callable	-	-	-	488.1	470.5	96%	-	-	-
Peak Load Management: Permanent	113.5	118.0	104%	52.3	54.5	104%	-	-	-
Enhanced Commercial/ Industrial Performance	845.9	836.3	99%	182.8	142.0	78%	6,593	4,615	70%
New York Energy $martSM Business Partners[8]	51.7	60.7	117%	11.0	13.3	120%	-	-	-
New York Energy $martSM Loan Fund and Financing	65.5	51.3	78%	11.7	15.0	128%	111,590	139,621	125%
New York Energy $martSM Focus	0	0	0	0	0	0	-	-	-

[6] Subtotals, totals and percentages may not calculate exactly due to rounding.

[7] Depending on the program and measure, non-electric savings are developed from either engineering calculations or deemed values for installations of energy efficiency measures. All fossil fuel savings are included in Table 2-7.

[8] Savings for the Commercial HVAC portion of the program have been reduced as of 4th Quarter 2006. This approach was taken due to the known short-term nature of savings from advanced diagnostics and commissioning, which were part of the program.

Program	Energy Savings (GWh)			Peak Demand Reduction (MW)			Fuel Savings (MMBtu)[7]		
	Reported GWh	**Adjusted GWh**	***% of Reported***	**Reported MW**	**Adjusted MW**	***% of Reported***	**Reported MMBtu**	**Adjusted MMBtu**	***% of Reported***
High Performance New Buildings	193.6	250.3	129%	41.4	53.5	129%	-	-	-
Flex Tech Technical Assistance: Permanent	612.0	697.6	114%	114	130.0	114%	2,513,073	2,864,903	114%
Flex Tech Technical Assistance: Curtailable	-	-	-	8.9	10.2	114%	-	-	-
Overlap Removed[9]	-	141.9	-	-	26.1	-	-	-	-
Subtotal Commercial/ Industrial	1,882.3	1,872.2	96%	910.2	862.9	95%	2,631,256	3,009,140	114%
Single Family Home Performance (excluding Assisted Home Performance)	15.9	18.4	116%	2.0	2.5	124%	858,955	987,109	115%
Single Family Home Performance: Assisted Home Performance	4.9	5.5	113%	0.7	0.8	120%	216,256	242,207	112%
Multifamily Building Performance (Excluding Assisted Multifamily Program)	14.7	15.1	103%	2.4	3.3	138%	-	-	-
Multifamily Building Performance: Assisted Multifamily Program	28.4	23.1	81%	1.7	1.8	106%	167,303	140,541	84%
Market Support Program[10]	287.7	303.8	106%	71.5	72.8	102%	341,920	341,920	100%
EmPower New York	27.9	27.9	100%	3.3	3.3	100%	66,891	66,891	100%
Subtotal Residential and Low-Income	379.5	393.9	104%	81.6	84.5	104%	1,651,325	1,778,668	108%

[9] Sector level savings have been adjusted to remove overlap between complementary programs, as such, the 'Achieved Savings' columns will not sum to the sector total.

[10] Savings numbers for the ENERGY STAR Products program have been developed by the MCAC Team.

Program	Energy Savings (GWh)			Peak Demand Reduction (MW)			Fuel Savings (MMBtu)[7]		
	Reported GWh	Adjusted GWh	*% of Reported*	Reported MW	Adjusted MW	*% of Reported*	Reported MMBtu	Adjusted MMBtu	*% of Reported*
DG-CHP Demonstration Program	93.5	96.7	103%	18.8	21.1	112%	-777,721[11]	-738,327	95%
Demand Response and Innovative Rate Research	-	-	-	208.1	137.2	66%[12]	-	-	-
Renewable Energy Production	104.4	104.6	100%	8.8	8.4	96%	-	-	-
Subtotal R&D	197.9	201.3	102%	235.7	166.7	71%	-777,721	-738,327	95%
Cross Sector Overlap Removed	-	7.7	-	-	1.5	-	-	-	-
NYE$ Portfolio	**2,459.7**	**2,459.7**	**100%**	**1,227.5**	**1,112.6**	**91%**	**3,504,860**	**4,049,481**	**116%**

2.2.3 Economic Analysis

This section discusses the macroeconomic impacts of the **New York Energy $mart**SM Program, as well as the cost effectiveness analysis of the deployment programs.

Macroeconomic Impact Analysis

Expenditures made by NYSERDA and participants within the **New York Energy $mart**SM Program have substantial macroeconomic impacts that go beyond direct benefits to participants. Purchases of goods and services through the program set off a ripple effect of spending and re-spending that influences many sectors of the New York economy, and the level and distribution of employment and income in the State.

The macroeconomic impact analysis of the **New York Energy $mart**SM Program undertaken for this report was designed to quantify the net impacts of the programs by comparing the impacts of Program expenditures and energy savings to the impacts that would have resulted had the programs not been implemented and the money not been paid by ratepayers into the System Benefits Charge (SBC) fund. The Base Case provides a frame of reference with which to compare the impacts of the **New York Energy $mart**SM Program. The Base Case estimates the impacts that the SBC funds would have had on the New York economy, had they been retained by the customers of the participating utilities in the absence of the program. The components of the Base Case include: (1) increased disposable income available to residential consumers; (2) increased retained earnings available to businesses; and (3) increased purchases of electricity, natural gas, and oil due to the absence of the energy savings provided

[11] Because the electricity saved by the DG/CHP projects replaces electricity formerly purchased from the grid, the program has reduced fuel used at central generating stations, for a net decrease statewide due to greater efficiency of the DG/CHP systems at sites where imported fuel is used. The fuel avoided at the central generating plant is determined from the electricity generated by the DG/CHP installations. Furthermore, at additional projects such as waste water treatment plants, electricity generation is powered fully or partially by digester gas produced on site. Such fuel switching achieves natural gas conservation above and beyond what is achieved through efficiency alone.

[12] The Demand Response and Innovative Rate Research Program does not require that enabled demand reductions be maintained. This large adjustment is based on M&V results and indicates the portion of the enabled MW reduction that was maintained.

by the program. The Program Case estimates the impact on the New York economy of SBC funds allocated to the portfolio of **New York Energy $mart**[SM] Program expenditures. The net macroeconomic impacts are expressed in terms of annual employment[13], labor income[14], total industry output[15], and value added[16]. Note that the macroeconomic results reported in this section are limited to the impacts that are most directly associated with the Program expenditures and the annual energy savings due to those expenditures. The analysis does not capture the more indirect and long-term potential impacts that may result from more widespread market transformation (*i.e*; permanent adoption of new energy efficiency measures as the status quo in the marketplace).

Material changes from the previous analyses are as follows.

1. The program implementation period has been changed from eight years to 13 years due to the extension of the **New York Energy $mart**[SM] Program though June 30, 2011.

2. The average life of measures installed under the **New York Energy $mart**[SM] Program was changed from 10 to 15 years.

3. The index for apportioning jobs created during the year of program implementation and the out years, is now based on the program's cumulative annual energy savings and annual spending, instead of solely on spending as was the case in previous analyses.

The last two changes were made based on available program data in an effort to improve the accuracy and usefulness of the results of this year's macroeconomic analysis.

Results of Analysis

Results of the macroeconomic analysis, encompassing 14 years of program implementation (1999-2012)[17] and fifteen years[18] following program implementation (2013-2027), indicate that the **New York Energy $mart**[SM] Program can reasonably be expected to provide net macroeconomic benefits to New York in the form of increased employment, labor income, total output, and value added. Table 2-8 indicates that the **New York Energy $mart**[SM] Program, averaged over the 29-year analysis period, is expected to create and sustain an average of over 8,600 jobs compared to the number of jobs that would have existed in the absence of the program. In addition, the program increases labor income by $321 million per year, increases total output by $456 million per year, and increases value added by $211 million per year.

---

[13] Employment includes total wage and salary employees as well as self-employed jobs in a region. It includes both full-time and part-time workers and is measured in annual average jobs.

[14] Labor income includes both employee compensation and proprietor income.

[15] Total industry output is the value of total sales revenue, which includes both final and intermediate goods and services. It can be measured as the total value of purchases by intermediate and final consumers.

[16] Value added includes the components of Labor Income (employee compensation and proprietor income) plus property income (interest, rental income, royalties, dividends, and profits) and indirect business taxes (primarily sales and excise taxes).

[17] Although the SBC funding period ends on June 30, 2011, not all funds are expected to be fully expended by this point. Therefore, the program implementation period was extended through 2012 based on a projection of when funds would be completely spent for installed equipment.

[18] A fifteen-year period was selected to represent the average life of measures installed under the **New York Energy $mart**[SM] Program.

Table 2-8. Summary of Macroeconomic Impacts of the New York Energy $mart^{SM} Program (Constant 2006$)

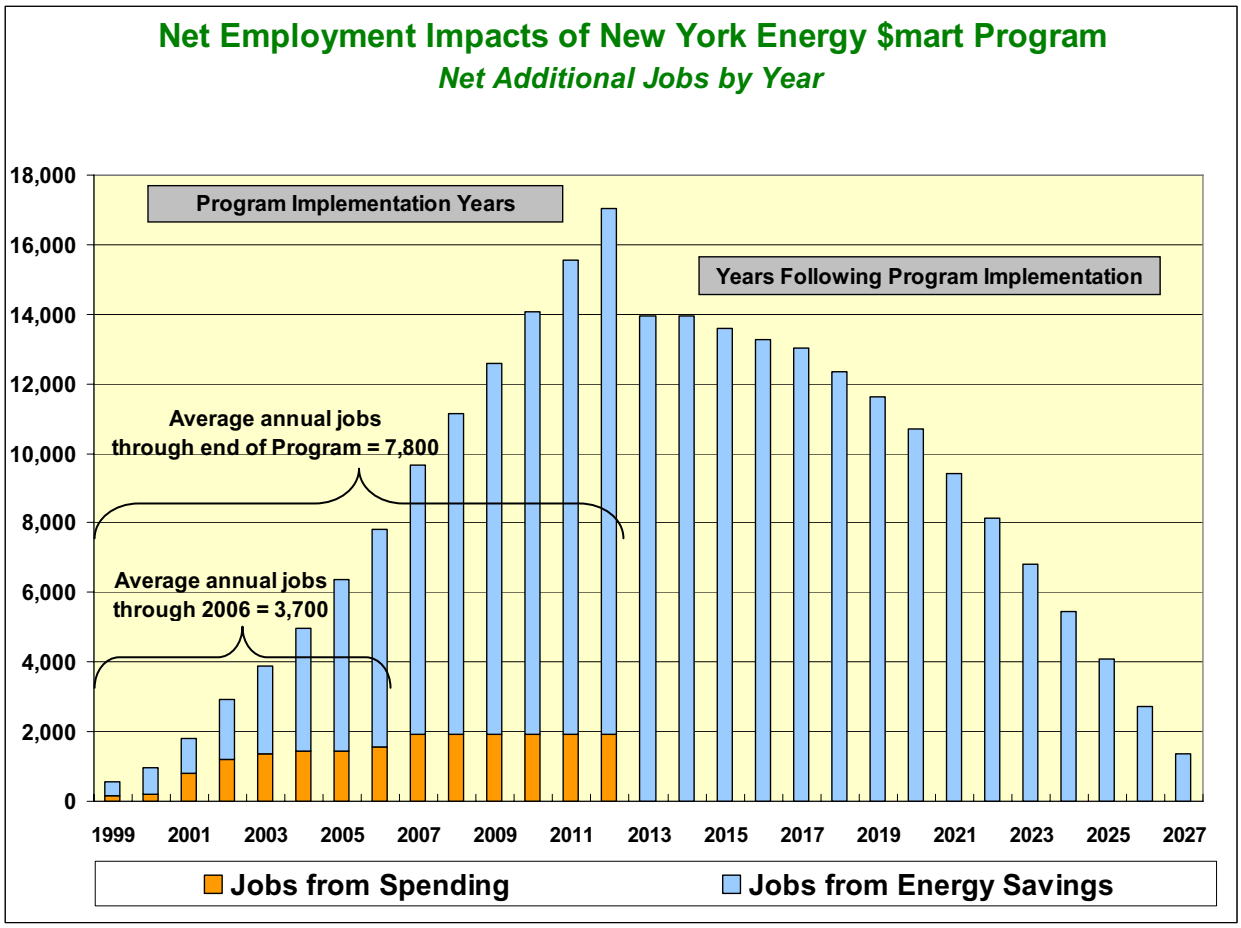
Economic Variable	Program Implementation Years (1999-2012)	Years Following Program Implementation (2013-2027)	Annual Average over 29-year Analysis Period (1999-2027)
Net Job Growth	7,807	9,362	8,612
Labor Income	$361 Million	$283 Million	$321 Million
Total Output	$573 Million	$346 Million	$456 Million
Value Added	$271 Million	$154 Million	$211 Million

Employment Results

Results of the analysis indicate that the **New York Energy $mart^{SM}** Program provides substantial net macroeconomic benefits to New York in the form of increased employment, both during the program implementation years (1999-2012) and throughout the years following implementation (2013-2027), during which the energy efficiency measures implemented by the program continue to accrue annual energy savings. As shown in Table 2-8 the program is estimated to create and sustain an average of over 8,600 jobs over the 29-year analysis period, compared to the estimated number of jobs that would have existed in the absence of the program. Figure 2-12 shows net jobs created and sustained by individual year, and shows that the program is estimated to result in an average net gain of approximately 7,800 jobs during the program implementation years, and an average of more than 9,300 jobs per year throughout the years following implementation.[19] On average, more than 8,600 net jobs are created over the 29 years of program implementation. These are jobs that are estimated to exist, net of jobs that are lost in certain sectors as a result of the program. Note that the annual average employment results are not additive; the values reported represent the number of jobs created and sustained over each of the specified periods: (1) the 14 program implementation years (1999-2012); (2) the 15 years following program implementation (2013-2027); or (3) the annual average over the entire 29-year analysis period (1999-2027).

[19] 82% of all jobs created during the program implementation years are due to energy bill savings, while 18% of jobs created are due to spending. In years following program implementation, all jobs created are due to energy savings.

Figure 2-12. 2006 Update – Net Employment Impacts by Year



Labor Income Results

Labor income includes both employee compensation and proprietor income. Results indicate that the **New York Energy $mart**[SM] Program also provides substantial net macroeconomic benefits to New York in the form of increased labor income. Table 2-8 shows that the Program is estimated to result in an average net gain of $321 million in labor income in each year over the 29-year analysis period. The program is estimated to provide a net gain in labor income of $361 million per year during the program implementation years (1999-2012) and $283 million throughout the years following implementation (2013-2027).

Total Output and Value Added Results

Total industry output is the value of total sales revenue, which includes both final and intermediate goods and services. It can be measured as the total value of purchases by intermediate and final consumers. Value added includes the components of Labor Income (employee compensation and proprietor income) plus property income (interest, rental income, royalties, dividends, and profits) and indirect business taxes (primarily sales and excise taxes). Table 2-8 shows that the program is estimated to result in an average net gain of $456 million in total output and $211 million in value added in each year over the 29-year analysis period. During the program implementation years (1999-2012), the program is estimated to provide a net gain in total output of $573 million per year and a net gain in value added of $271 million

per year. Throughout the years following implementation (2013-2027), the program is estimated to result in a net gain in total output of $346 million per year and a net gain in value added of $154 million per year.

Benefit Cost Analysis of Deployment Programs

This section presents an overview of the benefit cost analysis of the **New York Energy $mart**[SM] Program[20] for measures installed through year-end 2006. Four types of benefits were considered in the analysis:

1. Resource benefits, including benefits associated with reduced electricity generation and capacity (avoided costs), as well as reduced use of natural gas, oil, propane, and water.
2. Participant non-energy impacts, including monetized values for benefits such as comfort, safety, and productivity. These benefits accrue to participants and include spillover effects.
3. Energy and capacity market price effects including benefits accruing to all electricity customers by lowering the price of energy and capacity.
4. Macroeconomic value added. These benefits result primarily from lower energy bills and consumer spending of these bill savings. Value added includes the components of labor income (employee compensation and proprietor income) plus property income (interest, rental income, royalties, dividends, and profits) and indirect business taxes (primarily sales and excise taxes).

The monetized value of environmental benefits, such as reductions in emissions of sulfur dioxide, nitrogen oxides, and carbon dioxide, were not included as a benefit in the benefit cost analysis. With respect to sulfur dioxide and nitrogen oxides, since there are statewide regulatory emission caps as well as emission trading markets, emission credits may likely be sold in the marketplace, allowing generators to reduce operating costs (*e.g.*, through less stringent pollution controls) or expand generation (*e.g.*, to meet economic growth) without exceeding their caps. The net effect will be statewide emissions meeting the caps for sulfur dioxide and nitrogen oxides.

All costs incurred in years prior to 2006 were adjusted and are reported in year 2006 dollars. A discount rate of 3% was used to discount future benefits and costs and to compound past benefits and costs

A summary of the various benefits are presented in Table 2-9. Shown are the present values of resource benefits, non-energy impacts, market price effects, and macroeconomic benefits.

[20] A more detailed benefit cost analysis will be available in the 2007 1st Quarterly Report.

Table 2-9. Summary of Benefits ($ million)

	Through 2003	2004	2005	2006	Total
Present Value of Resource Benefits (2006$)	$1,901	$930	$664	$913	**$4,408**
Present Value of Non-Energy Impacts (2006$)	-	-	-	-	**$1,315**
Present value of 3-years of Market Price Effects (2006$)	$860	$214	$171	$220	**$1,465**
Present Value of Incremental Macroeconomic Benefits (2006$)	$431	$213	$245	$279	**$1,168**

A summary of costs is presented in Table 2-10. The cumulative measure cost is $1.65 billion, made up of $.3 billion of program incentives and $1.4 billion of participant co-funding. Program Implementation costs are $.2 billion. Implementation costs include a 9% administration and evaluation charge on all program spending, including spending on incentives.

Table 2-10. Summary of Costs Through 2006 ($ million)

	Incremental installed cost (full cost for retrofit)	Incentives	Participant Contribution	Program Implementation
Portfolio Total (2006$)	$1,650	$292	$1,447	$209

The calculation of the non-energy impacts (NEIs) are shown in Table 2-11. The impacts were estimated as a percentage of customer electricity and natural gas bill savings. The present value of the electricity bill savings is $2.36 billion, the natural gas bill savings is $925 million, and the present value of the non-energy impacts is $1.3 billion.

Table 2-11. Non-energy Impacts as a Percent of Bill Savings ($ million)

	Electric Retail Benefits	Natural Gas Retail Benefits	NEI %	NEI Value
Portfolio Total (2006$)	$ 2,363	$ 925	40%	$1,315

The energy market price effect results from lower average market clearing price for electricity due to kWh's saved by the **New York Energy $mart**^{SM} Program. Lower prices result because the most expensive units are backed out due to lower energy requirements. The per kWh effect was estimated to be 0.0115 cents per kWh. The capacity market price effect results from reduction in the price of capacity due to reduced demand. The effect, derived from the New York Independent System Operator Demand Curve, was estimated to be approximately $600 per kW-year for each kW reduction in the Con Edison Service area. For "Rest of State," the capacity cost reduction was estimated to be approximately $180 per kW-year for each kW reduction. The cost estimates were weighted by region, resulting in a cost of $277 per kW-year.

Benefit cost ratios for deployment programs are shown in Table 2-12 and are reported in a manner that is consistent with all past annual evaluation status reports. Two different tests were used to calculate B/C ratios:

1. Total Market Effects Test (TMET) compares quantifiable life-cycle benefits from program participants and spillover effects against both NYSERDA and customer costs incurred in achieving those benefits.

2. Program-Efficiency Test (PET) compares the same quantifiable life-cycle benefits against only NYSERDA's costs. This test can also be called the program administrator test.

Scenario 1 includes only resource benefits. Scenario 2 adds non-energy impacts to Scenario 1. Scenario 3 adds market price effects to Scenario 2. Scenario 4 adds macroeconomic impacts to Scenario 3.

Table 2-12. Benefit Cost Ratios for the New York Energy $mart^{SM} Portfolio

	Resource Benefits (Scenario 1)	Plus Non-Energy Impacts (Scenario 2)	Plus Price Effects (Scenario 3)	Plus Macroeconomic Impacts (Scenario 4)
Total Market Effects Test[1]	2.4	3.1	3.2	3.3
Program Efficiency Test	8.8	11.4	11.9	12.4

[1] The method of estimating measure costs for retrofit/early replacement programs was modified in this year's analysis resulting in higher measure costs, and therefore, lower benefit cost ratios for the total market effects test.

2.3 Portfolio Process Evaluation

2.3.1 Solicitations Released

During 2006, 49 solicitations were issued to competitively select contractors for program design and implementation services. In total, 461 proposals were received, 164 (36%) of which were approved for funding. Information on solicitations released in 2006 is shown in Table 2-13.

Table 2-13. Solicitations Released Through Year-End 2006[1]

Solicitation Number	Solicitation Name	Solicitation Release Date	Solicitation Closing Date
PON 949	Renewable Energy Business Development	2/13/06	5/3/06
PON 954	Energy Efficient Displays and Digital Signage	2/6/06	3/21/06
PON 998	Industrial Process and Productivity Improvement	4/3/06	6/8/06
PON 998A	Industrial Process and Productivity Improvement	4/3/06	10/5/06
PON 955	Peak Load Reduction Program	1/2/06	6/30/06
RFP 958	Contractor Services for Establishing NYS Appliance Standards	1/23/06	2/16/06
PON 984	Commercial/Industrial Performance Program	1/30/06	6/30/06
PON 1042	Power Systems Technologies	6/19/06	8/22/06
PON 1043	Distributed Generation as Combined Heat and Power	6/19/06	8/22/06
RFP 1032	Reference Design Guidebook	6/5/06	7/13/06
PON 989	Consumer Education Through Local TV	4/7/06	5/30/06

Solicitation Number	Solicitation Name	Solicitation Release Date	Solicitation Closing Date
RFP 1026	General Awareness and Education	5/1/06	6/12/06
PON 996	EMEP Outreach Assistance	4/24/06	5/24/06
PON 1001	Synthesis of Electricity Generation Impacts to Wildlife	4/10/06	5/4/06
PON 1035	New Construction Program Incentives	5/29/06	3/31/07
PON 1045	Technical Assistance	5/22/06	11/30/06
RFP 1030	New York Energy $mart Energy Audit Program	6/26/06	8/16/06
RFP 986	Marketing Strategy, Planning, Partner Support and PR	5/15/06	7/5/06
RFP 1011	Program Implementer for Multifamily Building Performance Program	5/22/06	6/22/06
PON 1031	Advanced Sensors & Controls for Energy Management, Power Quality, & Electricity System Reliability	7/31/06	9/25/06
PON 1040	Waste & Wastewater Technologies	8/7/006	10/3/06
PON 1062	Advanced Building Envelopes and Energy Systems	8/23/06	10/18/06
PON 1079	Daylighting Technical Consulting, Training, and Demonstration	9/18/06	11/13/06
PON 1087	Heating and Cooling	9/11/06	11/9/06
RFP 1057	New Construction Program Technical Assistance and Support Services	9/18/06	10/16/06
RFP 1007	Low Income Forum on Energy Implementation Support	7/3/06	8/9/06
RFP 1020	Products Program	7/10/06	8/23/06
RFP 1017	Homes Implementation	8/11/06	9/13/06
RFP 988	Hotline and Fulfillment	9/4/06	10/11/06
RFP 1005	Quality Assurance Services for NYSERDA Residential Programs	9/18/06	10/26/06
RFP 1012	New York Energy $mart℠ Communities Services and Support Contractor	9/18/06	11/1/06
RFP 1061	New York Energy $mart℠ Impact Assessment	8/7/06	9/5/06
RFP 1063	Process Assessment and Evaluation Management for the New York Energy $mart℠ Program	8/7/06	9/6/06
RFP 1065	Market Characterization and Assessment Evaluation Contractor for the New York Energy $mart℠ Program	8/7/06	9/7/06
RFP 1086	Data Collection Contractor for the New York Energy $mart℠ Program	9/25/06	10/19/06
PON 1085	Solar Thermal Evaluation	11/20/06	2/5/07
PON 1105	Next Generation Emerging Technologies	11/6/06	1/22/07
PON 1105A	Next Generation Emerging Technologies	11/6/06	6/7/07
RFP 1068	Lighting Incubator	11/13/06	1/25/07
RFP 1111	Natural Gas & Petroleum Exploration, Production, Efficiency, and Emissions Reduction	11/13/06	12/28/06
RFP 1111A	Natural Gas & Petroleum Exploration, Production, Efficiency, and	11/13/06	8/7/07

Solicitation Number	Solicitation Name	Solicitation Release Date	Solicitation Closing Date
	Emissions Reduction		
PON 1097	Peak Load Reduction Program	10/30/06	3/31/08
PON 1101	Enhanced Commercial/Industrial Performance Program	11/20/06	3/31/07
RFP 1051	Flexible Technical Assistance	10/30/06	12/11/06
RFP 1046	Technical Assistance	12/11/07	5/31/07
PON 1110	NYC Marketing & Education Through Local TV	11/13/06	12/21/06
RFP 1114	**New York Energy $mart**SM Communities Program	11/13/06	1/8/07
RFP 980	Outreach and Training Support for **New York Energy $mart**SM Loan Fund in Con Edison Service Territory	12/25/06	2/7/07
PON 1122	Innovation in Lighting: New Products, Demonstrations, and Testing	12/18/06	2/26/07

[1] Requests for Proposals (RFPs) are solicitations used for identifying and procuring projects that represent a specific area of interest and include a statement of work with a high degree of specificity describing the work contemplated and the evaluation criteria to be used. A single award with no cost-sharing is usually the norm. Program Opportunity Notices (PONs) are solicitations used for identifying and procuring projects that demonstrate technical, economic, and environmental characteristics in particular technology areas. Multiple awards are usually made and cost-sharing is the norm.

2.3.2 Evaluation Review and Recommendations

This summary, developed by the Research Into Action Process Evaluation team, presents a review of the evaluation process from June 2003 through October 2006.

Study Purpose

The purpose of the study was to assess the results of the evaluation work from the perspective of its execution and outcomes in the context of how it was envisioned and planned. Questions that were addressed included:

- Was the evaluation process effectively created?
- Did it have the outcomes intended (including building evaluation capacity, greater integration of evaluation into program processes, and meeting stakeholder requirements)?
- Was the evaluation model an effective one and should it be changed or revised?

In addition to addressing these questions, this review provides feedback to NYSERDA and the SBC Advisory Group as they work with contractors in the next phase of evaluation work to be undertaken. The study also provides insights for the larger evaluation community interested in assessing the most appropriate ways to evaluate such comprehensive, market-oriented programs like the **New York Energy $mart**SM portfolio.

Methodology

To address all of these research issues, the process evaluation team has undertaken two cycles of data collection. The first occurred in 2005 and included 30 interviews with NYSERDA's senior management, the Energy Analysis evaluation team, and program staffs. The interviews addressed the history of the evaluation effort, its implementation, and responses to the evaluation work done to date. The second

round of data collection, leading to the results summarized in this report, occurred in 2006. Twenty-nine individual and four group interviews were conducted with NYSERDA's Energy Analysis evaluation team and program staff members, as well as with the specialty evaluation contractors and members of the SBC Advisory Group that oversees the independent evaluation effort.

Three cycles of independent, third-party monitoring and evaluation reporting on **New York Energy $mart**[SM] programs have been completed during the period assessed (these three evaluation cycles concluded in 2004, 2005 and 2006), with each cycle resulting in recommendations for improvements in the programs. The interviewers asked NYSERDA staff to reflect on these cycles and the types of evaluation efforts conducted in each, and asked program staffs to assess the degree to which they had taken action in response to the recommendations of evaluators. The review of recommendations also asked staff members to identify the reasons for their actions or inaction. A total of 174 recommendations were reviewed for the first two evaluation cycles, and 93 were reviewed for the third cycle.

Finally, to place the results of the evaluation review in context of wider practices for using evaluation in large organizations, the process evaluation team conducted a review of the literature across a wide range of fields. The goal was to provide an overview of how other energy efficiency entities and other large organizations use evaluation findings in planning, program design, and program implementation.

Summary of Results

These results are viewed in terms of NYSERDA's unique approach to evaluation. With a budget ranging from less than 0.5% to 2% for evaluation during the SBC funding cycles, NYSERDA implemented an evaluation model using teams of specialty contractors to conduct crosscutting evaluations of multiple programs. NYSERDA's evaluation structure was intended to provide independent evaluation at many levels, with the goal of aggregation to the portfolio level. This focus on the portfolio level as the ultimate evaluation objective is driven by the reporting requirements of the PSC.

While the first year of the evaluation was especially challenging for program staffs, the Energy Analysis evaluation team, and the specialty evaluation contractors, significant improvement was reported over the three years. By year three, increased evaluation capacity was seen in the improved knowledge and skills of the Energy Analysis evaluation team, and in program staffs' more positive views of evaluation's use in program planning and implementation, as well as in greater communication with the Energy Analysis evaluation team. Further evidence of increased evaluation capacity is seen in the SBC Advisory Group's reported greater clarity of its role in the evaluation, and in the specialty contractors' reports of greater knowledge of the programs and processes.

Use of the evaluation findings has also increased over the three years, with both program staff and the Energy Analysis evaluation team reporting increased awareness of evaluation in program planning and solicitation processes. While some program staff indicate they do not use the evaluation findings, others report using the findings to change programs, improve data collection or recording, prepare public presentations, and for program marketing. Reported consideration of, or action on the recommendations resulting from the evaluations has also increased. In the earlier evaluation cycles, some action was reported on less than 50% of the recommendations; in the most recent cycle, this number had risen to 67%. While action on 100% of the recommendations is not expected, this increase may be due in part to: improvements on the part of the contractors (recommendations that reflect better knowledge of programs and are more realistic in context); program staffs' increased involvement in setting the research agenda and thus producing recommendations more closely related to timely programmatic issues; and/or some positive response bias as program staff, in this second round of interviews, perceived it important to indicate action was being taken. Also, it is important to note that NYSERDA staff have been quick to address many issues identified in the various evaluation contractor team reports – often before the draft

reports were even finalized. The Public Service Commission, Department of Public Service staff, and the SBC Advisory Group are also key users of the evaluation findings.

Reporting processes, initially characterized as disjointed and time-consuming (specifically in preparation of the annual report), have improved over the three evaluation cycles. The SBC Advisory Group expressed high levels of satisfaction with both the evaluation process and its outcomes, including reports.

Based on the findings of this review, there is clear indication that NYSERDA has achieved many of its goals for the evaluation effort and there has been definite improvement in both process and outcomes from year one of the assessment period to year three. However, there are still pockets of resistance among program staff members, including lingering views of the evaluation process as not meeting their needs or not adequately measuring their programs under consideration. Unrealistic expectations on the part of program staff, as well as conflicting, multiple objectives with a highly constrained evaluation budget likely contribute to this resistance. Also, there is inconsistent support among managers for evaluation and unclear expectations among some staff members regarding the recommendations they receive from the evaluation reports. All of these factors indicate that there is still room to continue the improvements already seen over the last three years by continued effort to foster a culture that recognizes the value and relevance of evaluation for program planning and implementation. The recommendations below are intended to address some of the residual effects of the first three years of the current evaluation model (especially from the first year) and to assist NYSERDA in continuing its path of improving the process and outcomes of the evaluation.

Recommendations

- Consider development of a theory and logic model for the evaluation. Program staff, as well as specialty and oversight evaluation contractors, identified the need for a clearly articulated evaluation plan. The literature review also points to the necessity of a clearly articulated vision for process and outcomes. As part of the March 2006 Amended SBC III Operating Plan, a vision was articulated, but a specific plan has not been developed, rather it is to be developed with the evaluation contractors. Development of a well-defined plan for process and outcomes will reduce uncertainty about evaluation expectations for all stakeholders and make transparent the balance between evaluation for program improvement and evaluation for stakeholder accountability in developing the goals and tasks. In this process, the following should be addressed:

    - Define the portfolio evaluation goals

    - Define the portfolio tasks and approach

    - Define tasks at the program and sector levels

- Once a theory and logic model has been developed for the evaluation, the resulting plan should be clearly communicated at all levels of the organization. General communication of an evaluation plan could greatly reduce the uncertainty and discomfort felt by all involved in the effort. Key elements of the plan to be communicated include:

    - Expectations of the Energy Analysis evaluation team, program staff, and contractors in the model

    - Expectations for how recommendations from the evaluation are to be used

- As part of the overall evaluation plan, a discussion of potential products resulting from the evaluation should occur. This process should involve program staff and other stakeholders in identifying all audiences for the evaluation findings, resulting in a plan for dissemination approaches to meet the range of audiences identified. Communication of evaluation results has so far focused largely on meeting stakeholder requirements and the products have successfully met these requirements. There are many other audiences for the evaluation results, including potential program participants, the general public, and other energy professionals.

- As part of a review of roles, NYSERDA should continue to examine the skills needed for their model of evaluation and ensure that Energy Analysis evaluation team members have the skills and direction to serve the roles defined for them. NYSERDA has continued to build evaluation knowledge and skills in the Energy Analysis evaluation team and program staff report that they are more often working with the team early in their program planning and solicitation processes. Some additional skills and knowledge are needed to ensure that capacity building continues within the Energy Analysis team and that the team members can then continue to help build capacity throughout the organization.

3

Commercial / Industrial Programs

3.1 Overview of Commercial/Industrial Programs

New York's commercial and industrial sectors account for nearly 50 percent of the State's primary energy use and have a significant impact on the State's economy, environment, and demand for electricity. NYSERDA's programs target commercial and industrial sectors, covering new and existing schools, hospitals, office buildings, government buildings, commercial establishments, not-for-profit facilities and industrial plants. The Energy Efficiency, Peak Load Management, and Outreach and Education programs promote competitive markets for energy efficiency services, engender widespread adoption of high-efficiency technologies, and result in increasing customer participation in peak demand response initiatives.

A number of the programs have been specifically designed for electric resource acquisition. Deployment programs offering technical assistance and financial incentives are also part of the program portfolio. NYSERDA helps the energy service companies (ESCOs) and curtailment service providers to incorporate real-time pricing opportunities into their business models. To help improve the reliability of the State's electric system, the programs include aggressive electric-system and peak-load reduction initiatives. These initiatives reduce the risk of energy supply disruptions and price volatility by implementing long-term energy efficiency improvements that have impact during system peaks and by improving load management capabilities of commercial and industrial facilities.

Market intervention and development strategies for commercial and industrial customers are designed to induce lasting structural and behavioral changes in the marketplace that result in increasing adoption of energy-efficient technologies and practices. Long-lasting, sustainable changes are achieved by reducing barriers to adoption of energy efficiency measures to the point where further public-funded interventions are no longer appropriate. Market development initiatives, including financial incentives for increasingly efficient products, increase the availability, promotion, retail stocking practices, and sales of energy-efficient products and services in end-use markets and sectors by changing the behavior of upstream market participants, including retailers, dealers, vendors, distributors, contractors, installers, trade associations, and manufacturers.

Specific program offerings are briefly described below:

Peak Load Management Program. The Peak Load Management Program (PLMP) works to improve New York's energy system reliability and security by reducing energy demand. Formerly known as the Peak Load Reduction Program (PLRP), in 2006 the program was renamed to reflect an increasing focus on enhanced building automation and dynamic retail pricing strategies. PLMP encourages measures for

demand management by offering financial incentives to allow participation in dynamic retail pricing, commodity purchase, and managing financial risk. The program provides incentives for equipment and technical solutions that enable significant demand reduction (MW) resources and requires participation in New York Independent System Operator demand response programs. In addition the incentives for load curtailment and shifting (LC/S), distributed generation (DG), and interval meters (IM), are also given for permanent demand reductions that are coincident with the electric system peak.

Enhanced Commercial/Industrial Performance Program. The Enhanced Commercial and Industrial Performance Program (ECIPP) serves commercial and industrial businesses, healthcare facilities, and State and local governments. It provides information and incentives to improve existing building loads, non-building loads, and process equipment. Building off the successful Commercial and Industrial Performance Program (CIPP) and Smart Equipment Choices (SEC), ECIPP is a consolidation of the two programs that simplifies customer access to incentives by having a single point of entry into NYSERDA and by providing to customers a streamlined and simplified process to the marketplace. ECIPP has three tiers of incentives, and adds a custom project incentive path serving industrial process opportunities, system approaches, and unique applications. Allowing customers, ESCOs, and contractors access to multiple incentive strategies to support their energy projects will enable the New York ESCO community to continue to grow the market for energy efficiency in existing buildings, process equipment and non-building leads.

New York Energy $mart^{SM} Business Partners. The **New York Energy $mart^{SM}** Business Partners Program is a consolidation of the Small Commercial Lighting Program (SCLP), Premium Efficiency Motors (PEM) Program, the Commercial HVAC Program, and the Innovative Opportunities Program. This new program focuses on market development. **New York Energy $mart^{SM}** business partners are allies that agree to work with NYSERDA to promote energy-efficient products and services. In exchange, business partners gain access to special training, tools, guidelines, and performance incentives. NYSERDA works with its business partners to help them differentiate their business in a highly competitive marketplace, while assuring that appropriate quality control mechanisms are in place. The strategy of partnering with businesses helps to strengthen the market infrastructure leading to increased energy-efficient product and service availability and demand. Thus, business partner efforts will also help to increase activity in NYSERDA's customer-targeted programs.

New York Energy $mart^{SM} Loan Fund and Financing Program. The **New York Energy $mart^{SM}** Loan Fund and Financing Program expands the availability of low-interest capital to help implement energy-efficiency projects and process improvements. Lenders enroll in the program by signing participation agreements and agreeing to reduce the interest rates on energy-related loans in exchange for a lump sum subsidy paid by NYSERDA. The Program's ongoing training of the financial sector includes tools to allow lenders to calculate the cash flow advantages their customers will gain from making energy-efficiency improvements. While the Loan Fund has met the needs of customers who do not avail themselves of other NYSERDA programs, the reduced-interest financing will also continue to be available to program participants.

Energy Smart Focus Program. Energy Smart Focus provides services to facilitate and encourage sector-specific energy efficiency improvements and practices. The program is a marketing and information transfer effort that will use existing core **New York Energy $mart^{SM}** programs and services to sponsor deployment, demonstration, research, and development projects in conjunction with sector customized strategies. Such strategies include benchmarking, targeted marketing materials and messages, training, partnerships with trade associations, and integration with regional and national efforts.

High Performance New Buildings Program. The High Performance New Buildings Program (formerly operating as the New Construction Program) was established to encourage energy-efficient design and

building practices among architects and engineers and to urge them to inform building owners about the long-term advantages of building to higher energy efficiency standards. The program aims to create long-term changes in design practices by integrating energy efficiency and green building concepts into new building designs. The program offers a performance-based approach in which incentives are determined by total electricity savings and are tiered to reward progressively better designs. Through design team incentives and recognition, the program promotes green building projects and projects planned for Leadership in Energy and Environmental Design (LEED) certification.

FlexTech Technical Assistance Program. The FlexTech Technical Assistance Program is a consolidation of services previously offered under the FlexTech, Technical Assistance, and the Energy Audit Programs. The Program provides customers with objective and customized information to facilitate wiser energy efficiency, energy procurement, and financing decisions. The Program is available to all commercial and industrial customers. Cost-shared technical assistance is provided for detailed energy efficiency studies from energy engineers and experts. Small customers are eligible for quick walk-through energy audits, with the cost share reimbursed upon implementation of recommendations. Participants may use NYSERDA-contracted or customer-selected consultants.

3.2 Commercial/Industrial Evaluation Activities

The Commercial/Industrial (C/I) program evaluation activities conducted in the past year are shown in Table 3-1. The table includes only new evaluation activities conducted in 2006. However, findings from earlier evaluations are also discussed in Section 3 to the extent that they contribute to the cumulative assessment of these programs.

Table 3-1. 2006 C/I Program Evaluation Activities

Program Name	Predecessor Program (if applicable)	Theory & Logic	Measurement and Verification (M&V)	Market Characterization, Assessment and Causality (MCAC)	Process Evaluation
Peak Load Management	Peak Load Reduction Program (PLRP) Enabling Technology	-	Database review	-	-
Enhanced Commercial and Industrial Performance Program	C/I Performance Program (CIPP) Smart Equipment Choices (SEC)	-	Database review	Update	-
New York Energy $martSM Business Partners Program	Premium-Efficiency Motors Commercial HVAC Small Commercial Lighting (SCLP) Innovative Opportunities	-	Database review for SCLP Motor management implementation rate	-	-
New York Energy $martSM Loan Fund and Financing	**New York Energy $mart**SM Loan Fund	-	-	-	-

Program Name	Predecessor Program (if applicable)	Theory & Logic	Measurement and Verification (M&V)	Market Characterization, Assessment and Causality (MCAC)	Process Evaluation
New York Energy $mart[SM] Focus	Energy Smart Schools Program	-	-	-	-
High Performance New Buildings	New Construction Program	Full	Database review	Update	Update
Flex Tech Technical Assistance	Technical Assistance, FlexTech, & Energy Audit Programs	Full	Update	Update	-

3.3 Key Commercial/Industrial Evaluation Findings

Significant progress is being made as the C/I portfolio transitions to the new, streamlined set of programs. This section summarizes key evaluation findings from the latest set of evaluation activities, and from the cumulative body of work conducted by NYSERDA and its evaluation contractors over the past several years.

3.3.1 Energy, Peak Demand and Fuel Savings

NYSERDA's Measurement and Verification (M&V) contractor assessed the energy and peak demand savings reported for the C/I programs. Methods used in this assessment included on-site verification of equipment installation and functionality, and review of NYSERDA's files for reasonableness and accuracy of recorded energy and demand savings. Based on this review, the M&V contractor adjusted the savings reported by NYSERDA. In turn, the MCAC contractor further adjusted these figures to account for freeridership and spillover. Tables 3-2 through 3-4 summarize the estimated electricity savings, peak demand reduction and other fuel savings for each of the C/I sector programs. Note that individual program savings are not adjusted for program overlaps. To avoid double counting in the total, sector-level savings estimate, the amount of overlap among the individual program savings estimates is subtracted at the bottom of the table.

As reported earlier in Section 2, overall, NYSERDA's M&V and MCAC contractor teams have found that savings for the C/I sector should be adjusted as follows:

- Electricity savings were adjusted downward by 4%.
- Peak demand savings were adjusted downward by 5%.
- Other fuel savings were adjusted upward by 14%.

These adjustments include changes in program reported savings due to database reviews and field work to measure and verify savings, as well as survey research and other activities to quantify freeridership and spillover. For most of the largest energy-saving programs (including ECIPP, High Performance New Buildings, and FlexTech Technical Assistance) spillover outweighs any freeridership that is occurring.

Several near-term goals were set for the first year of the third **New York Energy $mart**SM Program funding cycle. These goals established levels to reach, by June 30, 2007, for energy and peak demand savings as well as several other key metrics of program success. Overall, the C/I portfolio is performing well in terms of the energy savings and peak demand reduction goals. In the first six months of the one-year measurement period, the C/I portfolio has exceeded its goal for energy savings (123%) and reached the half-way point (47%) for the peak demand reduction goal. Table 3-2 shows progress for each applicable program toward the one-year goal for electricity savings. Table 3-3 shows progress for each program toward the one-year goal for peak demand reductions. There was no goal for other fuel savings.

Table 3-2. C/I Program Electricity Savings through December 31, 2006 and Progress toward One-Year Goal

Program	Energy Savings (GWh)			
	Savings Achieved through		One-Year Goal through June 30, 2007	Progress Toward One-Year Goal (% achieved)
	June 30, 2006	Dec. 31, 2006		
Peak Load Management: Permanent (ConEdison)	96.5 (74.9)	118.0 (77.9)	19.0 (9.0)	113% (33%)
Enhanced Commercial and Industrial Performance Program (ConEdison)	730.6 (224.1)	836.3 (241.7)	24.0 (n/a)	440% (n/a)
Business Partners Program (ConEdison)	54.1 (4.3)	60.7a (6.1)a	10.0 (n/a)	65% (n/a)
Loan Fund and Financing (ConEdison)	49.6 (0.5)	51.3 (9.8)	n/a (n/a)	n/a (n/a)
Focus Program (ConEdison)	0 (0)	0 (0)	5.0 (n/a)	0% (n/a)
High Performance New Buildings (ConEdison)	223.2 (48.2)	250.3 (54.1)	35 (n/a)	78% (n/a)
Flex Tech Technical Assistance (ConEdison)	644.1 (115.2)	697.6 (124.8)	70 (n/a)	76% (n/a)
Overlap Removed	**126.7**	**141.9**	**n/a**	**n/a**
ConEdison C/I Total	**467.3**	**514.4**	**n/a**	**n/a**
Statewide C/I Total	**1,671.5**	**1,872.2**	**163.0**	**123%**

Note: n/a means not applicable (*i.e.*, a goal has not been set for this program).

a Savings for the Commercial HVAC portion of the program have been reduced as of 4th Quarter 2006. This approach was taken due to the known short-term nature of savings from advanced diagnostics and commissioning, which were part of the program.

Table 3-3. C/I Program Peak Demand Savings through December 31, 2006 and Progress toward One-Year Goal

Program	Peak Demand Reductions (MW)			
	Savings Achieved through		One-Year Goal through June 30, 2007	Progress Toward One-Year Goal (% achieved)
	June 30, 2006	Dec. 31, 2006		
Peak Load Management: Callable (ConEdison)	461 (203.3)	470.5 (217.6)	53 (28)	18% (51%)
Peak Load Management: Permanent (ConEdison)	44.7 (31.1)	54.5 (38.3)	13 (8.0)	75% (90%)
Enhanced Commercial and Industrial Performance Program (ConEdison)	132.5 (54.7)	142.0 (58.8)	12.0 (n/a)	79% (n/a)
Business Partners Program (ConEdison)	11.8 (1.0)	13.3 (1.2)	2.5 (n/a)	59% (n/a)
Loan Fund and Financing (ConEdison)	14.3 (0.5)	15.0 (1.5)	n/a (n/a)	n/a (n/a)
Focus Program (ConEdison)	0 (0)	0 (0)	1.0 (n/a)	0% (n/a)
High Performance New Buildings (ConEdison)	45.5 (15.9)	53.5 (18.8)	4.0 (n/a)	201% (n/a)
Flex Tech Technical Assistance (ConEdison)	120.9 (30.6)	130.0 (20.5)	14.0 (n/a)	65% (n/a)
Flex Tech Technical Assistance: Callable	10.2	10.2	n/a	n/a
Overlap Removed	**24.5**	**26.1**	**n/a**	**n/a**
ConEdison C/I Total	**337.1**	**356.6**	**n/a**	**n/a**
Statewide C/I Total	**816.5**	**862.9**	**99.5**	**51%**

Note: n/a means not applicable (*i.e.*, a goal has not been set for this program).

Table 3-4. C/I Program Fuel Savings through December 31, 2006

Program	Fuel Savings (MMBtu)	
	Savings Achieved through	
	June 30, 2006	Dec. 31, 2006
Enhanced Commercial and Industrial Performance Program (ConEdison)	3,252 (495)	4,615 (703)
Loan Fund and Financing (ConEdison)	137,239 (4,941)	139,621 (7,966)
Flex Tech Technical Assistance[1] (ConEdison)	3,164,000 (800,846)	2,864,903 (725,141)
ConEdison C/I Total	**806,282**	**733,810**
Statewide C/I Total	**3,304,491**	**3,009,140**

Note: There were no one-year goals for fuel savings.

[1] The methodology to assess impacts focuses on developing samples based on electricity savings, rather than fuel, resulting in a less than optimal sample for fuel-savings projects and fluctuation over time in the impacts.

3.3.2 Summary of Other Key Program Impacts

Across the programs, twelve additional logic model-driven near-term goals were set for other key metrics besides energy savings such as the number of customers receiving assistance, funds leveraged, allies participating, and percentage of target markets affected by programs. Overall, the programs are also performing well with respect to these other goals. In fact, two of the goals have already been exceeded. The results of each program's progress toward its stated goals are shown in table format in the subsequent sections.

Other key findings from studies of participants, non-participants and other market actors include the following:

- Participant surveys found that NYSERDA programs are being cited more often as an important factor in the decision to install energy efficiency measures and equipment in C/I facilities. Respondents are citing NYSERDA unaided, making these findings especially significant.
- End-use customers continue to gain more experience, education, and trust in energy efficiency measures, equipment, and services. Historically, these were lacking among end-use customers and were often cited as reasons for not taking action on energy-efficient purchases or services.
- Even customers who have not participated directly in NYSERDA program offerings have shown increasing levels of familiarity with energy-efficient measures and equipment.
- Surveys indicate high levels of awareness of **New York Energy $mart**[SM] C/I Programs, with 88% of end-use customers and 81% of contractors reporting awareness of at least one program offering.
- Respondents were more familiar with NYSERDA programs in general, and were less aware of specific program offerings. This indicates that NYSERDA is achieving a greater degree of brand recognition than are the numerous individual program names.

- Survey results indicate that NYSERDA is becoming a trusted source for information and support in the adoption of energy-efficient practices. Respondents report that NYSERDA brings credibility to the various services offered through its programs and contractors. This year's evaluations of the Technical Assistance and Commercial/Industrial Performance Programs reaffirmed NYSERDA's trust and credibility in the market.

- Survey results for key C/I programs indicate that end use customers and contractors credit the programs with having an impact on decision making regarding incorporation of high-efficiency measures.

- C/I customers who participated in **New York Energy $mart**[SM] programs expressed high satisfaction levels of 80%-90% with project results. This suggests that they are likely to continue working with NYSERDA in the marketplace to improve efficiency.

- Process evaluation surveys and interviews indicate that the New Construction Program (NCP) compares favorably to other new construction programs on most process elements examined. Findings also suggest the NCP could increase savings "per building" and encourage market transformation by placing even greater emphasis on personal outreach to the design community and upon its whole building and LEED® certification components.

3.4 Peak Load Management Program

3.4.1 Program Description

The main goal of the Peak Load Management Program (PLMP) is to improve New York's energy system reliability and security by reducing energy demand. Formerly known as the Peak Load Reduction Program (PLRP), in 2006 the program was renamed to reflect the program's increasing focus on enhanced building automation and dynamic retail pricing strategies.

PLMP encourages measures for demand management by offering financial incentives to allow participation in dynamic retail pricing, commodity purchase, and managing financial risk. The program provides incentives for equipment and technical solutions that enable significant demand reduction (MW) resources and requires participation in NYISO demand response programs. In addition the incentives for load curtailment and shifting (LC/S) and distributed generation for Demand Response (DR), and interval meter (IM), incentives are also given for permanent demand reductions that are coincident with the system peak.

PLMP targets commercial, industrial, and institutional customers and mission critical facilities such as data centers, communications facilities, government locations, and academic research facilities that are interested in participating in reliability and dynamic pricing. The program is offered statewide, with marketing emphasis in areas of demonstrated need, *e.g.,* where electricity demand is growing and where local power needs are nearing capacity.

The 13-year program budget is $82.7 million.

3.4.2 Recent Program Accomplishments

Two near-term, annual goals have been set for the PLMP. These goals and progress for the first six months are shown in Table 3-5.

Table 3-5. Peak Load Management Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Customers receiving assistance	145	47
Demand reductions (MW)	66	8.5

In November 8-9, 2006, NYSERDA sponsored the Peak Load Management Association's Fall 2006 conference focusing on demand response technologies, services, and practices. Conference attendees included representatives of international and regional Independent System Operators, New York utilities, demand response providers, and large energy users.

3.4.3 Long-Term Program Accomplishments

This section highlights key indicators of market progress. All values reported are cumulative since program inception. Table 3-6 presents a sample of key logic model-driven indicators of program success, as tracked by the evaluation and program activities. An earlier study assessed market indicators for other elements of the Peak Load Reduction Program (including Load Curtailment/Shifting, Dispatchable Emergency Generation Initiative, and Permanent Demand Reduction Efforts). These earlier findings were presented in the May 2004 ***New York Energy $mart***^{SM} *Program Evaluation and Status Report* (Volume 2).

Table 3-6. PLMP – Key Market Indicators and Program Cumulative Progress

Topic	Indicator	Value (2004)
Awareness and Knowledge	Change in awareness of demand response, the NYSERDA and NYISO programs, and related benefits	IM providers felt 88% of participating customers were slightly or somewhat familiar with IM and IM services 77% of IM providers felt their familiarity with IM and IM services had increased in the past five years
	Change in knowledge of the benefits of demand response for NYSERDA and NYISO programs	67% of IM providers felt customer awareness of the capabilities and benefits of IM and IM services had increased significantly or somewhat over the past five years
Availability of Services	Increase in services and availability	IM providers and PLRP staff felt there was a modest increase in IM and IM services
Change in Practices	Change in behavior	29% of IM participants made equipment changes, and 43% made operating changes after the installation of the IM equipment
	Change in participation in NYSERDA and NYISO programs	50% of IM participants said they were participating in the NYISO demand response program The IM program increased (from 14% to 50%) participation in NYISO demand response programs for IM program participants

3.4.4 Program Impact Evaluation

This section presents cumulative annual energy savings for the program from inception through December 31, 2006.

Gross Savings

The objective of the M&V evaluation review is to verify the estimate of the program's cumulative savings. Based on Nexant's review, as of December 31, 2006, the program has resulted in the energy savings and demand reductions shown in Table 3-7.

Net Savings

The final step to determining net energy savings is attribution analysis. Attribution analysis determines, through various methods, whether the gross savings estimate from the M&V activities should be adjusted downward or upward for freeridership or spillover. Adjustments for freeridership and spillover, and the ultimate program net-to-gross ratio and net savings are shown in Table 3-7.

Table 3-7. PLMP Cumulative Annual Energy and Peak Demand Savings (through December 2006)

	Program Reported Savings	M&V Realiza-tion rate	Adjusted Gross Savings	Freerider-ship	Spillover	Net-to-Gross Ratio[1]	Net Savings
LC/S & DEGI (Demand Response Measures) MW	242.4	1.02	247.2	24%	25%	0.95	234.9
PDRE (MW)	43.7	1.02	44.5	25%	37%	1.03	45.9
Cooling Recom-missoning (MW)	8.6	1.0	8.6	0%	0%	1.0	8.6
IM (MW)	245.7	0.88	216.2	10%	22%	1.09	235.7
Total MW	**540.3**	**-**	**516.5**	**-**	**-**	**-**	**525**
PDRE (MWh)	88,784	1.02	90,560	25%	37%	1.03	93,276
Cooling Recom-missoning (MWh)	24,700	1.0	24,700	0%	0%	1.0	24,700
Total MWh	**113,484**	**-**	**115,260**	**-**	**-**	**-**	**117,977**

[1] Net-to-Gross Ratio = (1-Freeridership) * (1+Spillover).

3.5 Enhanced Commercial and Industrial Performance Program

3.5.1 Program Description

The ECIPP serves commercial and industrial businesses, healthcare facilities, and state and local governments. It provides information and incentives to improve existing building loads, non-building loads, and process equipment. Building off the successful CIPP and SEC Program, ECIPP is a consolidation of the two programs that simplifies customer access to incentives by having a single point of entry into NYSERDA and by providing to customers a streamlined and simplified process to the marketplace.

When separate programs, CIPP and SEC focused on different customers. CIPP provided incentives to ESCOs and other contractors to promote energy efficiency-related capital improvement projects. NYSERDA provides financial incentives on a performance-basis through the ESCO's measurement and

verification activities. A main objective of the CIPP program was to help build a robust ESCO and energy efficiency service industry in New York. Overall ESCO activity in New York has increased during the past eight years. Recent evaluation studies report increased ESCO activity and improved quality of work and a significant increase in the familiarity of energy efficient products. The SEC program provided financial incentive awards to defray part of the incremental capital cost to purchase and install energy-efficient equipment. The goal of SEC was to produce permanent improvement in standard equipment specifications and drive cost-effective demand reduction by encouraging the purchase and installation of energy-efficient equipment, particularly for small renovation and equipment-replacement projects. Both CIPP and SEC achieved success in New York.

ECIPP has three tiers of incentives and adds a custom project incentive path serving industrial process opportunities, system approaches, and unique applications. It improves the performance-based incentive structure used in CIPP by adding increased incentives to better support permanent peak-demand-reduction measures. To help alleviate the growing electric load downstate, the ECIPP has an increased presence in New York City. Allowing customers, ESCOs, and contractors multiple incentive strategies to support their energy projects will enable the New York ESCO community to continue to grow that market. Customers have the option of using ESCOs or applying directly and receiving incentives from NYSERDA.

By providing a structured approach to the existing buildings market, NYSERDA can provide customers sustainable performance improvement strategies. With the single-entry point to ECIPP, NYSERDA can strengthen links to other **New York Energy $mart** efforts, such as Technical Assistance, Loan Fund and Financing, and Energy Smart Business Partners.

The thirteen-year program budget is $246.6 million.

3.5.2 Recent Program Accomplishments

Near-term, annual goals have been set for the ECIPP Program. These goals and progress for the first six months are shown in Table 3-8.

Table 3-8. Enhanced Commercial and Industrial Performance Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Leveraged Funds ($ million)	$80	$75.0 million for CIPP
Customer projects	680	353

3.5.3 Long-Term Program Accomplishments

This section highlights key program outputs and market progress. All values reported are cumulative since program inception. Table 3-9 presents the key outputs for ECIPP through December 31, 2006. Table 3-10 presents a sample of key logic model-driven indicators of program success, especially those related to market progress, as tracked by the evaluation and program activities. Together, these tables indicate the most important ways that program progress is being measured, and report how those values are changing due to program activities.

Table 3-9. Enhanced Commercial and Industrial Performance Program – Key Program Outputs

Output	Value (Cumulative through December 2006)
CIPP	
Number of CIPP applications received and approved	1,200
Number of projects completed	980 installed and 810 with completed M&V
Dollar value of incentives paid and total project cost	$83 million for incentives and $683 million in total project cost
SEC	
Number of SEC projects completed	3,244
Dollar value of incentives for completed projects	$8.6 million
Average project incentive	$2,640

Table 3-10. Enhanced Commercial and Industrial Performance Program – Key Market Indicators and Program Cumulative Progress

Topic	Indicator	Initial Value (year)
Awareness and Knowledge	Customer familiarity with energy-efficient measures and equipment	97% of participants (n=31) were extremely or somewhat familiar with energy-efficient measures and equipment compared to 68% of non-participants (n=120) (2004) 37% of participants (n=31) said their familiarity increased significantly during the past five years compared to 22% of non-participants (n=120) (2004)
	Customer becomes aware of CIPP	31% of participating end-use customers learned about CIPP through an ESCO or electrical contractor, followed by equipment vendors (9%) and program marketing materials (7%) (2006)
	Contractor (ESCO) familiarity with energy-efficient measures and equipment	80% of participants (n=46) were extremely familiar with energy efficiency measures, equipment, and services, compared to only 11% of non-participants (n=51) (2004) 46% of participants (n=46) believe their familiarity increased significantly in the past five years, compared to only 21% of non-participants (n=51) (2004)
Availability of Services	Customer and contractor perception of availability	55% of customers and 41% of ESCOs participating in CIPP said availability of energy efficiency measures is becoming less of a barrier (2004)
	Level and quality of ESCO activity in New York	Nearly half of the participating and non-participating contractors reporting higher ESCO activity and improved quality of work by ESCOs (2004)
Change in practices	Increased marketing and promotion of energy efficiency measures	More than 60% of participating ESCOs (n=46) were significantly or somewhat increasing their marketing of energy-efficient measures, compared to only 38% of the non-participant Contractor group (n=51) (2004)
Perceived Value to the Customer	Role of energy efficiency in decision making	74% of SEC participants said the role of energy efficiency in the selection of equipment has increased over the past five years compared to 65% of non-participants (2004)
	Satisfaction with energy efficiency measures	Nearly all SEC participants were either extremely (65%) or somewhat (31%) satisfied with the measures installed through the program (2004)
Decision-Making	Criteria for deciding to undertake a project	90% of respondents indicated that payback was considered as part of the decision-making process and as a “make or break” criterion (2006)
Market Penetration	CIPP market penetration in terms of total project cost	1999 – 2000 = ~1% 2001 - 2004 = ~2%

3.5.4 Program Impact Evaluation

This section presents cumulative annual energy savings for the program from inception through December 31, 2006. Savings estimates and adjustments are shown in Table 3-11.

Gross Savings

The objective of the M&V evaluation review is to verify the estimate of the program's cumulative savings. Based on Nexant's review, as of December 31, 2006, the program has resulted in the energy savings and demand reductions shown in Table 3-11.

Net Savings

The final step to determining net energy savings is attribution analysis. Attribution analysis determines, through various methods, whether the gross savings estimate from the M&V activities should be adjusted downward or upward for free ridership or spillover. Adjustments for free ridership and spillover, and the ultimate program net-to-gross ratio and net savings are shown in Table 3-11.

Table 3-11. ECIPP Cumulative Annual Energy and Peak Demand Savings (Through December 2006)

	Program Reported Savings	Realiza-tion Rate	Adjusted Gross Savings	Freerider-ship	Spillover	Net-to-Gross Ratio	Net Savings
Commercial/Industrial Performance Program							
MWh/year	724,649	1.01	731,900	31%	44%	1.04a	757,427
MW	157.2	0.77	121.0	31%	44%	1.04a	125.3
Smart Equipment Choices							
MWh/year	121,288	0.94	112,640	51%	45%	0.7b	78,848
MW On-Peak	25.5	0.93	23.9	51%	45%	0.7b	16.7
MMBtu/year	6,593	1.0	6,593	51%	45%	0.7b	4,615
Enhanced Commercial/Industrial Performance Program (ECIPP) - Total							
MWh/year	845,937	N/A	844,540	N/A	N/A	N/A	836,275
MW On-Peak	182.8	N/A	144.9	N/A	N/A	N/A	142.0
MMBtu/year	6,593	N/A	6,593	N/A	N/A	N/A	4,615

a Net-to-Gross Ratio = 1-Freeridership+Spillover (a weighted average of the NTG ratios estimated in the previous MCAC analysis and this current analysis is shown here).

b Net-to-Gross Ratio = (1-Freeridership) * (1+Spillover).

Non-Energy Impacts

The Summit Blue MCAC team evaluated non-energy impacts for both the CIPP and SEC programs. Key results are presented in Table 3-12. Non-energy impacts (NEIs) are expressed as a percentage of energy savings.

Table 3-12. ECIPP NEI Results

Results from Direct Query Approach (year of study)	Percentage of Energy Savings
Commercial/Industrial Performance Program (2005)	46%
Smart Equipment Choices Program (2004)	42-45%

3.6 New York Energy $mart^{SM} Business Partners

3.6.1 Program Description

The **New York Energy $mart^{SM}** Business Partners Program is a consolidation of four prior programs. These programs are described below.

- Small Commercial Lighting Program: Promoting effective, energy-efficient lighting - "The Right Light" - in commercial and industrial spaces up to 25,000 square feet by partnering with lighting practitioners. The program has provided training, field support, project incentives and demonstration awards to participating lighting practitioner allies, including contractors, distributors, manufacturer representatives, lighting designers, architects and engineers.

- Premium Efficiency Motors Program: Working with suppliers and providers of motors and motor repair services to promote sales of NEMA Premium® motors, quality motor repairs, and motor management services. Motor management includes motor assessments, planning for future repair and replacement, and consideration of drives. The Program has worked with vendors to present the case for a motor management program to their customers, to conduct motor assessments, and to facilitate implementation of motor management plans and policies whenever possible.

- Commercial HVAC Program: Program activities have focused in two areas. First, NYSERDA has provided training, workshops, outreach events, information and support to HVAC contractors, distributors and commercial building owners to increase the market share of energy-efficient unitary HVAC units and to work with market participants to become more successful in selling related energy-efficient products and maintenance services. Second, NYSERDA offered study incentives, conducted outreach meetings and provided technical training for service providers with a particular focus on the downstate metropolitan region surrounding New York City to increase demand for retro-commissioning (RCx) services in existing commercial buildings.

- Innovative Opportunities Program: Competitively selected projects on emerging and under-used technologies to increase market adoption and penetration. Past projects have focused on technologies such as light-emitting-diode-powered (LED) traffic signals, efficient commercial refrigeration equipment, ENERGY STAR® transformers, and computer power management.

New York Energy $mart^{SM} business partners are allies who agree to work with NYSERDA to promote energy-efficient products and services. In exchange, business partners gain access to special training, tools, guidelines, and performance incentives. NYSERDA works with its business partners to help them differentiate their business in a highly competitive marketplace, while assuring that appropriate quality control mechanisms are in place. This involves creating a brand identity that conveys the theme that mid-market businesses are vital to the growth of the energy efficiency industry and important to the economy of the State.

The Business Partners Program activities, such as training, tools and field support, help improve the awareness of and familiarity with targeted technologies and services. The strategy of partnering with businesses helps to strengthen the market infrastructure leading to increased product and service availability and demand. Additionally, business partner efforts will also help to increase activity in NYSERDA's customer-targeted programs.

The thirteen-year program budget is $41.3 million.

3.6.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the **New York Energy $mart^{SM}** Business Partners Program. These goals and progress for the first six months are shown in Table 3-13. The former SCLP, PEM and Commercial HVAC programs have all built strong ally networks and encouraged mid-market actors to use customer incentives and other sales tools to maximize customer participation and project implementation.

Table 3-13. New York Energy $mart^{SM} Business Partners Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Business Partners (signed up)	300	737
Demand Reductions (MW)	2.5	1.9
Energy Savings (GWh)	10	8.3

NYSERDA is in the process of developing solicitations to hire contractors to implement the various program elements. Other program highlights from the last six months include:

- NYSERDA's motor management activities have generated interest across the country. Program administrators at one California utility recently requested information on NYSERDA's program approach with the intent of possibly using NYSERDA's model for developing a new program.
- The Small Commercial Lighting Program launched its The Right Light^{TM} marketing campaign to end users in Syracuse, the Capital District, and Westchester County.
- Under the power management program efforts, NYSERDA has worked with the New York Power Authority and the Vermont Energy Investment Corporation (VEIC) (contractor for LIPA) to assist them in launching Computer Power Management programs. This program is now a statewide effort.
- A major milestone was recently reached for the 80 PLUS power supply activities when HP—the world's largest PC vendor—announced that it plans to offer customers an 80 PLUS certified power supply option on its 7000 and 5000 Series of business PCs as early as January 2007. When the Program first launched in the fall of 2004, it had only one sponsor, one certified power supply and little interest from the major computer manufacturers in participating. Today, there are 87 power supplies from 22 manufacturers certified 80 PLUS. In addition to HP, there are 14 other participating computer manufacturers currently offering qualified computer models to customers. This is a direct result of the commitment by New York and other regions to support purchasing of 80 PLUS compliant products.

- Between July and December 2006, NYSERDA's Business Partners program implementation contractor conducted group information sessions on the **New York Energy $mart** Offices Project at four sites around the State that included 18 state universities, community colleges, and private colleges. From those group sessions, 11 colleges signed up to participate in the on-site data collection and analysis. In addition, three other colleges are participating in the 2006 program for a total of 14.

- Based on the success of the Capital District Commercial Kitchens pilot, the program was extended to the New York metropolitan market in early November 2006.

- In total 20 retro-commissioning projects were completed representing 10.5 million square feet, resulting in six projects submitted directly to the Technical Assistance Program, and an additional six projects funded under the Building Performance Program for full scale retro-commissioning investigation and implementation.

3.6.3 Long-Term Program Accomplishments

This section highlights key program outputs and market progress. All values reported are cumulative since program inception. Table 3-14 presents the key outputs for the program through December 31, 2006. Table 3-15 presents a sample of key logic model-driven indicators of program success, especially those related to market progress, as tracked by the evaluation and program activities. Together, these tables indicate the most important ways that program progress is being measured, and report how those values are changing due to program activities.

Table 3-14. New York Energy $mart^{SM} Business Partners Program – Key Program Outputs

Outputs	Value (Cumulative through December 2006)
Small Commercial Lighting	
Number of participating allies	711
Dollar value of incentives awarded	$454,525
Number of completed projects	695
Square footage of projects completed	5,354,746
Total persons trained on effective, energy-efficient lighting	1,496
Number of individuals at SCLP ally companies that have taken the National Council on Qualifications for Lighting Professions (NCQLP) certification exam	11
Premium-Efficiency Motors	
Number of motors incented under the former Premium-Efficiency Motor vendor incentive program	11,004
Number of participating vendors (vendors who have participated in at least one customer ride along visit)	26
Number of vendor motor management training sessions held and number of people attending training sessions	7 sessions with 26 attendees
Number of completed customer motor inventories using MotorMaster and number of motors inventoried	65 completed inventories representing 6,749 motors
Number of written motor management plans developed by customers	1
Commercial HVAC	
Number of participating vendors	26
Number of commissioning and retrocommissioning providers trained	289 Commissioning and 134 Retrocommissioning
Number of HVAC contractors and distributors trained	292 (93 DCV, 89 Advanced Diagnostics, 110 Spec and Sell)
Number of unitary HVAC RTUs tested with advanced diagnostics	1,240

Table 3-15. New York Energy $mart^{SM} Business Partners Program – Key Market Indicators and Program Cumulative Progress

Topic	Indicator	Value (2004 unless noted)
Small Commercial Lighting		
Awareness and Knowledge	Allies are aware of the benefits of effective-energy-efficient lighting	95% indicated that they were either "extremely familiar" or "somewhat familiar" with effective, energy-efficient lighting applications 74% of allies said their familiarity had either "increased significantly" or "increased somewhat" over the past two years Active allies were more likely than inactive allies to say familiarity increased (79% for active vs. 64% for inactive)
	Customer awareness of the benefits of effective-energy-efficient lighting	55% of allies reported that small commercial customers were either "extremely aware" or "somewhat aware" of the benefits 54% of allies indicated that small commercial customers' awareness of the benefits of effective, energy-efficient lighting applications had increased over the past two years, 42% indicated that customer awareness stayed the same
Market Share and Sales	Promotion by market actors of effective, energy-efficient lighting	55% of inactive trade ally survey respondents and 69% of the active allies indicated that their promotion had "increased significantly" or "increased somewhat" over the past two years
Premium-Efficiency Motors		
Awareness and Knowledge	Awareness of the NEMA Premium efficiency standard	57% of active participating vendors and 43% of inactive vendors were very familiar
	Increase in end-use customer familiarity with NEMA Premium efficiency standard	In 2004, 42% were extremely familiar or familiar (the percentage who were "extremely familiar" increased by 22 percentage points (to 27.8%) over the past two years) In 2005, 60% were extremely familiar
Availability of Services	Number of vendors actively promoting NEMA Premium motors	Nearly 66% of active participating vendors' sales staff informs customers of NEMA motors most or all of the time, while only 23% of inactive participating vendors do
	Stocking of NEMA Premium motors by participating vendors	40% of participating vendors said stock increased since joining the program
Market Share and Sales	Estimated sales of integral motors and NEMA Premium motors, and market share of NEMA Premium motors in New York	~67,700 total motors sold ~14,825 NEMA Premium motors sold ~22% market share NEMA Premium
Incremental Cost	Average price difference (per HP) between EPACT and NEMA motors	$12.91 (2004) $18.05 (2005)

Topic	Indicator	Value (2004 unless noted)
Commercial HVAC		
Awareness and Knowledge	Customer awareness of various HVAC applications (Contractor's view) *Percentage of respondents giving a 4 or 5 on a 5-point scale (5=extremely aware)*	Advanced Diagnostics = 0% Demand Control Ventilation =0% Dual-Enthalpy Economizers = 13% ENERGY STAR HVAC Equipment =16% Commissioning = 13% Retrocommissioning = 9%
	Change in customer awareness of various HVAC applications (Contractor's view) *Percentage of respondents giving a 4 or 5 on a 5-point scale (5=increased significantly)*	Advanced Diagnostics = 20% Demand Control Ventilation =41% Dual-Enthalpy Economizers = 9% ENERGY STAR HVAC Equipment =58% Commissioning = 57% Retrocommissioning = 74%
	Service provider familiarity with various HVAC applications *Across all types of providers, mean on a 1-to-5 scale (where 1=no/low awareness and 5=high awareness)*	Advanced Diagnostics = 3.77 Demand Control Ventilation = 4.01 Dual-Enthalpy Economizers = 3.89 ENERGY STAR HVAC Equipment = 4.18 Commissioning/Retrocommissioning = 3.17
	Change in service provider awareness of various HVAC applications *Across all types of providers, mean on a 1-to-5 scale (where 1=no change in the past two years and 5=significant change)*	Advanced Diagnostics = 3.62 Demand Control Ventilation = 3.77 Dual-Enthalpy Economizers = 3.37 ENERGY STAR HVAC Equipment = 3.86 Commissioning/Retrocommissioning = 3.53
Availability of Services	Increased market interest in HVAC services/applications	81% of program allies surveyed indicated that the market for their HVAC application had increased over the past two years
Market Share and Sales	Prevalence of commissioning in newly constructed facilities	Respondents indicate that 29% of newly constructed facilities are commissioned each year. This equates to approximately 21.3 million square feet commissioned per year.
	Percentage of commissioning projects in the state done by participating allies (as estimated via survey responses and secondary data sources)	Program participants active in commissioning likely worked on 38% of new whole building commissioning projects in the State during the past several years
	Sales HVAC packaged units	Participating allies sold approximately 7,000 packaged HVAC units in the past year. This accounts for only 5.4% of the estimated shipments to New York.
	Change in market for various HVAC applications over past two years *Percentage of allies reporting market increased significantly or somewhat*	Advanced Diagnostics = 74% Demand Control Ventilation =91% High Efficiency HVAC Sales = 88% Commissioning and Retrocommissioning = 82%

3.6.4 Program Impact Evaluation

This section presents cumulative annual energy savings for the program elements from inception through December 31, 2006.

Gross Savings

The objective of the M&V evaluation review is to verify the estimate of the program's cumulative savings. Based on Nexant's review, as of December 31, 2006, the program has resulted in the energy savings and demand reductions shown in Table 3-16. Note that the realization rate shown is applicable to the entire program period.

Net Savings

The final step to determining net energy savings is attribution analysis. Attribution analysis determines, through various methods, whether the gross savings estimate from the M&V activities should be adjusted downward or upward for freeridership or spillover. Adjustments for free ridership and spillover, and the ultimate program net-to-gross ratio and net savings are shown in Table 3-16. Adjustments for freeridership and spillover were not estimated for the Hospitality Lighting Program. For Commercial HVAC, the savings estimates were determined by the MCAC team based on market research.

Table 3-16. New York Energy $mart^{SM} Business Partners Cumulative Annual Energy and Peak Demand Savings (through December 2006)

	Program-Reported Savings	Realization Rate	Adjusted Gross Savings	Freeridership	Spillover	Net-to-Gross Ratio[1]	Net Savings
Small Commercial Lighting							
MWh/year	33,541	1.0	33,541	39%	79%	1.09	36,559
MW On-Peak	8.3	1.0	8.3	39%	79%	1.09	9.0
Premium-Efficiency Motors[2]							
MWh/year	9,689	1.0	9,689	67%	168%	0.88	8,822
MW On-Peak	1.8	1.0	1.8	67%	113%	0.70	1.3
Commercial HVAC[3]							
MWh/ year	6,767	N/A	6,767	N/A	N/A	N/A	6,767
MW On-Peak	2.0	N/A	2.0	N/A	N/A	N/A	2.0

Hospitality Lighting							
MWh/ year	8,505	Not Evaluated	8,505	Not Evaluated	Not Evaluated	Not Evaluated	8,505
MW On-Peak	0.9	Not Evaluated	0.9	Not Evaluated	Not Evaluated	Not Evaluated	0.9
Total Business Partners							
MWh/ year	58,497	N/A	58,497	N/A	N/A	N/A	60,653
MW On-Peak	13.0	N/A	13.0	N/A	N/A	N/A	13.3

[1] Net-to-Gross Ratio = (1-Freeridership) * (1+Spillover).

[2] Savings from the prior motor incentive program have been held constant since last year. Savings achieved in 2006 from the new motor management program and the STAC 100 Motors program, in the amount of 296,202 kWh and 48 kW, have been added in the Net Savings column.

[3] Savings for the Commercial HVAC portion of the program have been reduced as of 4th Quarter 2006. This approach was taken due to the known short-term nature of savings from advanced diagnostics and commissioning, which were part of the program.

Non-Energy Impacts

Past non-energy impacts studies by the MCAC team have focused on the Small Commercial Lighting Program and Commercial HVAC. Results are shown in Table 3-17.

Table 3-17. Business Partners NEI Results

Results from Direct Query Approach (year of study)	Percentage of Energy Savings
Small Commercial Lighting Program (2005)	51%
Commercial HVAC Program (2004)	25-55%

3.7 New York Energy $mart^{SM} Loan Fund and Financing Program

3.7.1 Program Description

The **New York Energy $mart^{SM}** Loan Fund and Financing Program expands the availability of low-interest capital to help implement energy-efficiency projects and process improvements. Lenders enroll in the program by signing participation agreements and agreeing to reduce the interest rates on energy-related loans in exchange for a lump sum subsidy paid by NYSERDA. Interest rate reductions range from 4% in most of the State to 6.5% in parts of the Con Edison utility area. The Loan Fund has been an implementation tool for many types of projects, allowing reduced interest rate financing for cutting edge technologies. The Program has been especially beneficial in encouraging lender financing of photovoltaic and wind turbine projects, and in promoting green building measures in new construction. These types of activities will continue to be promoted.

The Program's ongoing training of the financial sector includes tools to allow lenders to calculate the cash flow advantages their customers will gain from making energy-efficiency improvements. Going forward, NYSERDA will work with ENERGY STAR® to develop new or modify existing ENERGY STAR tools to meet this goal. While the Loan Fund has met the needs of customers who do not avail themselves of

other NYSERDA programs, the reduced-interest financing will also continue to be available to customers participating in other NYSERDA programs.

NYSERDA has worked with over 100 lenders and leasing companies across the State to increase the availability of low-interest capital for energy efficient equipment and process improvements through the New York Energy $mart℠ Loan Fund program.

The thirteen-year program budget is $21.0 million.

3.7.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Loan Fund Program. These goals and progress for the first six months are shown in Table 3-18.

Table 3-18. New York Energy $mart℠ Loan Fund and Financing Program – Near-Term Goals and Achievements for Commercial/Industrial Projects

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Customers receiving assistance (closed loans)	100	39
Participating lenders (signed participation agreements)	25	14
Leveraged loan amount	$12,000,000	$12,693,552

Other highlights from the past six months include:

- An RFP for a Loan Fund support contractor was issued in December 2006 to obtain a contractor to continue NYSERDA's efforts to provide outreach and training, and support lenders participating in the program.

3.7.3 Long-Term Program Accomplishments

This section highlights key program outputs as identified through the logic model development work and associated market progress. All values reported are cumulative since program inception. Table 3-19 presents the key outputs for Loan Fund and Financing Program through December 31, 2006. Table 3-20 presents a sample of key logic model-driven indicators of program success, especially those related to market progress, as tracked by the evaluation and program activities. Together, these tables indicate the most important ways that program progress is being measured.

Table 3-19. Loan Fund and Financing Program – Key Program Outputs for Commercial/Industrial Projects

Outputs	Value (Cumulative through December 2006)
Number of loans closed	388
Value of loans closed	$85,104,504
Average loan value	$219,342

Outputs	Value (Cumulative through December 2006)
Number of lenders with signed participation agreements	109
Number of lenders actively processing loans	109
Number of lenders with multiple loans	95
Number of lenders with statewide coverage	24

Table 3-20. Loan Fund and Financing Program Key Program – Key Market Indicators and Program Cumulative Progress

Topic	Indicator	Value (2005)
Awareness and Knowledge	Increasing awareness among lenders about the financial benefits of energy efficiency	85% of lenders surveyed have at least some familiarity with energy efficiency, compared to only 62% for renewable energy Of those lenders claiming some knowledge, about two-thirds have become more familiar with the technologies and related economics over the past five years
	Awareness of the Loan Fund among contractors and vendors	More than half of borrowers (51% of commercial and 85% of residential) report that their contractor or vendor had either referred them to the Loan Fund or was aware of the program.
	Lenders are able to speak accurately about the economic benefits of energy efficiency and renewable energy investments	35% of lenders consider it important (4 or 5 on a 5-point scale where 5 is the highest) that they understand "the technologies and economics related to energy efficiency equipment and measures" before making loans for new construction or renovation projects that incorporate high efficiency. Lenders have similar views on renewable energy projects.
	Lenders include energy savings within cash flow analysis when reviewing loans	11 out of the 21 commercial lenders surveyed "always" or "often" include energy costs in the cash flow analysis for new construction and renovation projects
Perceptions and Practices	Value of energy efficiency investments is based on principles similar to other business investments (*e.g.,*, ROI, payback)	75% of commercial borrowers say they evaluate energy efficiency investments on the same basis as other business investments
	Property owners perceive that renewable energy technology or efficiency products will provide adequate payback	39% of commercial borrowers and 10% of residential borrowers were confident that high efficiency equipment would pay back quickly enough without a financial incentive
	Lenders have confidence that new renewable energy technology or efficiency products will be improve ability of borrower to repay loan	Lenders were evenly split on the importance of reduced energy costs improving borrowers' ability to repay loans and only 7% consider it "extremely important"

3.7.4 Program Impact Evaluation

This section presents cumulative annual energy savings for the program from inception through December 31, 2006.

Gross Savings

The objective of the M&V evaluation review is to verify the estimate of the program's cumulative savings. Based on Nexant's review, as of December 31, 2006, the program has resulted in the energy savings and demand reductions shown in Table 3-21. Note that the realization rate shown is applicable to the entire program period.

Net Savings

The final step to determining net energy savings is attribution analysis. Attribution analysis determines, through various methods, whether the gross savings estimate from the M&V activities should be adjusted downward or upward for freeridership or spillover. Adjustments for freeridership and spillover, and the ultimate program net-to-gross ratio and net savings are shown in Table 3-21.

Table 3-21. Loan Fund Cumulative Annual Energy and Peak Demand Savings (Through December 2006)

	Program-Reported Savings	Realiza-tion Rate	Adjusted Gross Savings	Freerider-ship	Spillover	Net-to-Gross Ratio[1]	Net Savings
MWh/year	65,549	0.85	55,717	27%	19%	0.92	51,260
MW	11.8	1.39	16.3	27%	19%	0.92	15.0
MMBtu	111,590	1.36	151,762	27%	19%	0.92	139,621

[1] Net-to-Gross Ratio = 1-Freeridership+Spillover.

3.8 Energy Smart Focus Program

3.8.1 Program Description

Energy Smart Focus is a sector-specific effort to facilitate and encourage greater energy efficiency awareness and energy efficiency market penetration to the targeted sectors. The program is a marketing and information transfer effort that will use existing core New York Energy Smart programs and services to sponsor deployment, demonstration, research, and development projects in conjunction with sector customized strategies, including:

- Outreach and one-on-one interactions
- Targeted marketing materials and messages
- Training
- Partnerships with trade associations
- Integration with regional and national efforts
- Benchmarking

Efforts will center on each sectors' core mission, and increasing productivity while improving energy efficiency and reducing demand. Strategies will vary by sector, and will be developed to leverage non-energy benefits such as environmental benefits, indoor air quality, productivity and maintenance savings, which often drive energy efficiency decisions. These efforts will be augmented by sector-independent web support services.

The 5-year program budget is $19.9 million.

3.8.2 Recent Program Accomplishments

Near-term, annual goals have been set for the Energy Smart Focus Program. These goals and progress for the first six months are shown in Table 3-22.

Table 3-22. Energy Smart Focus Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Participants Receiving Assistance	2,000	550a

a Participants of the Comprehensive Energy Strategies (Energy Smart Schools) Program, a precursor to the institutional sector of the Energy Smart Focus Program, were provided assistance and are thus represented in this table.

Program Highlights

This new initiative will provide services to facilitate and encourage sector-specific energy efficiency improvements and practices.

- An internal team developed the program, refined the program goals, and identified individual sector needs.
- The internal NYSERDA team allocated funding to each sector of the program as follows: Institutions - $4.0 million; Industrial Manufacturing - $2.0 million; Commercial Real Estate - $2.5 million; Municipal Water/Wastewater $ 1.0 million; Hospitality - $1.0 million; Healthcare - $1.0 million; Colleges and Universities - $ 1.0 million; and other sector Support Services - $0.5 million.
- An RFP was released to selected contractors to service: the hospitality sector; the institutional sector, including K-12 schools, State government facilities; commercial real estate; industrial manufacturing, and municipal water and wastewater facilities. Twenty-four proposals were received.

3.8.3 Program Impact Evaluation

To date, direct energy impacts have not been tracked for the Comprehensive Energy Strategies (Energy Smart Schools) Program, a precursor to the institutional sector of the Energy Smart Focus Program. It is anticipated that the evaluation team will attempt to quantify the direct impacts for the Energy Smart Focus Program and data will be provided as it becomes available.

3.9 High Performance New Buildings Program

3.9.1 Program Description

The New Construction Program (NCP) was established to encourage energy-efficient design and building practices among architects and engineers and to urge them to inform building owners about the long-term advantages of building to higher energy standards. The program was renamed the High Performance New Buildings Program in 2006.[1] The name change to High Performance New Buildings reflects greater emphasis on whole building approaches to energy efficiency and green concepts. A revised program logic diagram is included at the end of Section 3.

The program objective is to create long-term changes in design practices by mainstreaming energy efficiency and green building concepts. The program is structured upon a performance-based approach in which incentives are determined by total building performance and are tiered to reward progressively more efficient designs. Through design team incentives and recognition, the program promotes Green building projects and projects planned for LEED® certification. Enhancements under the High Performance New Buildings Program include prescriptive and fast-track approaches using detailed custom analysis tools to ensure that smaller, simpler projects can be reviewed and incentives quickly awarded.

This mature and multi-faceted program addresses a complex and technically sophisticated market segment. The NYSERDA program staff has been working within the design and new construction community since 1999, and the program has evolved to better meet the unique needs of this market segment.

The 13-year program budget is $150.8 million.

3.9.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the High Performance New Buildings Program. These goals and the progress for the first six months are shown in Table 3-23.

Table 3-23. High Performance New Buildings Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Customers receiving assistance (completed projects)	140	43
Construction market affected (sq.ft.)	14,000,000	5,700,000
Participating A&E firms	180	160

[1] Within this section, the old program name (NCP) is used when discussing evaluations that occurred prior to the name change.

3.9.3 Long-Term Program Accomplishments

This section highlights key program outputs as identified through the logic model development work and associated market progress. All values reported are cumulative since program inception. Table 3-24 presents the key outputs for High Performance New Buildings through December 31, 2006. Table 3-25 presents a sample of key logic model-driven indicators of program success, especially those related to market progress, as tracked by the evaluation and program activities. Together, these tables indicate the most important ways that program progress is being measured, and report how those values are changing due to program activities.

Table 3-24. High Performance New Buildings Program – Key Program Outputs

Outputs	Value (Cumulative through December 2006)
Number of buildings participating	1,357 active projects (913 with encumbered dollars)
Square footage affected	Nearly 138 million
Number of completed projects	670
Number of projects receiving TA studies	879
Number of projects receiving commissioning	182

Table 3-25. High Performance New Buildings Program – Key Market Indicators and Program Cumulative Progress

Topic	Indicator	Initial Value (2003, unless noted)	Most Recent (2006, unless noted)
Availability of Services	Number of unique A&E firms participating	526	750
Awareness and Knowledge	Awareness of NYSERDA among *non-participating* A&E firms and owners	A&Es: 58%	A&Es: 81% Owners: 73%
	A&E firm familiarity with energy efficiency measures and designs	Participant: 88% (n=44) Non-participant: 89% (n=85)	Participant: 92% (n=48) Non-participant: 74% (n=30)
	Building owner familiarity with energy efficiency measures and designs	Participant: 92% (n=26) Non-participant: 61% (2004)	Participant: 85% (n=48) Non-participant: 73% (n=30)
Value of Program Services	Importance of technical assistance for achieving savings according to participating designers and owners	Designers: 38% critically important or important (n=40) Owners: 76% critically important or important (n=31)	Designers: 67% critically important or important (n=48) Owners: 88% critically important or important (n=48)
	Importance of incentives for achieving savings according to participating designers and owners	Designers: 70% said incentives were important or critically important (n=44) Owners: 80% said incentives were important or critically important (n=32)	Designers: 98% said incentives were helpful or critical (n= 48) Owners: 90% said incentives were helpful or critical (n= 48)

Topic	Indicator	Initial Value (2003, unless noted)	Most Recent (2006, unless noted)
Market Penetration	Percentage of New York market participating in the program.	0.4-2% (2000)	Approximately 12% (2005)
	Percentage of New York A&E community participating	18% of the ~2,900 A&Es working on non-residential projects over the past 2 years have participated	30% of the ~2,500 A&Es working on non-residential projects over the past 2 years have participated
	Percentage of top architecture and engineering firms, by dollar value and number of projects, participating in the program	50% of architects by dollar value 60% of architects by number of projects 40% of engineers by dollar value and number of projects	80% of architects by dollar value 40% of architects by number of projects 60% of engineers by dollar value 50% of engineers by number of projects

3.9.4 Program Impact Evaluation

This section presents cumulative annual energy savings for the program from inception through December 31, 2006.

Gross Savings

The objective of the M&V evaluation review is to verify the estimate of the program's cumulative savings. Based on Nexant's review, as of December 31, 2006, the program has resulted in the energy savings and demand reductions shown in Table 3-26. The realization rate of 1.06 is applicable to the entire program period, and indicates that the program records were slightly under-estimating the actual energy savings. These results are from the M&V analysis conducted in 2005.

Net Savings

The final step to determining net energy savings is attribution analysis. Attribution analysis determines, through various methods, whether the gross savings estimate from the M&V activities should be adjusted downward or upward for freeridership or spillover. Adjustments for freeridership and spillover, and the ultimate program net-to-gross ratio and net savings are shown in Table 3-26. The net-to-gross ratio for the High Performance New Buildings Program is 1.22, meaning that freeridership that is occurring is outweighed by spillover. These findings are from attribution analyses conducted in 2005.

Table 3-26. High Performance New Buildings Cumulative Annual Energy and Peak Demand Savings (through December 2006)

	Program-Reported Savings	Realiz-ation Rate	Adjusted Gross Savings	Freerider-ship	Spillover	Net-to-Gross Ratio[1]	Net Savings
MWh/year	193,586	1.06	205,201	40%	85%	1.22	250,345
MW	41.4	1.06	43.9	40%	85%	1.22	53.5

[1] Net-to-Gross Ratio = 1-Freeridership+Spillover (a weighted average of the NTG ratios estimated in the previous MCAC analysis and this current analysis is shown here).

Non-Energy Impacts

The MCAC team last evaluated non-energy impacts (NEIs) for the New Construction Program in 2005. The study found that customers valued NEIs at 40% of the value of the energy savings achieved in their new buildings. This value is similar to the value of NEIs found in an earlier study on the NCP.

3.9.5 Process Evaluation

A best practices study, the third in a series of process evaluation reports for the NCP, was conducted by Research Into Action. The prior reports, completed in 2004 and 2005, showed the NCP was a valuable and effective program focused on acquiring energy savings within a market transformation framework. The program and project managers currently report that several factors, including the threat of insufficient power supplies in New York, have changed their emphasis to resource acquisition and demand reduction, with market transformation as an important but secondary goal. The managers requested this best practices review of other notable new construction programs throughout the country to compare various approaches and to uncover useful insights and ideas that might benefit the program. The following topics were addressed in this study:

- Balancing resource acquisition with market transformation
- Emphasizing LEED® or green projects
- Alternative program delivery models
- Reaching the right decision-makers
- Conducting successful scoping meetings
- Benchmarking and monitoring usage over time
- Coordinating with other programs

After working with the program managers to identify nine other exemplary new construction programs,[2] evaluators gathered and analyzed information from best practices literature, program materials, and interviews with program managers. Results of this best practices study are provided below.

[2] Programs include those from National Grid, NSTAR, Northeast Utilities, California, the Energy Trust of Oregon, MidAmerican, Xcel Energy, New Jersey, and Wisconsin.

Adjust Strategies for Greater Savings and Longer Term Market Transformation

Nationally, new construction programs are changing their strategies so that they can attract projects earlier and achieve greater "per project" savings. These approaches also support longer-term goals to transform the market. While the NCP already encourages whole building design and LEED® certification, it should consider a greater emphasis on:

- Building personal strategic relationships with owners and design firms: These outreach efforts include targeted education and training, including having a designated educational arm supporting existing "cutting edge" training through organizations such as the New Buildings Institute (NBI) offering lunch and learn presentations at A& E firms; identifying and maintaining relationships with the largest market players; and having a strong and consistent presence at professional meetings such as the American Institute of Architects (AIA) and American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). In some cases, specific market sectors with high potential for savings, such as hospitals or schools, might be targeted. These outreach efforts are intentional, coordinated, and wherever possible, personal. Targeted marketing materials are important tools to support person-to-person outreach strategies but cannot substitute for them.

- Increased leveraging of market trends and opportunities: One of the key market effects of new construction programs is the development of more stringent energy codes (e.g., California, MidAmerican, and Xcel) which in turn provides programs the opportunity to push for higher levels of efficiency.

- Other clear market trends reflect a greater concern for the environment. LEED® is an example of an environmentally-oriented market opportunity that some programs like the NCP and the Energy Trust have used to increase interest in and allegiance to the programs' efficiency goals. NYSERDA has been very aggressive in promoting LEED certified buildings with over 120 such projects in the pipeline. Global warming is another environmental issue that new construction programs can leverage. Architecture2030 has developed the 2030 Challenge to promote carbon-neutral buildings to help reduce greenhouse gas emissions to acceptable levels. Energy efficiency is at the center of these efforts. Key organizations have endorsed this challenge including the AIA, the U.S. Conference of Mayors, and ASHRAE.

- As suggested above, innovative training opportunities may also push the market; National Grid believes attendance at NBI's trainings has significantly affected the view of architects participating in their programs, moving them to the point of wanting to try more robust energy efficiency strategies.

- Making service delivery as efficient as possible: Moving to a less complex delivery model that relies on one or two program management consultants can result in less burden on program managers, more efficient, consistent and higher quality service delivery, and more time for program managers to focus on key program improvement strategies and critical projects. While the NCP is continuously working on improving its processes, its current delivery model for the NCP requires considerable effort to attract, recruit, and manage qualified firms. The program managers should further investigate the "single contractor" approach used by the programs at the Energy Trust of Oregon, MidAmerican, and Xcel to see if this program delivery model could be useful for improving its service delivery.

- Getting projects off to a good start: Effective project screening and scoping meetings need to be orchestrated events with everyone understanding and "buying into" the process. While the NCP program is an "open" solicitation that serves all program applicants regardless of their project

complexities, the program should consider using enhanced screening to help match program services with the project scope. It should also consider developing a "how-to" manual and sponsoring training (e.g., from the Weidt Group that implements MidAmerican's program) to fine tune scoping meeting skills, so that these meetings are as consistent and effective as possible.

Leverage Experience of Other Leading Programs Nationally

Leading commercial new construction programs across the country have much to offer each other in terms of specific experience and lessons learned but have limited exposure to one another. The program managers and staff should consider the following strategies to leverage the experience of other leading programs:

- Continue its review of materials from other programs, such as application packages, program manuals, marketing materials, and software, to see how these approaches might complement and improve the program's own efforts.
- Communicating with program managers identified in this study, along with others that might be recommended, to assess how communication of lessons learned and best practices might best be promulgated among the interested parties.
- NCP managers should consider initiating a forum with leading new construction program managers and implementation contractors nationwide that would allow attendees to present and discuss what they have learned. This might be accomplished through an existing national meeting structure, such as the ACEEE Summer Study for Efficiency in Buildings, Greenbuild, NEEP, NBI or other venues in which NYSERDA staff have already participated.

3.10 FlexTech Technical Assistance Program

3.10.1 Program Description

The FlexTech Technical Assistance Program is a consolidation of services previously offered under the FlexTech, Technical Assistance, and the Energy Audit Programs. This change is part of a continuous stream of evolutionary revisions the program has undergone for the past eight years.

The purpose of the Program is to provide customers with objective and customized information to facilitate wiser energy efficiency, energy procurement, and financing decisions. The Program is available to all commercial and industrial sectors. The Program strives to increase productivity and economic competitiveness by identifying and encouraging the implementation of cost-effective energy-efficiency measures. Studies also include operations management, energy procurement, and on-site Combined Heat and Power (CHP). Cost-shared assistance is provided for detailed studies from energy engineers and experts. Small customers are eligible for quick walk-through energy audits, with the cost share reimbursed upon implementation of recommendations. Participants may use NYSERDA-contracted or customer-selected consultants.

The thirteen-year program budget is $66.5 million.

3.10.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the FlexTech Technical Assistance Program. These goals and progress for the first six months are shown in Table 3-27.

Table 3-27. FlexTech Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Customers receiving assistance (approved proposals)	540	220

Program Highlights

- An RFP was issued for supplemental FlexTech contractors in the Con Edison territory. Eleven new contractors were selected and awarded three year contracts. The new FlexTech contractors will provide additional coverage and market outreach to Con Edison customers.
- The Audit Program, which provides walk-though audits for smaller customers, was bid to select contractors for the next five years. The Audit Program is comprised of four geographical regions. The RFP adjusted the regions to provide increased coverage in Con Edison territory. A new contract was awarded for each region.
- CHP and Renewable Generation Technical Assistance Program were merged with the traditional energy efficiency Technical Assistance Program.
- An on-line application process was created for FlexTech and Audit programs.

3.10.3 Long-Term Program Accomplishments

This section highlights key program outputs as identified through the program logic modeling work and associated market progress. All values reported are cumulative since program inception. Table 3-28 presents the key outputs for the FlexTech Technical Assistance Program through December 31, 2006. Table 3-29 presents a sample of key logic model-driven indicators of program success, especially those related to market progress, as tracked by the evaluation and program activities. Together, these tables indicate the most important ways that program progress is being measured, and report how those values are changing due to program activities.

Table 3-28. FlexTech Program – Key Program Outputs

Outputs	Value (Cumulative through December 2006)
Customers receiving assistance (approved proposals)	3,540
Number of studies completed	3,290
Total funds committed	$27,400,000
Customer cofunding of studies	$27,000,000
Participating allies (ESCOs and engineering firms)	280

Table 3-29. FlexTech Program – Key Market Indicators and Program Cumulative Progress

Topic	Indicator	Value (2004, unless noted)
Awareness and Knowledge	Customer familiarity with energy efficiency measures and equipment	90% of participating customers (n=67) and 68% of non-participants (n=120) said they were extremely or somewhat familiar
	Change in customer familiarity with energy efficiency measures and equipment over time	54% of participating customers (n=67) and 22% of non-participants (n=120) said their familiarity had increased significantly over the past five years
	Contractor familiarity with energy efficiency measures, equipment and services	77% of participating contractors (n=40) and 11% of the non-participants (n=55) said they were extremely familiar
	Change in contractor familiarity with energy efficiency measures and equipment over time	48% of participating contractors (n= 40) and 21% of the non-participants (n=53) said their familiarity had increased significantly over the past five years
Availability of Services	Change in level of technical service provider (TSP) activity in New York over time	55% of participating contractors (n=38) and 43% of non-participating contractors (n=55) said TSP activity has increased over the past five years
	Change in quality of TSP activity in New York over time	46% of participating contractors (n=40) said the quality of TSP activity has increased over the past five years

Topic	Indicator	Value (2004, unless noted)
Change in Practices	Contractor promotion/marketing of energy efficiency measures, equipment and services	74% of participating contractors (n=38) are significantly or somewhat increasing their marketing of energy-efficient measures, compared to only 38% of non-participating contractors (n=50)
	Difference in efficiency level of participating and non-participating projects	Participating contractors said that a typical TA project was 25% more energy efficient than a standard design, non-participating project (responses ranged from 1-50% more efficient, however)
Participant Motivations and Decision-Making Criteria	End-use customer decision-making practices	66% of respondents sent the report to higher-level staff for a final decision regarding implementation, whereas 6% of the respondents were the ultimate decision makers (2006)
	Criteria for deciding to undertake a project	90% of respondents indicated that payback was considered in the decision-making process and 71% of respondents indicated that the up-front cost relative to the available budget was considered. In addition, 58% of respondents characterized payback as a "make or break" criterion when deciding to undertake a project (2006)

3.10.4 Program Impact Evaluation

This section presents cumulative annual energy savings for the program from inception through December 31, 2006.

Gross Savings

The objective of the M&V evaluation review is to verify the estimate of the program's cumulative savings. Based on Nexant's review, as of December 31, 2006, the program has resulted in the energy savings and demand reductions shown in Table 3-30. Note that the realization rate shown is applicable to the entire program period.

Net Savings

The final step to determining net energy savings is attribution analysis. Attribution analysis determines, through various methods, whether the gross savings estimate from the M&V activities should be adjusted downward or upward for freeridership or spillover. Adjustments for freeridership and spillover, and the ultimate program net-to-gross ratio and net savings are shown in Table 3-30.

Table 3-30. FlexTech Program Cumulative Annual Energy and Peak Demand Savings (through December 2006)

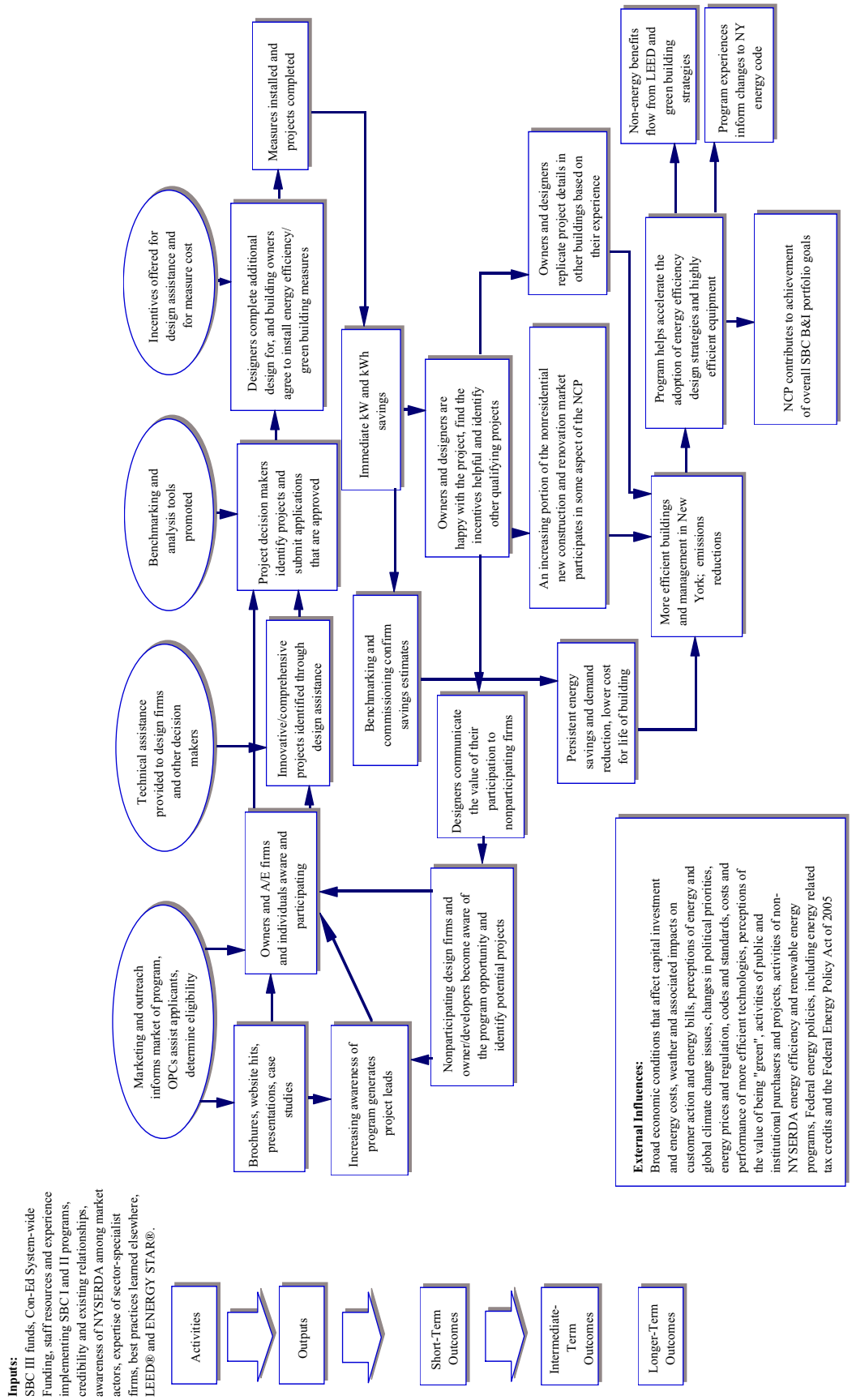
	Program-Reported Savings	Realization Rate	Adjusted Gross Savings	Freeridership	Spillover	Net-to-Gross Ratio[1]	Net Savings
MWh/ year	611,962	1.0	611,962	25%	48%	1.14	697,637
MW	114.0	1.0	114.0	25%	48%	1.14	130.0
MW Enabled	9.0	1.0	9.0	25%	48%	1.14	10.2
MMBtu	2,513,073	1.0	2,513,073	25%	48%	1.14	2,864,903

[1] Net-to-Gross Ratio = 1-Freeridership+Spillover (a weighted average of the NTG ratios estimated in the previous MCAC analysis and this current analysis is shown here).

Non-Energy Impacts

The MCAC team last evaluated NEIs for the Technical Assistance Program in 2004. The study found that customers valued NEIs at 37-55% of the value of the energy savings achieved in their new buildings.

High Performance New Buildings Program Logic Model



4

Residential and Low-Income Programs

4.1 Overview of the Residential and Low-Income Programs

4.1.1 Residential Programs

The residential energy efficiency programs are designed to influence decisions regarding electricity use and to reduce households' energy bills. The programs also address petroleum and natural gas use when included as part of a comprehensive energy service package. Evaluations of the following residential programs are discussed in this section:

Single Family Home Performance Program. This program, which addresses one- to four-unit homes, includes the Home Performance with ENERGY STAR® Initiative (HPwES) for existing homes, and the New York ENERGY STAR Labeled Homes Initiative (NYESLH) for newly constructed homes. On the supply side, these initiatives support market development through recruitment, training and incentives for builders and contractors, in order to encourage them to offer energy efficient options. On the demand side, these initiatives market the benefits of energy efficiency to residential consumers in order to increase demand for efficient products and services. Both HPwES and NYESLH have low-income components providing additional incentives for low-income households.

Multifamily Building Performance Program. The Multifamily Building Performance Program provides a single point of entry for multifamily building owners and developers interested in improving the energy efficiency of new and existing buildings. The ENERGY STAR Multifamily Building Initiative (EMP) – the track for new buildings (and complete gut-rehabilitation projects) – concentrates on providing technical assistance to mid-stream market participants and incorporates renewable technologies, advanced metering technologies, real-time pricing strategies, and combined heat and power systems, especially for electrically heated buildings with base domestic hot water loads. The Multifamily Building Performance Initiative – the track for existing buildings – develops market-based business opportunities for building auditors, financial packagers, designers, architects, and construction inspectors in order to enhance the energy services infrastructure. The Multifamily Building Performance Initiative also has a low-income component, providing technical and financial assistance to low-income building owners and their tenants to make energy efficiency improvements, thus reducing energy bills and providing increased health and safety benefits to building occupants.

Market Support Program. The **New York Energy $mart℠** Market Support Program provides support services to the building performance and low-income programs by increasing the availability of energy-efficient products and by increasing consumer demand. There are three major components to the Market Support Program: 1) the ENERGY STAR® Products Initiative, which seeks to increase the availability

and sales of residential ENERGY STAR appliances, lighting and home electronics products; 2) the Program Marketing Initiative, which provides marketing for the Single Family Home Performance Program, the Multifamily Building Performance Program, the summer and winter tips campaigns, and leveraged campaigns such as "Change a Light, Change the World" as well as marketing assistance to mid-stream partners; and 3) the GetEnergySmart.org website, which provides consumers with information about programs, names of contractors and retailers, and energy efficiency tips, provides potential program partners with participation information, and serves as a communication tool with current partners.

Communities and Education Program. The Communities and Education Program offers market infrastructure development for both short-term program support and long-term market development for residential energy efficiency, with the aim of helping to develop an energy-conscious society. The two major components are the Energy Smart Students (ESS) Initiative and the **New York Energy $mart** Communities (NYE$C). ESS provides energy efficiency curricula for teachers of students in grades K-12. ESS is part of NYSERDA's effort to offer comprehensive services to K-12 schools, including educational curriculum support, facilities improvements, and transportation efficiency improvements. ESS offers teacher workshops to introduce hands-on, project-based lessons aligned with the New York State teaching standards. NYE$C facilitates bringing organizations and agencies together to develop and support local projects that serve as demonstrations of energy efficiency and renewable technologies and show how these projects create economic, social, and environmental benefits. NYE$C also provides face-to-face education to the community on various energy topics and **New York Energy Smart^{SM}** programs. Finally, NYE$C has primary responsibility for recruiting mid-stream partners for **New York Energy Smart^{SM}** residential programs.

4.1.2 Low-Income Programs

The low-income programs are designed to reduce the energy burden of low-income households by improving energy efficiency and providing energy management and aggregated energy procurement services. Evaluations of the following low-income programs are discussed in this section:

EmPower New York^{SM}. The EmPower New York^{SM} program provides energy efficiency services to utility customers earning less than 60% of the state median income and households enrolled in utility low-income payment assistance programs, targeting both owners and tenants of one- to four-family homes and multifamily buildings with fewer than 100 units. The program coordinates with the delivery of federal weatherization services through New York State Division of Housing and Community Renewal (DHCR).

Buying Strategies and Energy Awareness Program. The Buying Strategies and Energy Awareness Program consists of four initiatives: 1) the Buying Strategies Initiative, which assists the Office of Temporary and Disability Assistance to negotiate discounts on purchases of home heating oil by the Low-Income Home Energy Assistance Program, and also includes a preventive maintenance component for oil-fired heating systems; 2) the Targeted Marketing and Outreach Initiative, which seeks to increase participation in all NYSERDA, State, Federal, utility and community-based low-income energy efficiency and energy assistance programs by targeting hard-to-reach (HTR) customers such as the elderly, the low-income population, and the non-English speaking population; 3) Low-Income Forum on Energy (LIFE), which provides a forum – large statewide conferences, smaller regional meetings, and steering committee meetings – where energy industry professionals, policy makers, agencies serving the low-income population, and energy program implementers can discuss energy issues relevant to the low-income sector; and 4) contributions of funding to the Energy Smart Students (ESS) Initiative (described above).

4.2 Residential and Low-Income Evaluation Activities

The Residential and Low-Income program evaluation activities conducted in the past year are shown in Table 4-1. The table includes only new evaluation activities conducted in 2006. However, findings from earlier evaluations are also discussed in Section 4 to the extent that they contribute to the cumulative assessment of these programs.

Table 4-1. 2006 Residential and Low-Income Program Evaluation Activities

Program Name	Predecessor Program (if applicable)	Theory & Logic	Measurement and Verification (M&V)	Market Characterization, Assessment and Causality (MCAC)	Process Evaluation
Single Family Home Performance Program	Home Performance with ENERGY STAR ENERGY STAR Homes Program	Full	Database review	-	-
Multifamily Building Performance Program	Residential Comprehensive Energy Management (CEM) Program Residential Technical Assistance Program (ResTech) Assisted Multifamily Program (AMP)	Full	-	-	-
Market Support Program	Keep Cool, Stay Cool! ENERGY STAR Products and Marketing Program	-	-	-	-
Communities and Education Program	**New York Energy $mart^{SM}** Communities Energy Smart Students Program	Full	-	-	-
EmPower New York		Full	Database review	-	Partial
Buying Strategies and Energy Awareness Program	Low-Income Buying Strategies Program Low Income Energy Program Awareness Low-Income Forum on Energy	-	-	-	-

4.3 Residential and Low-Income Evaluation Findings

Significant progress is being made as the Residential and Low-Income portfolio transitions to the new, streamlined set of programs. This section summarizes key evaluation findings from the latest set of

evaluation activities, and from the cumulative body of work conducted by NYSERDA and its evaluation contractors over the past several years.

4.3.1 Energy, Peak Demand and Fuel Savings

NYSERDA's M&V contractor assessed the energy and peak demand savings reported for its Residential and Low-Income programs. Methods used in this assessment included on-site verification of equipment installation and functionality, and review of NYSERDA's files for reasonableness and accuracy. Based on this review, the M&V contractor adjusted the savings reported by NYSERDA. In turn, the MCAC contractor further adjusted these figures to account for freeridership and spillover. Table 4-2 through Table 4-4 summarize the estimated electricity savings, peak demand reductions, and fuel savings for each Residential and Low-Income program. Savings for the low-income program elements are broken out in the footnotes to each table.

As reported earlier in Section 2, overall, NYSERDA's M&V and MCAC contractor teams have found that savings for the Residential and Low-Income sector should be adjusted as follows:

- Electricity savings were adjusted upward by 4%.
- Peak demand savings were adjusted upward by 4%.
- Other fuel savings were adjusted upward by 8%.

These adjustments include changes in program-reported savings due to database reviews and field work to measure and verify savings, as well as survey research and other activities to quantify freeridership, naturally occurring adoption, spillover and market effects.

Several near-term goals were set for the first year of the third **New York Energy $mart**SM Program funding cycle. These goals established levels to reach, by June 30, 2007, for energy and peak demand savings as well as several other key metrics of program success. Overall, in the first six months of the one-year measurement period, the Residential and Low-Income portfolio has achieved 15% of its goal for electricity savings, and 20% of its goal for fuel savings. There is no goal for peak demand reduction in this sector. Progress toward the one-year goal is shown for each applicable program in Table 4-2 and Table 4-4. A few key programs appear to be either progressing somewhat more slowly than planned or have not yet reported progress toward goals. Reasons for this slower progress are as follows:

- The Multifamily Building Performance Program for Existing Buildings has reached 16% of the electricity savings goal and 8% of the other fuel savings goal. This program is undergoing a significant change, combining the three former programs into one streamlined program offering. This emphasis on program development, coupled with a transition to a new implementation contractor, have slowed intake somewhat. However, staff reports that the program is still expected to reach its one-year goals within the next six months.
- The Multifamily Building Performance Program for New Buildings has not yet reported any electricity or other fuel savings. This is a completely new program launched in November 2006. Development of program rules and design has been the major emphasis in 2006, although the program did have approximately seven applications in the design phase by the end of December.
- The Market Support Program has not updated its electricity savings since December 31, 2005. Over the past several years, the savings for this market transformation program have typically been estimated by NYSERDA's Market Characterization, Assessment, and Causality (MCAC) evaluation

contractor team based on sales and shipment data, primary research such as consumer and retailer surveys, and other sources. The MCAC team is in the process of updating the savings for this program and progress will be presented in the first quarter of 2007. The program is expected to meet its one-year goal.

Table 4-2. Residential and Low-Income Program Electricity Savings through December 31, 2006 and Progress toward One-Year Goals

Program	Energy Savings (GWh)			
	Savings Achieved through		One-Year Goal through June 30, 2007	Progress Toward One-Year Goal (% achieved)
	June 30, 2006	Dec. 31, 2006		
Single Family Home Performance Program: Existing Homes[1]	13.5	14.6	5.3	20%
(ConEdison)	(0.2)	(0.3)	(n/a)	(n/a)
Single Family Home Performance Program: New Homes	7.3	9.3	1.8	108%
(ConEdison)	(0.7)	(0.7)	(n/a)	(n/a)
Multifamily Building Performance Program: Existing Buildings[2]	31.0	38.2	45.1	16%
(ConEdison)	(30.2)	(37.3)	(n/a)	(n/a)
Multifamily Building Performance Program: New Buildings	0	0	4.8	0%
(ConEdison)	(0)	(0)	(n/a)	(n/a)
Market Support Program	303.8	303.8	30	0%
(ConEdison)	(69.9)	(69.9)	(n/a)	(n/a)
EmPower New York	23.2	27.9	10.2	46%
(ConEdison)	(2.0)	(2.3)	(n/a)	(n/a)
ConEdison Residential & Low-Income Total	**103.0**	**110.4**	**n/a**	**n/a**
Statewide Residential & Low-Income Total	**378.9**	**393.8**	**97.2**	**15%**

[1] Savings for the low-income Assisted Home Performance Program are included in this row. They represent 5.5 GWh of these savings.

[2] Savings for the low-income Assisted Multifamily Program are included in this row. They represent 23.1 GWh of these savings.

Table 4-3. Residential and Low-Income Program Peak Demand Reductions through December 31, 2006

Program	Demand Reductions (MW)	
	Savings Achieved through	
	June 30, 2006	Dec. 31, 2006
Single Family Home Performance Program: Existing Homes[1] (ConEdison)	2.0 (0.0)	2.2 (0.0)
Single Family Home Performance Program: New Homes (ConEdison)	0.9 (0.2)	1.1 (0.1)
Multifamily Building Performance Program: Existing Buildings[2] (ConEdison)	3.9 (3.8)	5.0 (4.9)
Multifamily Building Performance Program: New Buildings (ConEdison)	n/a (n/a)	0 (0)
Market Support Program (ConEdison)	72.8 (16.7)	72.8 (16.7)
EmPower New York (ConEdison)	2.5 (0.0)	3.3 (0.0)
ConEdison Residential & Low-Income Total	**20.8**	**21.9**
Statewide Residential & Low-Income Total	**82.2**	**84.4**

Note: No goals were set for peak demand reduction.

[1] Savings for the low-income Assisted Home Performance Program are included in this row. They represent 0.8 MW of these savings.

[2] Savings for the low-income Assisted Multifamily Program are included in this row. They represent 1.8 MW of these savings.

Table 4-4. Residential and Low-Income Program Fuel Savings through December 31, 2006 and Progress toward One-Year Goals

Program	Fuel Savings (MMBtu)			
	Savings Achieved through		One-Year Goal through June 30, 2007	Progress Toward One-Year Goal (% achieved)
	June 30, 2006	Dec. 31, 2006		
Single Family Home Performance Program: Existing Homes[1] (ConEdison)	523,821 (9,900)	642,458 (12,142)	239,800 (n/a)	49% (n/a)
Single Family Home Performance Program: New Homes (ConEdison)	508,247a (40,660)	586,858 (41,080)	103,700 (n/a)	76% (n/a)
Multifamily Building Performance Program: Existing Buildings[2] (ConEdison)	43,932 (12,581)	140,541 (53,687)	1,202,900 (n/a)	8% (n/a)

Multifamily Building Performance Program: New Buildings (ConEdison)	n/a (n/a)	0 (0)	129,800 (n/a)	0% (n/a)
Market Support Program (ConEdison)	341,920 (58,126)	341,920 (58,126)	n/a	n/a
EmPower New York (ConEdison)	59,341 (0)	66,891 (0)	21,700 (n/a)	35% (n/a)
ConEdison Residential & Low-Income Total	**121,267**	**165,036**	**n/a**	**n/a**
Statewide Residential & Low-Income Total	**1,477,261**	**1,778,688**	**1,697,900**	**18%**

[1] Savings for the low-income Assisted Home Performance Program are included in this row. They represent 242,207 MMBtu of these savings.

[2] Savings for the low-income Assisted Multifamily Program are included in this row. They represent 140,541 MMBtu of these savings.

a This value does not match an earlier published value due to changes made to the program tracking database in response to evaluation completed by the M&V contractor.

4.3.2 Summary of Other Key Program Impacts

Across the programs, 22 additional near-term goals were set for other key metrics besides energy savings, such as the number of customers receiving assistance, funds leveraged, allies participating, and outreach activities completed. Overall, the programs are making progress with respect to these other goals. Nine out of the 22 goals are approximately 50% or more achieved. In fact, three of the goals have already been reached or exceeded. The results of each program's progress toward its stated goals are shown in table format in the subsequent sections.

Most of the new evaluation work on the Residential and Low-Income programs has consisted of updating and creating program logic models. Therefore, other key findings from secondary data and studies of participants, non-participants and other market actors shown below are largely repeated from previous major evaluation efforts:

- The ENERGY STAR label is the overarching symbol for NYSERDA's Residential Programs. New Yorkers' recognition of the ENERGY STAR label has increased steadily, from 34% in 1999 to 77% in 2005. The proportion of consumers in New York who show high understanding of the label has also increased from 35% in 1999 to 87% in 2005. In 2005, 63% of New York consumers saw television ads related to ENERGY STAR - evidence linking increased awareness and understanding directly to NYSERDA's efforts.

- The percentage of ENERGY STAR-qualified models out of all models on display in partner stores increased from 14% in 1999 to 35% in 2005 for refrigerators, from 10% to 82% for dishwashers, from 16% to 39% for clothes washers, and from 26% to 61% for room air conditioners.

- NYSERDA's program efforts from 1999 to 2005 have helped increase the market share of ENERGY STAR refrigerators among NYSERDA partners from 28% to 47%; from 48% to 76% for dishwashers; from 24% to 41% for clothes washers; and from 45% to 76% for room air conditioners. The proportion of new single-family homes sold that are ENERGY STAR-labeled has increased from 0.3% in 2001 to 11.1% in 2006. The proportion of the home improvement market installing efficiency measures through the HPwES Program has increased from 0.2%-0.3% in 2001 to 2.1%-3.3% in 2005.

- NYSERDA continues to be effective in recruiting partners in appropriate markets, and in providing them with tools—such as training and marketing—to help them persuade consumers to adopt more efficient products and behaviors. Association with NYSERDA's programs and with energy efficiency has helped many of these partners differentiate their businesses from competitors.

- Nearly all parties involved in these programs, including builders, contractors and consumers, indicate a high degree of satisfaction with the programs. This year's process evaluation surveys and interviews indicate that the results of the EmPower program pilot were largely positive for the six participants. The contractors are pleased with the increased speed with which they can complete jobs by avoiding the pre-approval process under the EmPower pilot program, and believe the measures selected for direct installation without pre-approval are the appropriate ones.

- An important evaluation finding for the Assisted Multifamily Program is that 6.1% of eligible units had efficiency measures installed through the program, and an additional 8.8% had participated in the audit offered by the program. This sums to almost 15% of the eligible population of the low-income multifamily market that had participated in some aspect of the program. This is as of the end of 2005.

4.3.3 Low-Income Customers Served

In total, more than 60,000 low-income customers have been served by the **New York Energy $mart**SM Program. Approximately one-half of the customers served are in the ConEdison utility area where the low-income population is concentrated in larger multi-family buildings. Table 4-5 shows the distribution of low-income customers served by program and utility service area.

Table 4-5. Number of Low-Income Customers Served by Program and Utility Area

Utility Service Area	Assisted Multifamily Program	EmPower	Weatherization Network Initiative	Assisted Home Performance	Direct Install	Total
Central Hudson Gas & Electric	712	128	120	27	766	1,753
ConEdison	3,630	203	1,785	27	24,933	30,578
National Grid	4,075	4,781	2,281	2,275	0	13,412
NYSEG	636	4,553	928	2,275	0	8,392
Orange & Rockland	0	1	72	27	561	661
Rochester Gas & Electric	4,563	185	507	561	0	5,816
Total	13,616	9,851	5,693	5,192	26,260	60,612

4.4 Single Family Home Performance Program

4.4.1 Program Description

The Single Family Home Performance Program addresses one- to four-unit homes through the New York ENERGY STAR® Labeled Homes Initiative (NYESLH) for newly constructed homes, and the Home Performance with ENERGY STAR Initiative for existing homes. Both of these efforts are market-based.

On the supply side, these initiatives use recruitment, training and incentives to encourage builders and contractors to offer energy efficient options. On the demand side, the initiatives market the benefits of energy efficiency to residential consumers to increase demand for products and services that make homes more efficient.

NYESLH provides technical assistance and financial incentives to one- to four-family home builders to encourage the adoption of energy-efficient design features and the selection and installation of more energy-efficient equipment in new construction and substantial renovation projects. Participating builders construct New York ENERGY STAR labeled homes that use approximately 30% less energy than homes built to the current energy code. In addition, the program is an enhanced version of the EPA's ENERGY STAR Labeled Homes Program, because in order to earn the New York ENERGY STAR home label, these homes must include a qualified ventilation system; electrical savings measures (either ENERGY STAR lighting or appliances) that produce annual electricity savings of 600 kWh, compared to standard efficiency measures; and have their performance verified by a certified Home Energy Rating System Rater (HERS) who acts as the independent third party, ensuring that these homes meet program performance criteria.

The Home Performance with ENERGY STAR (HPwES) Initiative is designed to enhance the current market capacity for delivering comprehensive energy efficiency services to existing one- to four-family residences. The program seeks to create a "one-stop shopping" experience for consumers looking to make energy efficiency improvements to their homes. This is accomplished by requiring the participating contractor who provides the comprehensive home assessment to have the capability to prepare a scope of work and install the energy efficiency measures. The program also fosters consumer protection by offering training, a robust quality assurance/quality control (QA/QC) process and a one-year warranty, and by requiring certification and accreditation for participating contractors.

Energy efficiency improvements covered by HPwES include building shell measures such as air sealing and insulation, electric measures like ENERGY STAR refrigerators, heating measures such as boilers and furnaces, cooling measures such as ENERGY STAR room or central air conditioners, and certain renewable energy technologies. Eligible homeowners can elect to receive financing from the **New York Energy $mart**[SM] Loan Fund or the New York ENERGY STAR financing option.

Integrated with these market-based efforts is the Low-Income Single Family Initiative, which includes the Assisted Home Performance with ENERGY STAR effort and the Assisted New York ENERGY STAR Labeled Homes effort. This initiative provides additional incentives for low-income households, in some cases up to 50% of the approved work scope. In addition, participants can use the New York Energy Smart Loan Fund to further offset costs. The "Assisted" components of the Single Family Performance Program are available to residents with up to 80% of the state's median incomes (as compared to the 60% of state median income criterion used for participation in the federally funded Weatherization Assistance Program). Logic models for ENERGY STAR Homes and Home Performance can be found at the end of Section 4.

The 13-year program budget is $189.1 million. This budget includes $81.5 million for the low-income program element.

4.4.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Single Family Home Performance Program. These goals and progress for the first six months are shown in Table 4-6.

Table 4-6. Single Family Home Performance Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
New York ENERGY STAR Labeled Homes Initiative		
New ENERGY STAR Labeled Homes built	2,150	1,082
New low-income ENERGY STAR Labeled Homes built	800	1
Home Performance with ENERGY STAR Initiative		
Existing homes served (receiving treatment)	3,225	1,270
Existing low-income homes served (receiving treatment)	2,100	691

4.4.3 Long-Term Program Accomplishments

This section highlights key program outputs as identified through the logic model development work and related market progress. All values reported are cumulative since program inception. Table 4-7 presents the key outputs for Single Family Performance Buildings through December 31, 2006. Table 4-8 presents a sample of key logic model-driven indicators of program success, especially those related to market progress, as tracked by the evaluation and program activities. Together, these tables indicate the most important ways that program progress is being measured, and report how those values are changing due to program activities.

Table 4-7. Single Family Home Performance Program – Key Program Outputs

Outputs	Value (Cumulative through December 2006)
New York ENERGY STAR Labeled Homes Initiative	
Number of completed projects by type	8,568 projects completed including: ▪ 7,717 Single-family labeled homes ▪ 240 Assisted NYESLHs ▪ 444 Model homes ▪ 167 Display homes
Number of "active" participating builders (built at least one home)	297
Dollar value of incentives paid	$11.45 million
Home Performance with ENERGY STAR Initiative	
Number of homes treated	13,804
Number of participating BPI-certified contractors and firms	449 BPI-certified technicians 127 Participating BPI-accredited firms
Dollar value of incentives paid	$7.98 million in participating contractor incentives

Table 4-8. Single Family Home Performance Program – Key Market Indicators and Program Cumulative Progress

Topic	Indicator	Initial Value (2003, unless noted)	Most Recent (2005, unless noted)
New York ENERGY STAR Labeled Homes Initiative			
Awareness and Knowledge	Consumer awareness of the ENERGY STAR label for new homes	59% of participating home buyers (those who purchased a NYESLH) were aware of the ENERGY STAR label for homes 52% of non-participating home buyers are aware of the label	92% of participating home buyers were aware of the ENERGY STAR label for homes
	Builder familiarity with energy efficiency measures and equipment	82% of participating builders reported that their familiarity had increased significantly (29%) or somewhat (53%) as a result of the program (2004 IDC survey)	85% of the participating builders reported that their familiarity had increased significantly (31%) or somewhat (54%) in the last few years 65% of the non-participating builders reported increasing familiarity
Availability of Services	Availability of New York ENERGY STAR homes	73% of NYESLH purchasers in 2002-2003 reported that NYESLHs were very or somewhat available	72% of NYESLH purchasers in 2004-2005 reported that NYESLHs were very or somewhat available

Topic	Indicator	Initial Value (2003, unless noted)	Most Recent (2005, unless noted)
	Energy efficiency measures showing changes in availability	Not Available	Builders reported that efficient lighting (93% of participating builders), water heaters (92%), central ACs (86%), and furnaces/boilers (83%) had all shown substantial increases in availability during the last few years
	Availability of HERS raters	Not Available	Fewer than half of the non-participating (36%) and participating (43%) builders stated that HERS raters were very or somewhat available
Market Share and Sales	Market penetration of New York ENERGY STAR Homes (including single and 2-4 family markets)	0.3% in 2001 3% in 2002 7.8% in 2003	11.1% in 2004 and 2006
Home Performance with ENERGY STAR Initiative			
Awareness and Knowledge	Homeowner familiarity with energy efficiency measures and equipment	Not Available	81% of the participating home owners reported that their familiarity had increased either significantly or somewhat during the last few years More than half of these participants said "all" or "most" of the increase was due to their participation in the HPwES Program
	Contractor familiarity with energy efficiency measures and equipment	Not Available	89% of the contractors said their familiarity had increased significantly or somewhat during the last few years 87% said "all" or "most" of this increase was due to their participation in the HPwES Program
	Homeowner awareness of BPI	Not Available	38% of participants had heard of the BPI
Perceived Value	Homeowner views on the importance of BPI certification	Not Available	Among those who had heard of the BPI, 82% considered BPI certification very or somewhat important in their selection of a contractor
	Contractors viewing BPI as a selling point	Not Available	36% view BPI as a strong selling point and 30% see it as a moderate selling point
	Homeowner satisfaction with the HPwES program contractors	Not Available	75% of the participating homeowners were very or somewhat satisfied with their contractors

Topic	Indicator	Initial Value (2003, unless noted)	Most Recent (2005, unless noted)
Availability of Services	Contractor promotion of HPwES Program	Not Available	89% of the participating contractors indicated that they were very (53%) or somewhat (36%) actively promoting the HPwES Program
	Participating contractor views on availability of energy efficiency measures and equipment	58% reported that energy-efficient measures and equipment are very available	82% reported that energy-efficient measures and equipment are very available
Market Share and Sales	Penetration of the HPwES Program in the home remodeling market	0.2-0.3% in 2001 0.7-1.1% in 2002 1.7-2.7% in 2003	1.7-2.7% in 2004 2.1-3.3% in 2005

4.4.4 Program Impact Evaluation

This section presents cumulative annual energy savings for the program from inception through December 31, 2006.

Gross Savings

The objective of the Measurement and Verification (M&V) evaluation review is to verify the estimate of the program's cumulative savings. Based on Nexant's review, as of December 31, 2006, the program has resulted in the energy savings and demand reductions shown in Table 4-9. Note that the realization rate shown is applicable to the entire program period.

Net Savings

The final step in determining net energy savings is attribution analysis. Attribution analysis determines, through various methods, whether the gross savings estimate from the M&V activities should be adjusted downward or upward for freeridership or spillover. Adjustments for freeridership and spillover, and the ultimate program net-to-gross ratio and net savings are shown in Table 4-9.

Table 4-9. Single Family Home Performance Program Cumulative Annual Energy and Peak Demand Savings (Through December 2006)

	Program-Reported Savings	Realization Rate	Adjusted Gross Savings	Freeridership	Spillover	Net-to-Gross Ratio[1]	Net Savings
New York ENERGY STAR Labeled Homes Initiative							
MWh/year	7,835	1.01	7,914	28%	47.6%	1.17	9,259
MW On-Peak	0.8	1.11	0.9	28%	47.6%	1.17	1.1
MMBtu	501,588	1.0	501,588	28%	47.6%	1.17	586,858
Home Performance with ENERGY STAR							
MWh/year	12,909	1.01	13,031	26%	41%	1.12	14,595
MW On-Peak	1.9	1.07	2.0	26%	41%	1.12	2.2
MMBtu	573,623	1.0	573,623	26%	41%	1.12	642,458
Single Family Home Performance Program – Total							
MWh/year	20,737	N/A	20,945	N/A	N/A	N/A	23,854
MW On-Peak	2.7	N/A	2.9	N/A	N/A	N/A	3.3
MMBtu	1,075,211	N/A	1,075,211	N/A	N/A	N/A	1,229,316

[1] Net-to-Gross Ratio = 1-Freeridership+Spillover (a weighted average of the NTG ratios estimated in the previous MCAC analysis and this current analysis is shown here).

Non-Energy Impacts

The MCAC team examined non-energy impacts (NEIs) for ENERGY STAR Labeled Homes in 2005, and NEIs for Home Performance were last studied in 2003. Results from the most recent evaluations are shown in Table 4-10.

Table 4-10. Single Family Home Performance NEI Results

Results from Direct Query Approach (year of study)	Percentage of Energy Savings
ENERGY STAR New Homes (2005)	51%
Home Performance with ENERGY STAR (2003)	50%

4.5 Multifamily Building Performance Program

4.5.1 Program Description

The Multifamily Building Performance Program has two tracks: one for new construction (and complete gut-rehabilitation projects) named the ENERGY STAR Multifamily Building Program (EMP); and one for existing buildings named the Multifamily Building Performance Initiative.

Before 2007, construction of new multifamily buildings was addressed through what was then the New Construction Program (now the High Performance New Buildings Program). Because multifamily buildings differ from non-residential buildings, and because market penetration for multifamily buildings was lower than for other building types, NYSERDA has now moved new multifamily building construction to the residential program portfolio. The EMP initiative provides technical assistance to mid-stream market participants, addressing renewable technologies, advanced metering technologies, real-time pricing strategies, and combined heat and power systems, especially for electrically heated buildings with base domestic hot water loads. Training regarding the rationale for energy efficiency measures is also provided for engineers, architects, building owners, building maintenance staff, and tenants.

The Multifamily Building Performance Initiative, for existing buildings, focuses on enhancing the energy services infrastructure. This involves developing market-based business opportunities for building auditors, financial packagers, designers, architects, and construction inspectors. It consolidates several previous multifamily initiatives in order to provide "one-stop shopping" and allow multifamily building owners and developers to find appropriate NYSERDA services more easily. The previous initiatives now incorporated into the Multifamily Building Performance Initiative include the following:

- The Residential Technical Assistance (ResTech) Program, which improved the operation of multifamily housing by identifying and encouraging the implementation of cost-effective energy-efficiency measures that also enhance health, safety, and comfort. Activities supported included: feasibility studies, computer-assisted building modeling, energy-efficiency technical training, and commissioning.
- The Residential Comprehensive Energy Management (CEM) Program, which promoted the acquisition and installation of energy management and advanced metering systems. This program helped position residential customers to take advantage of retail competition, while enabling program implementers to access customers' energy-use data.
- The **New York Energy $mart**^{SM} Loan Fund (Loan Fund) program, which supported the implementation of energy efficiency measures within multifamily buildings. The multifamily component of the Loan Fund provided reduced-interest financing for energy-efficiency measures and related facility improvements. Lending institutions and borrowers in the commercial, industrial, institutional, municipal, multifamily, and residential markets (including building owners and tenants) were all targeted by the program. The Loan Fund provided interest reductions on loan amounts up to $5 million for multifamily homes for up to five years.

Both initiatives in the Multifamily Building Performance Program have low-income components. The low-income component of EMP (for new buildings) provides financial assistance during the design and construction phase to help owners complete the construction process, provides training and education to building owners and managers, and monitors energy savings.

The low-income component of Multifamily Building Performance Initiative (for existing buildings) provides technical and financial assistance to building owners and tenants to make energy efficiency improvements, thus reducing energy bills and providing increased health and safety benefits to building occupants. The low-income component of the Multifamily Building Performance Initiative incorporates many of the features of a previous program, the Assisted Multifamily Program (AMP). The Multifamily Building Performance logic model can be found at the end of Section 4.

The thirteen-year program budget is $189 million. The majority of the budget ($151.2 million) is allocated to the low-income program elements.

4.5.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Multifamily Building Performance Program. These goals and progress for the first six months are shown in Table 4-11.

Table 4-11. Multifamily Building Performance Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Number of existing multifamily units receiving energy efficiency services (completed projects)	7,800	6,803
Number of new multifamily units receiving energy efficiency services	1500	0
Tenant energy savings per unit per year	$250	$214

4.5.3 Long-Term Program Accomplishments

This section highlights key program outputs as identified through the logic model development work and associated market progress. All values reported are cumulative since program inception. Program highlights include the following:

- Since its inception, there have been 79 existing multifamily properties comprising 13,616 individual units that have received efficiency services.

Table 4-12 presents a sample of key logic model-driven indicators of program success, especially those related to market progress, as tracked by the evaluation and program activities

Table 4-12. Multifamily Building Performance Program – Key Market Indicators and Program Cumulative Progress

Topic	Indicator	Initial Value (2004, unless noted)
Awareness and Knowledge	Building owner/manager familiarity with advanced metering	61% of participants (n=36) are somewhat or extremely familiar compared to only 30% of non-participants (n=18)
	Change in building owner/manager familiarity with advanced metering over time	65% of participants (n=36) reported that familiarity has increased somewhat or significantly in the past two years compared to approximately 20% of non-participants
	Promotion of advanced meters	91% of metering providers said promotion of advanced metering services has increased significantly or somewhat (n=15)
Market barriers	Change in market barriers to advanced metering (according to contractors, consultants, manufacturers, and participating building owners/managers)	Decreasing barriers: Lack of experience, high cost of meters, uncertainty about savings, uncertainty about performance, availability of meters Increasing or unchanged barriers: Tenant resistance, regulatory barriers, real time pricing availability

Topic	Indicator	Initial Value (2004, unless noted)
Satisfaction	Building owner/manager satisfaction with advanced meters	88% are extremely or somewhat satisfied with program-installed meters (n=15)
Demand, Market Share/Sales, and Market Penetration	Demand for advanced meters	67% of metering providers indicated that demand for advanced metering services has increased somewhat to significantly over the past two years (n=16) 91% of metering providers believe demand will continue to increase somewhat or significantly over the next two years (n=16)
	Percentage of eligible low-income units participating (projects with installed measures, installation underway, and audits complete)	14.8% (2005 results) 6.1% had audits and installed measures (2005 results) 8.8% had an audit only (2005 results)

4.5.4 Program Impact Evaluation

The objective of the Measurement and Verification (M&V) evaluation review is to verify the estimate of the program's cumulative savings. Based on Nexant's review, as of December 31, 2006, the program has resulted in the energy savings and demand reductions shown in Table 4-13. Note that the realization rate shown is applicable to the entire program period.

Net Savings

The final step in determining net energy savings is attribution analysis. Attribution analysis determines, through various methods, whether the gross savings estimate from the M&V activities should be adjusted downward or upward for freeridership or spillover. Adjustments for freeridership and spillover, and the ultimate program net-to-gross ratio and net savings are shown in Table 4-13.

Table 4-13. Multifamily Building Performance Program Cumulative Annual Energy and Peak Demand Savings (Through December 2006)

	Program-Reported Savings	Realization Rate	Adjusted Gross Savings	Free-ridership	Spillover	Net-to-Gross Ratio[1]	Net Savings
Assisted Multifamily Program (AMP)							
MWh/year	28,362	0.97	27,511	27%	15%	0.84	23,109
MW On-Peak	1.7	1.26	2.1	27%	15%	0.84	1.8
MMBtu	167,303	1.0	167,303	27%	15%	0.84	140,541
Comprehensive Energy Management (CEM) Program							
MWh/year	3,192	0.97	3,096	2%	18%	1.16	3,592
MW On-Peak	0.8	1.77	1.4	2%	18%	1.16	1.6
Low Income Direct Installation							
MWh/year	11,494	1.0	11,494	0%	0%	1.0	11,494
MW On-Peak	1.6	1.0	1.6	0%	0%	1.0	1.6
Multifamily Building Performance Program – Total							
MWh/year	43,048	N/A	42,101	N/A	N/A	N/A	38,209
MW On-Peak	4.1	N/A	5.1	N/A	N/A	N/A	5.0
MMBtu	167,303	N/A	167,303	N/A	N/A	N/A	140,541

[1] Net-to-Gross Ratio = (1-Freeridership) * (1+Spillover).

Non-Energy Impacts

The MCAC team has examined non-energy impacts for both elements of the combined Multifamily Building Performance Program. The Assisted Multifamily Program was studied in 2003, while the Comprehensive Energy Management Program was the focus of an evaluation in 2004. Results are shown in Table 4-14.

Table 4-14. Multifamily Building Performance NEI Results

Results from Direct Query Approach (year of study)	Percentage of Energy Savings
Assisted Multifamily Program (2003)	54%
Comprehensive Energy Management Program (2004)	22-55%

4.6 Market Support Program

4.6.1 Program Description

The **New York Energy $mart**SM Market Support Program provides support services to the building performance and low-income programs by increasing the availability of energy-efficient products, and by providing residential program outreach and marketing services to recruit midstream participants and build consumer demand. The three initiatives involved in this program are the ENERGY STAR Products Initiative, the Program Marketing Initiative, and the GetEnergySmart.org website.

The ENERGY STAR Products Initiative, established in 1999, seeks to increase sales of residential ENERGY STAR appliances, lighting and home electronics products. This initiative works on both the supply and demand sides of the market. Its goals are: 1) to increase the supply of products through partnerships with retailers, manufacturers and distributors, and 2) to create demand for ENERGY STAR products through consumer awareness and understanding of the ENERGY STAR label.

The Program Marketing initiative provides marketing assistance to mid-stream partners, develops and distributes brochures and advertising aimed at consumers, and places advertising. This initiative also performs market research and leverages regional and national initiatives that meet program needs. Program Marketing provides support for the following **New York Energy $mart**SM residential efforts: Single Family Home Performance Program, Multifamily Building Performance Program, summer and winter energy-saving tips campaigns, and leveraged campaigns such as the "Change a Light, Change the World" campaign.

The GetEnergySmart.org website was initially developed to provide consumers with an on-line tool to assess the energy efficiency of their homes, as well as to provide recommendations on how to improve this efficiency. As the website evolved, it also came to provide consumers with program and partner information and energy efficiency tips, and to provide potential program partners with participation information. On-line marketing campaigns and e-mail newsletters were increasingly used to bring consumers to the website. The website has become an essential communication, marketing and education tool for residential programs.

The thirteen-year program budget is $144.2 million.

4.6.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Market Support Program. These goals and progress for the first six months are shown in Table 4-15.

Table 4-15. Market Support Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
New manufacturing partners signed up	4	40
New retail partners (independent) signed up	20	10
New retail partners (big box, mass merchandisers) signed up	1+	1
ENERGY STAR market share increase on targeted products (on average, across products)	5%	3%
Annual energy savings	30 GWh	Not available

Additional program highlights include:

- Acting on a recommendation of the Process Evaluation and MCAC team, the Program increased its recruiting efforts for lighting partners in additional distribution channels. For example, Wegman's Food Markets Inc. became a partner in December 2006, bringing 51 stores into the Program in an area spanning from Buffalo to Binghamton.

- The continued collaboration with the New York State Department of Environmental Conservation on CFL mercury disposal has produced an educational brochure on proper disposal methods for CFLs. Planning for a public training is underway for spring of 2007.

- The Program launched the HVAC Supplier pilot initiative in December 2006 targeting HVAC suppliers who stock ENERGY STAR HVAC equipment. The initiative will be closely tied to the Home Performance with ENERGY STAR Program to ensure that proper installation techniques are being used by partners.

4.6.3 Long-Term Program Accomplishments

This section highlights key program outputs as identified through the logic model development work and associated market progress. Table 4-16 presents the key outputs for the Market Support Program through December 31, 2006. Table 4-17 presents a sample of key logic model-driven indicators of program success, especially those related to market progress, as tracked by the evaluation and program activities. Together, these tables indicate the most important ways that program progress is being measured, and report how those values are changing due to program activities.

Table 4-16. Market Support Program – Key Program Outputs

Outputs	Value (Cumulative through December 2006)
Number of retailer participants	373 (store fronts)
Number of manufacturer partners	22
Dollars spent on cooperative advertising	$14.5 million

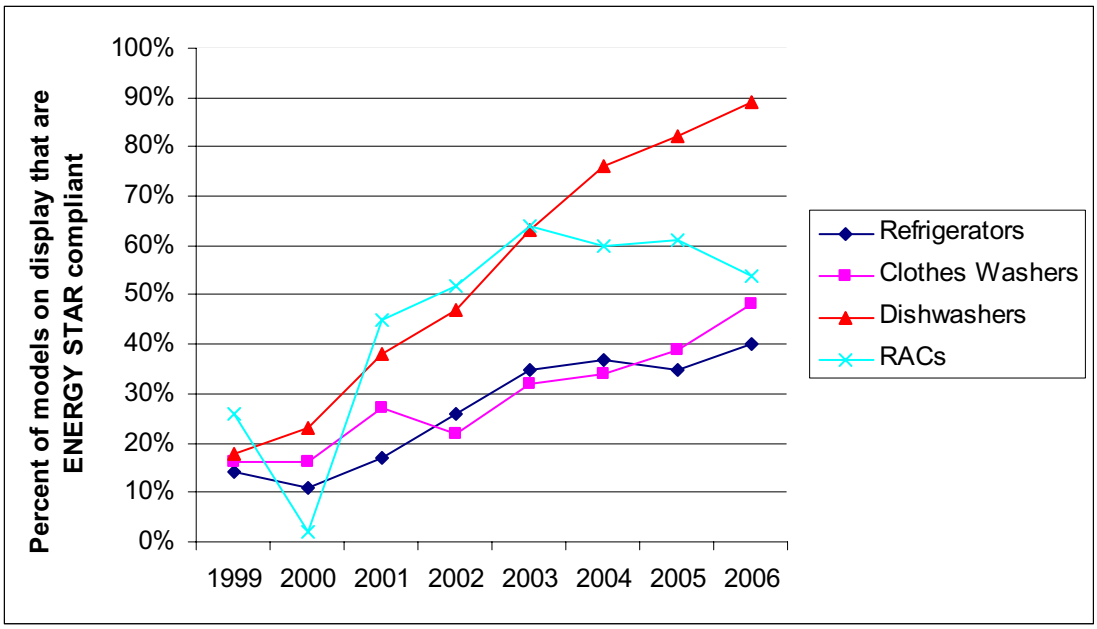
Table 4-17. Market Support Program – Key Market Indicators and Program Cumulative Progress

Topic	Indicator	Initial Value (2003, unless noted)	Most Recent
Energy Savings	Cumulative Net MWh, MW and MMBtu savings	2003 Data 122,600 MWh and 22.7 MW	2005 Data 303,839 MWh, 71.7 MW and 341,920 MMBtu
Awareness and Knowledge	NY consumer awareness of the ENERGY STAR label	1999 Data 34% (aided awareness from NYSERDA mail survey)	2005 Data 77% (unaided awareness from NYSERDA telephone survey)
	Consumer understanding of the ENERGY STAR label	1999 Data 35% 2003 Data 47%	2005 Data 87%
Product Availability	Percent of models on display at partner retailers that are ENERGY STAR qualified See Figure 4-1 for interim data points on appliances.	1999 Data Refrigerators – 14% Clothes Washers – 16% Dishwashers – 18% RACs – 26% CFL Bulbs[1] – 16% All Fixtures – 0-4%	2006 Data Refrigerators – 40% Clothes Washers – 48% Dishwashers – 89% RACs – 54% CFL Bulbs[1] – 24% All Fixtures – 0-33%
	Percent of models on display at non-partner retailers that are ENERGY STAR compliant	Not available	2006 Data CFL Bulbs[1] – 14% CFL Fixtures – 5-39%
Market Share & Sales	ENERGY STAR refrigerator market share	2001 Data 28% NY Partners 16% National Partners in NY[2]	2005 Data 47% NY Partners 52% National Partners in NY[2]
	ENERGY STAR dishwasher market share	2001 Data 48% NY Partners 15% National Partners in NY[2]	2005 Data 76% NY Partners 90% National Partners in NY[2]
	ENERGY STAR clothes washer market share	2001 Data 24% NY Partners 12% National Partners in NY[2]	2005 Data 41% NY Partners 34% National Partners in NY[2]
	ENERGY STAR RAC market share	2001 Data 45% NY Partners 21% National Partners in NY[2]	2005 Data 76% NY Partners 50% National Partners in NY[2]
Incremental Cost	Simple average incremental cost of ENERGY STAR products (% more than non-ENERGY STAR)	2004 Data Refrigerators – $465 (62%) Clothes Washers – $410 (89%) Dishwashers – $174 (47%) RACs – $44 (18%)	2005 Data Refrigerators – $413 (44%) Clothes Washers – $471 (106%) Dishwashers – $159 (37%) RACs – $37 (15%)

[1] Compared to all competing bulbs.

[2] Participating National EPA ENERGY STAR Partner Sales Data, Collected by D&R International.

Figure 4-1. Percent of Appliance Models on Display at Partner Stores that are ENERGY STAR Compliant



Note that the percentage of ENERGY STAR-labeled RACs on display declined in 2000, as shown in Figure 4-1, due to a change in Federal minimum efficiency standards. While this percentage increased after that time, it has been declining since 2003 due to the conclusion of the Keep Cool RAC Bounty Program. Although display of ENERGY STAR RACs has declined, market share of ENERGY STAR RACs remains high among New York retailers (at 76%) relative to other appliances.

4.6.4 Program Impact Evaluation

Gross Savings

The objective of the Measurement and Verification (M&V) evaluation review is to verify the estimate of the program's cumulative savings. Based on Nexant's review, as of December 31, 2006, the program has resulted in the energy savings and demand reductions shown in Table 4-18. Note that the realization rate shown is applicable to the entire program period.

Net Savings

The final step in determining net energy savings is attribution analysis. Attribution analysis determines, through various methods, whether the gross savings estimate from the M&V activities should be adjusted downward or upward for freeridership or spillover. Adjustments for freeridership and spillover, and the ultimate program net-to-gross ratio and net savings are shown in Table 4-18.

Table 4-18. Market Support Program Cumulative Annual Energy and Peak Demand Savings (Through December 2006 unless noted)

	Program-Reported Savings	Realiza-tion Rate	Adjusted Gross Savings	Free-ridership	Spillover	Net-to-Gross Ratio[1]	Net Savings
ENERGY STAR Products and Marketing (2005) [2]							
MWh/year	n/a	n/a	n/a	n/a	n/a	n/a	238,828
MW On-Peak	n/a	n/a	n/a	n/a	n/a	n/a	54.0
MMBtu	n/a	n/a	n/a	n/a	n/a	n/a	325,628
Keep Cool							
MWh/year	29,460	1.0	29,460	18%	15%	0.94	27,781
MW On-Peak	13.6	1.0	13.6	18%	15%	0.94	12.8
Bulk Purchase							
MWh/year	19,451	2.03	39,397	10%	5%	0.95	37,230
MW On-Peak	3.9	1.62	6.4	10%	5%	0.95	6.0
MMBtu	24,307	0.71	17,240	10%	5%	0.95	16,292
Market Support Program – Total							
MWh/year	n/a	n/a	n/a	n/a	n/a	n/a	303,839
MW On-Peak	n/a	n/a	n/a	n/a	n/a	n/a	72.8
MMBtu	n/a	n/a	n/a	n/a	n/a	n/a	341,920

[1] Net-to-Gross Ratio = (1-Freeridership) * (1+Spillover).

[2] Savings for ENERGY STAR products and marketing are through year-end 2005. Year-end 2006 savings are currently being estimated by the MCAC evaluation team and will be presented in the first quarter 2007 report.

Non-Energy Impacts

The MCAC team has examined non-energy impacts for CFLs and clothes washers. Results from the most recent direct query analysis on both of these measures are shown in Table 4-19.

Table 4-19. Market Support Program NEI Results

Results from Direct Query Approach (year of study)	Percentage of Energy Savings
Clothes Washers (2004)	27%
CFLs (2005)	60%

4.7 Communities and Education Program

4.7.1 Program Description

The Communities and Education Program provides face-to-face contact with New York residents on energy efficiency topics and NYSERDA programs through schools, local seminars and workshops, and events. The ultimate goal of the program is to help develop an energy-conscious society in New York with the desire and capability to create more efficient and sustainable communities. More immediate goals of the program include: 1) educating teachers, students, homeowners, renters, representatives of

community-based organizations, and community leaders on various energy topics, including energy efficiency and the relationship between energy, sustainability, and economic development in their communities; and 2) making them aware of **New York Energy $mart**[SM] programs that can be combined with local, State, and federal resources to reduce energy consumption in their communities. The two initiatives making up this program are Energy Smart Students (ESS) and **New York Energy $mart**[SM] Communities (NYE$C).

Beginning in 2004, ESS introduced energy and energy efficiency curricula to New York's K-12 teachers and students. ESS offers hands-on, project-based lessons which are aligned with the New York State Learning Standards for math, technology, language arts, science, and social studies. ESS has also introduced building sciences to vocational schools, laying the groundwork for the growth of the building performance specialists industry. EES offers one-day workshops for classroom teachers and other educators on energy literacy, science of energy, energy efficiency at home and at school, and more specialized topics, such as bio-diesel and hydrogen. Teachers attending the workshops are provided with a curriculum for grade levels K-12. The curriculum offers teachers the ability to select modules of varying lengths based on the needs of the students. ESS also sponsors an annual Energy Educator Conference to provide more intensive training to teachers willing to commit to assisting ESS with the training of other teachers. ESS offers teachers mini-grants to fund innovative energy projects in the classroom and community. The program also produces *Energy Smarts*, a bi-monthly newsletter devoted to energy education. In addition, the program participates in statewide teacher conferences and organizations, including the NYS Technology Educators Association and the Science Teachers Association of New York State.

NYE$C was developed as a partnership with the U.S. Department of Energy's Rebuild America Program. This initiative educates consumers and community leaders on the benefits of energy efficiency and renewable resources, and their ability to impact their own energy costs, using the community infrastructure to increase message reach and impact. NYE$C also provides ready access to **New York Energy $mart**[SM] programs by referring building owners and managers to appropriate program entry points. The initiative includes nine partnerships throughout New York State: Western New York, Finger Lakes Region, Central New York, Southern Tier, North Country, Capital Region, Mid-Hudson, and two partnerships in New York City. Throughout the year, the partnerships sponsor seminars and workshops, meet with community leaders, and staff the NYSERDA booth at local events, for the following purposes: to educate the public on saving energy at home and in the workplace; to provide public forums for the discussion of energy issues important to their community; and to work with planners in their communities to ensure that energy is addressed in local ordinances and growth plans. In addition, NYE$C has primary responsibility for recruiting builders, contractors, retailers, realtors, code officials, architects, engineers and others into the residential programs as mid-stream partners, thus eliminating the need for multiple program implementation contractors to recruit partners within the same regions, and reducing confusion and redundancy in the marketplace.

The thirteen-year program budget is $12.6 million.

4.7.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Communities and Education Program. These goals and progress for the first six months are shown in Table 4-20. Slow progress on the goal for recruiting seminars is due to transitioning this role from prior implementation contractors to the Energy $mart Communities coordinators.

Table 4-20. Communities and Education Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Teachers trained	1,000	308
Students reached	30,000	14,569
Community events held statewide	200	73
Recruiting seminars held statewide	100	0
Home performance contractors, technicians, builders and raters recruited for the Single Family Home Performance Program	160	36
Building analysts, designers, energy consultants, equipment installers, etc. recruited for Multifamily Building Performance Program	20	Not available

4.7.3 Long-Term Program Accomplishments

This section highlights key program outputs as identified through the logic model development work and associated market progress. All values reported are cumulative since program inception. Program highlights include the following:

- Since its inception, there have been 1,701 teachers trained on teaching about energy issues at 76 workshops. All 76 workshops received free use of space and promotional assistance from the host organization. In addition, 18 workshops received funding from utility and government.
- An estimated 180,000 students have been reached.
- 42 students participated in ten completed Energy Education Grants with a total of 2,800 students impacted and an estimate of 41,000 parents and community members reached.
- More than 800 meeting and outreach sessions have been held, attracting more than 97,000 attendees.

Table 4-21 presents the key logic model-driven outputs for the Communities and Education Program through December 31, 2006.

Table 4-21. Communities and Education Program – Key Program Outputs

Outputs	Value (Cumulative through December 2006)
Energy Smart Students Initiative	
Number of teacher conferences attended to promote ESS	25
Number of energy curricula offered	4 core workshops and 4 specialty workshops
Number of workshops	76
Number of teachers (including administrators) trained on energy education topics	1,701
Number of student-centered events attended	13
Number of energy education projects awarded through mini grants)	40

4.8 EmPower New York^{SM}

4.8.1 Program Description

The EmPower New York^{SM} Program is part of NYSERDA's portfolio of **New York Energy $mart^{SM}** programs that serve low-income households in the state. Customers of SBC-participating utilities with incomes below 60% of state median income and households enrolled in utility low-income payment assistance programs are eligible for services. Both property owners and tenants may be served, and the program targets 1-to-4 family homes and multifamily buildings with fewer than 100 units. Priority is given to:

- Households participating in utility low-income programs
- Seniors referred by Offices for the Aging due to financial hardship
- Eligible households receiving services that are coordinated or co-funded by the Weatherization Assistance Program (WAP, run by the New York Division of Housing and Community Renewal, and funded by the U.S. Department of Energy), so as to create comprehensive work scopes that include appropriate electric reduction measures
- Eligible households in buildings not eligible for services through WAP
- Smaller buildings eligible for the Multifamily Building Performance Program that NYSERDA determines are better served through EmPower NewYork^{SM}

EmPower New York^{SM} prioritizes cost-effective electric efficiency measures, particularly lighting and refrigerator replacements. Home performance services, such as insulation, heating system repair and replacement, and air-sealing, are provided in situations where they offer the best means of improving energy affordability. Health and safety measures, such as carbon monoxide (CO) detectors and

emergency repairs, are also implemented as the need arises. Whenever possible, services are coordinated and cost-shared with WAP.

All customers that are referred to the program receive a package of information with educational materials, three CFL light bulbs, a water temperature thermometer, and a nightlight. These households are called "partial participants." Households expected to benefit from more comprehensive treatments receive energy audits and in-home energy education, and additional electric reduction measures (e.g., CFLs and ENERGY STAR-compliant refrigerators) or home performance measures as appropriate. These households are "full participants." There is no cost to the customer for these services and equipment. In rental situations, measures that directly benefit the eligible tenant may be installed without a landlord contribution. Additional measures generally require a 25% landlord contribution. The program also provides free workshops on energy use and financial management offered to the general public by the Cornell Cooperative Extension. Program audit and installation services are provided through a network of weatherization agencies and private energy services contractors, all of whom are accredited by the Building Performance Institute (BPI).

Effective July 2006, the Weatherization Network Initiative was merged with EmPower New York. The Weatherization Network Initiative was launched in 2003 to deliver electric reduction measures through the statewide network of weatherization agencies in coordination with the Weatherization Assistance Program. A total of 5,693 households received services through the Weatherization Network Initiative. The total cost was $7.8 million with an average cost of $670 and average annual savings of $174 per household. As services are tailored to the needs of the household, actual costs and savings can vary from the average by an order of magnitude or more. EmPower expanded the involvement of these weatherization agencies while adding private contractors to ensure cost-effective and timely services.

The combined SBC budget through June 2011 is $58.3 million. In addition, the program has leveraged non-SBC funds totaling $6,250,000 to install efficiency measures for an additional 4,489 households. Table 4-22 displays details of the budget and goals of the non-SBC funding sources.

Table 4-22. Non-SBC Funds Leveraged

Source	Budget	Unit Goal	Expended	Completions
Indian Point 2 Joint Proposal	$2,400,000	2,200	$1,915,367	1,939
Western New York Environmental Projects	$895,000	1,000	$169,663	280
National Grid Low Income Gas Customer Efficiency Program	$2,500,000	1,075	$1,995,769	959
AES Environmental Mitigation Project	$455,000	255	0	0
Total	$6,250,000.00	4,530	$4,080,799.00	3,178

4.8.2 Recent Program Accomplishments

One near-term, annual goal has been set for the EmPower New York^{SM} Program. This goal and progress for the first six months are shown in Table 4-23.

Table 4-23. EmPower New York^{SM} Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Households served (completed)	6,300	3,289

4.8.3 Long-Term Program Accomplishments

This section highlights key program outputs as identified through the logic model development work and associated market progress. All values reported are cumulative since program inception. Program highlights include the following:

- The EmPower New York^{SM} Program including the Weatherization Network Initiative (non-SBC funding) has served 15,544 low-income households in New York.
- The energy cost for the average low-income household served by the program has been reduced by $226 per year at a cost of $1005.

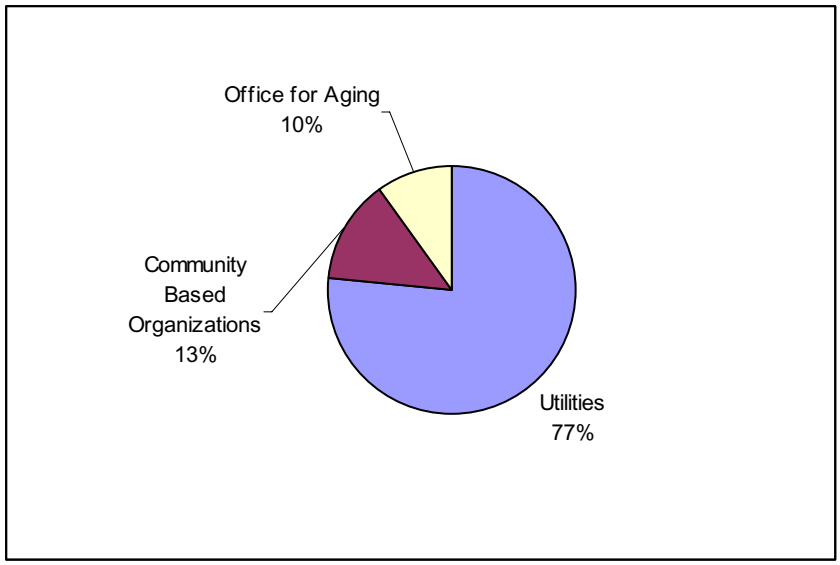
Table 4-24 presents a sample of key logic model-driven indicators of program success, especially those related to market progress, as tracked by the evaluation and program activities.

Table 4-24. EmPower New York^{SM} Program – Key Market Indicators and Program Cumulative Progress (SBC-funded only)

Topic	Indicator	Most Recent (2006, unless noted)
Recruitment of Low-Income Households	Number of WAP agency referrals to program	7,313 See Figure 4-2 for more information on the source of referrals.
	Number of participants selected for comprehensive audit, education, electric reduction, and Home Performance services	18,365
	Number and types of community-based organizations working with program	34 Offices for the Aging, 8 Local Department of Social Services, 6 Housing Agencies, and 18 other Community Based Organizations
	Number of WAP agencies working with program	60
	Number of utilities working with program	6
	Number of energy services contractors working with program	75

Topic	Indicator	Most Recent (2006, unless noted)
Low-income Households and Buildings Served	Number of audits completed	16,096
	Participants receiving print and in-home education	23,336
	Participants attending energy and financial management workshops	8,030 attendees in 841 workshops
	Number of low-income buildings with energy efficient equipment installed	15,544

Figure 4-2. Referrals to EmPower by Source



4.8.4 Program Impact Evaluation

This section presents cumulative annual energy savings for the program from inception through December 31, 2006. Savings for the EmPower Program are shown in Table 4-25. M&V and attribution analysis have not been conducted on this program. Therefore, no adjustments have been made to the program reported savings.

Table 4-25. EmPower New York^{SM} Program Cumulative Annual Energy and Peak Demand Savings (Through December 2006)

	Program-Reported Savings	Realization Rate	Adjusted Gross Savings	Net-to-Gross Ratio	Net Savings
MWh/year	27,933	Not Evaluated	27,933	Not Evaluated	27,933
MW On-Peak	3.3	Not Evaluated	3.3	Not Evaluated	3.3
MMBtu	66,891	Not Evaluated	66,891	Not Evaluated	66,891

4.8.5 Program Recommendations and Process Evaluation

The process evaluation team, Research Into Action, conducted a short-term analysis of NYSERDA's EmPower New York^{SM} program, with a specific focus on a pilot involving six participating contractors in 2006. The results presented below are based upon program data and interviews with NYSERDA staff, program implementation management and staff from Honeywell, and interviews with representatives from six contractors who deliver services to households under the EmPower New York^{SM} program.

The pilot was conducted in mid-2006 to waive the pre-approval process for selected commonly installed measures under the EmPower New York^{SM} program. The purpose of the pilot was to speed up the job completion process by eliminating the pre-approval step.[1] Six contractors who expressed interest in the program change participated in the pilot and were interviewed as to their experiences; an analysis of pilot contractor activity level statistics compared to those of non-pilot contractors was also conducted.

Results of the pilot were largely positive for the six participants. They reported shorter turnaround times for jobs, due to elimination of the pre-approval step, and a strong level of support for the streamlined process. Their reports are substantiated by the data reviewed: pilot contractors completed jobs faster than non-pilot contractors. Results of the pilot were mixed from the perspective of the implementation contractor.[2] Most agencies and jobs complied with the pilot requirements; however, a few projects in the pilot did not follow procedures and this led to disputes regarding payments.

As the program continues using this approach, program staff should continue to monitor the program and note whether there are any increases in administrative costs to check work scopes after the fact or if there is an increase in disputed jobs. Staff are addressing these issues in a statewide expansion plan and planning for ways to extend the privilege selectively such that a process for ensuring compliance is established.

Based on the experiences of those involved in the pilot, there are pros and cons to the pilot approach, resulting in a mixed set of experiences. The agencies that participated reported that the approach worked better for them however, it is also clear that it took a while for some to learn the new system and one or more of the contractors did not read the guidelines carefully. The recommendations that follow are

[1] In the pre-approval step, the program implementation contractor would approve the project work scope. NYSERDA program staff felt that responsibility for work scope approval more appropriately rested with participating contractors, instead of the implementation contractor. This change also enhances the professionalism of the participating contractors who also take on responsibility for completing the energy analysis that drives measure selection using various audit software.

[2] The implementation contractor notes that its perspective has changed based on the refinements to direct installation approach and feels satisfied that this approach will be successful.

suggested by this evaluation as the Direct Installation process is expanded statewide. Program staff note that these recommendations are currently being instituted.[3]

Recommendations

1. NYSERDA should expand the program gradually to enable more contractors and agencies to become familiar with the new guidelines under the direct install approach. This expansion should include offering the direct installation approach to contractors with experience in the program who have demonstrated high quality work and knowledge of the program rules and high quality work.

2. NYSERDA should offer the direct installation approach to contractors with experience in the program who have demonstrated high quality work and knowledge of the program rules and high quality of work.

3. NYSERDA must continue to work with the implementation contractor to evolve clear guidelines for Direct Installation.

4. The implementation contractor must ensure that guidelines are clearly communicated to the contractor.

5. The implementation contractor must be clear and direct in implementing such guidelines. Over time, this clarity of procedure will reduce post-invoice conflicts.

6. Contractors must take responsibility for becoming familiar with and following the guidelines that are provided.

4.9 Buying Strategies and Energy Awareness Program

4.9.1 Program Description

The Buying Strategies and Energy Awareness Program is part of NYSERDA's portfolio of **New York Energy $mart**[SM] programs serving low-income households in the state. The Buying Strategies and Energy Awareness Programs consist of four initiatives:

- ***Buying Strategies*** – This initiative works with the Office of Temporary and Disability Assistance (OTDA) to secure discounts on purchases of home heating oil for customers of the federally funded Low Income Home Energy Assistance Program (LIHEAP) customers.[4] The initial Buying Strategies pilot program was launched in 2003 and tested a variety of strategies for securing reduced prices for home heating oil. Using "margin over rack" and "discount off retail" buying strategies, the program has increased the buying power of LIHEAP funds for heating oil by 7 to 13 percent, saving about $50 per year per household. Based on the successes of the earlier pilot efforts, the Office of Temporary and Disability Assistance committed to a three-year phased implementation of the

[3] Program staff noted that NYSERDA is committed to offering training to its contractors in the use of TREAT, the software used by Home Performance with ENERGY STAR. Enhancing the skills and knowledge of its contractors is an important reflection of NYSERDA's commitment to a market transformation approach.

[4] Customers whom have an annual income of 60 percent or less than the State Median Income.

program. During the 2005-2006 heating season, the Buying Strategies program included 20 counties, and 200 oil vendors participated in the program. The program expanded its offerings to 39 counties during the 2006-2007 heating season (with a total of 317 participating oil vendors) and plans to reach all 62 counties in New York for the 2007-2008 heating season.

The Buying Strategies initiative includes a preventive maintenance component for oil-fired heating systems. Under LIHEAP, recipients are offered heating repair and replacement assistance for inoperable furnaces, but they are not offered preventive maintenance services. The Buying Strategies maintenance component addresses this gap by providing maintenance services, resulting in increased efficiencies for operating heating systems and reduced health risks and safety problems due to malfunctioning systems. The "Clean & Tune" service is currently available to LIHEAP customers of participating oil vendors as an incentive to offer the discount on oil purchases.

The newest component of the Buying Strategies initiative will provide technical assistance to OTDA and local Departments of Social Services in the delivery of the Heating Equipment Repair and Replacement component of New York's enhanced version of LIHEAP. At the close of December 2006, negotiations were underway with a contractor selected through RFP 1005 to provide quality assurance for the New York-specific HEAP Heating Equipment Repair and Replacement component. Subject to agreement by OTDA, the quality assurance services will begin with a several month-long pilot in up to seven counties. A plan for expansion of services statewide will then be developed with OTDA based on the lessons learned in the pilot.

- ***Targeted Marketing and Outreach*** – This initiative works to increase participation in all NYSERDA-, State-, Federal-, utility- and community-based low-income energy efficiency and energy assistance programs. The initiative targets hard-to-reach (HTR) customers such as the elderly, the low-income population, and the non-English speaking population, delivering messages specifically tailored for these groups to make sure they can make informed choices about their options for reducing energy costs. The initiative supplements existing marketing activities and distributes information through events, seminars and meetings sponsored by community-based organizations (CBOs). It also places print advertisements and articles in publications and newspapers that are specifically designed to reach low-income and other HTR populations, as well as radio advertising.

- ***Low-Income Forum on Energy (LIFE)*** – LIFE provides a forum where energy industry professionals, policy makers, low-income serving agencies, and energy program implementers can discuss issues relevant to the low-income sector. LIFE conducts large statewide conferences, smaller regional meetings and steering committee meetings to share information about emerging issues and best practices.

- ***Energy Smart Students*** – The Buying Strategies and Energy Awareness Program contributes funding to the Energy Smart Students (ESS) Program, which is described in Section 4.8 above.

The program budget is $17.7 million.

4.9.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Buying Strategies and Energy Awareness Program. These goals and progress for the first six months are shown in Table 4-26.

Table 4-26. Buying Strategies and Energy Awareness Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Funds leveraged through Buying Strategies initiative	$4 million	Not available
Additional low-income individuals reached via newsletters, weekly newspapers, etc. (readership)	1,000,000	240,000
Additional low-income individuals reached via seminars and workshops (attendees)	3,000	7,625
Additional contractors and other partners recruited in low-income districts	10	6
Additional students reached in schools serving low-income populations (number of individuals given educational materials)	20,000	9,137

4.9.3 Long-Term Program Accomplishments

This section highlights key program outputs as identified through the logic model development work and associated market progress. All values reported are cumulative since program inception. Program highlights include the following:

- Forty-four companies have signed Participation Agreements to participate in the Clean and Tune service under Buying Strategies.
- The price savings per gallon of fuel delivered through the Buying Strategies Initiative averaged $0.13, assuming an average LIHEAP grant of $400, the average out-of-pocket savings per LIHEAP client for the heating season is about $44.
- An estimated 9,137 low-income students will benefit from improved energy education as a result of workshops held by the Energy Smart Students program in the past six months.

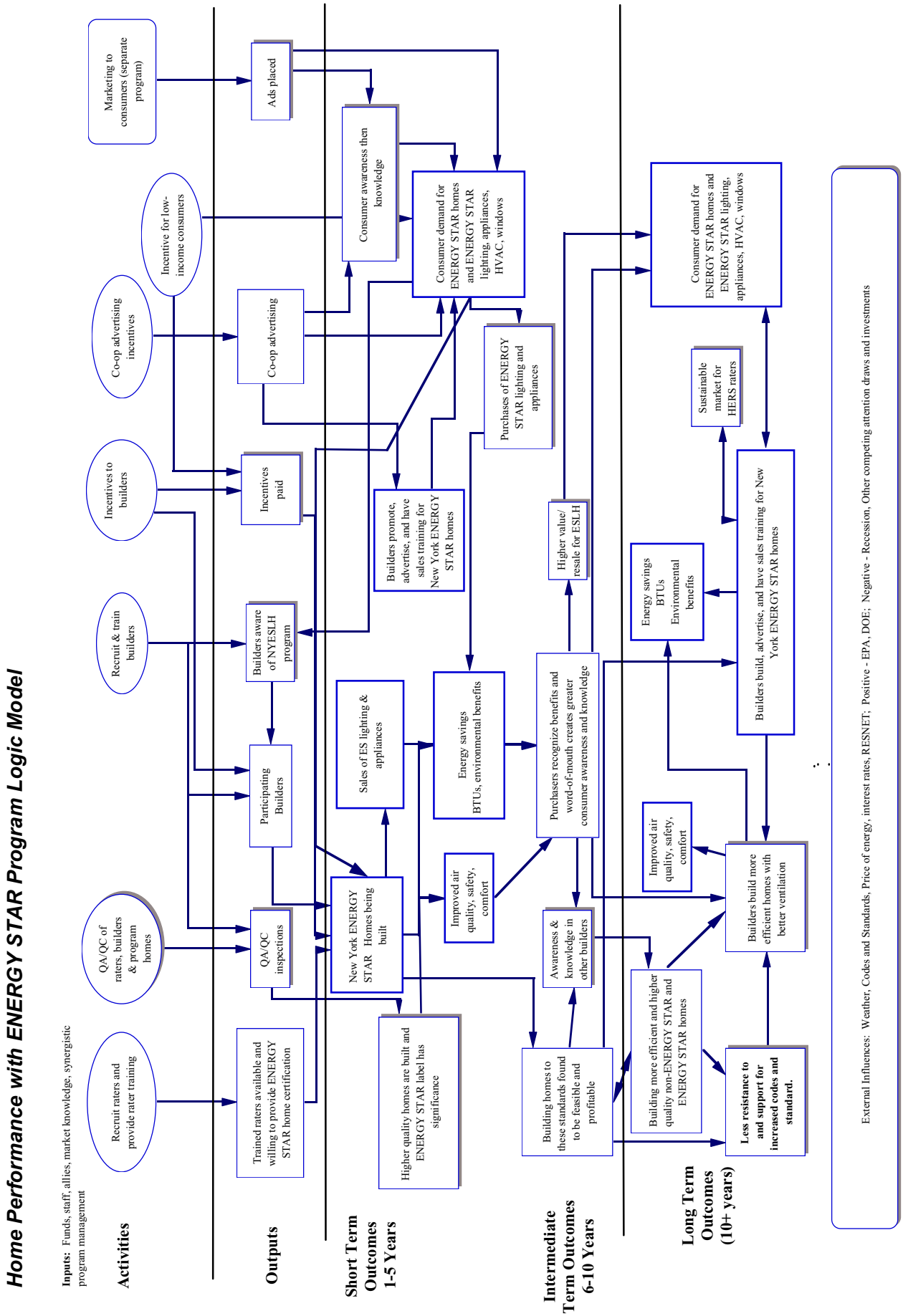
Table 4-27 presents the key outputs for the Buying Strategies and Energy Awareness Program through December 31, 2006. Table 4-28 presents a sample of key logic model-driven indicators of program success, especially those related to market progress, as tracked by the evaluation and program activities. Together, these tables indicate the most important ways that program progress is being measured, and report how those values are changing due to program activities.

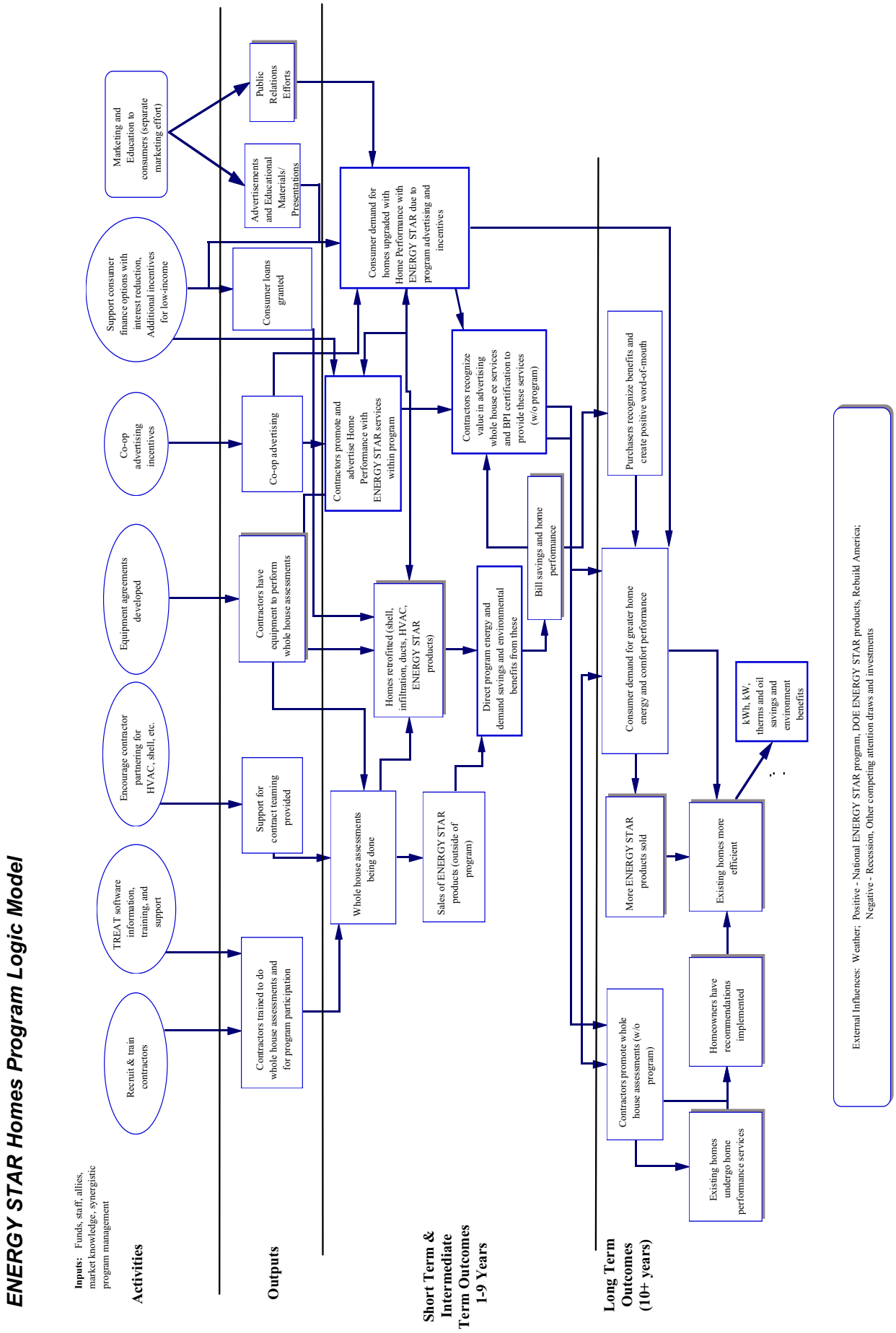
Table 4-27. Buying Strategies and Energy Awareness Program – Key Program Outputs

Outputs	Value (Cumulative through December 2006)
Buying Strategies	
Total number of participating oil vendors	317
Number of clean and tune contractors enrolled	44
Number of clean and tune services	496
Number of oil buying educational material distributed (includes materials sent out by OTDA and NYSERDA)	50,000
Low-Income Forum on Energy (LIFE)	
Numbers of LIFE Steering Committee members	24 member organizations
Number of LIFE meetings and conferences held	28 regional meetings, 5 statewide conferences
Number of attendees at LIFE meetings and conferences	1,117

Table 4-28. Buying Strategies and Energy Awareness Program – Key Market Indicators and Program Cumulative Progress

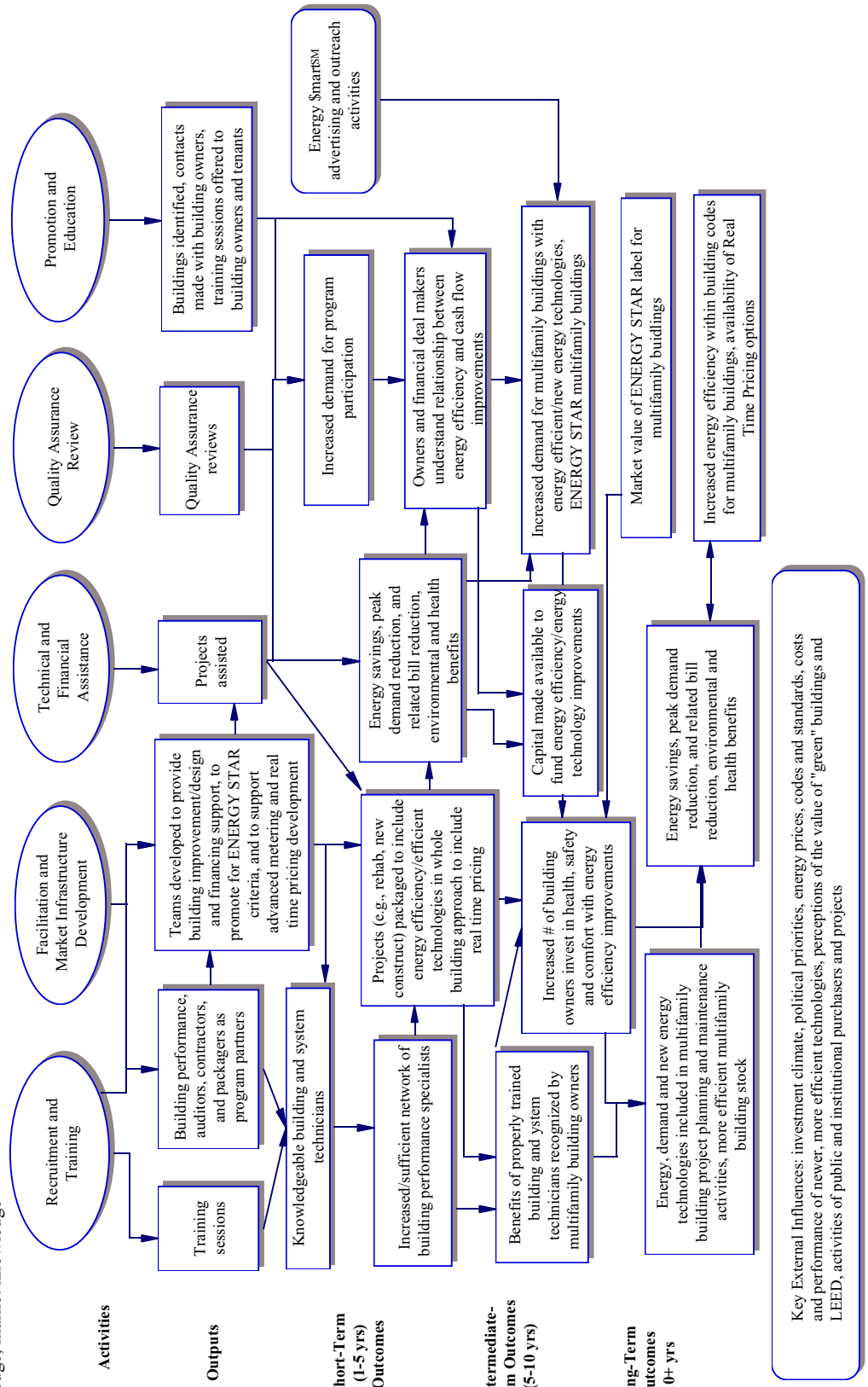
Topic	Indicator	Initial Value (2003, unless noted)	Most Recent (2006, unless noted)
Buying Strategies			
Availability of services	Number of Clean and Tune services provided	0	496
	Number of DSS agencies working with HEAP/Oil Buying	5	39
	Number of oil dealers participating	0	317
	Number of participating heating equipment service providers by type	0	44


Home Performance with ENERGY STAR Program Logic Model
Inputs: Funds, staff, allies, market knowledge, synergistic program management
Activities
Outputs
Short Term Outcomes 1-5 Years
Intermediate Term Outcomes 6-10 Years
Long Term Outcomes (10+ years)
Marketing to consumers (separate program)
Incentive for low-income consumers
Co-op advertising incentives
Incentives to builders
Recruit & train builders
QA/QC of raters, builders & program homes
Recruit raters and provide rater training
Ads placed
Co-op advertising
Incentives paid
Builders aware of NYESLH program
Participating Builders
QA/QC inspections
Trained raters available and willing to provide ENERGY STAR home certification
Consumer awareness then knowledge
Consumer demand for ENERGY STAR homes and ENERGY STAR lighting, appliances, HVAC, windows
Builders promote, advertise, and have sales training for New York ENERGY STAR homes
Sales of ES lighting & appliances
New York ENERGY STAR Homes being built
Higher quality homes are built and ENERGY STAR label has significance
Purchases of ENERGY STAR lighting and appliances
Energy savings BTUs, environmental benefits
Improved air quality, safety, comfort
Higher value/ resale for ESLH
Purchasers recognize benefits and word-of-mouth creates greater consumer awareness and knowledge
Awareness & knowledge in other builders
Building homes to these standards found to be feasible and profitable
Consumer demand for ENERGY STAR homes and ENERGY STAR lighting, appliances, HVAC, windows
Sustainable market for HERS raters
Energy savings BTUs Environmental benefits
Builders build, advertise, and have sales training for New York ENERGY STAR homes
Improved air quality, safety, comfort
Builders build more efficient homes with better ventilation
Building more efficient and higher quality non-ENERGY STAR and ENERGY STAR homes
Less resistance to and support for increased codes and standard.
External Influences: Weather, Codes and Standards, Price of energy, interest rates, RESNET; Positive - EPA, DOE; Negative - Recession, Other competing attention draws and investments


ENERGY STAR Homes Program Logic Model
Inputs: Funds, staff, allies, market knowledge, synergistic program management
Activities
Outputs
Short Term & Intermediate Term Outcomes 1-9 Years
Long Term Outcomes (10+ years)
Recruit & train contractors
TREAT software information, training, and support
Encourage contractor partnering for HVAC, shell, etc.
Equipment agreements developed
Co-op advertising incentives
Support consumer finance options with interest reduction, Additional incentives for low-income
Marketing and Education to consumers (separate marketing effort)
Contractors trained to do whole house assessments and for program participation
Support for contract teaming provided
Contractors have equipment to perform whole house assessments
Co-op advertising
Consumer loans granted
Advertisements and Educational Materials/ Presentations
Public Relations Efforts
Whole house assessments being done
Contractors promote and advertise Home Performance with ENERGY STAR services within program
Consumer demand for homes upgraded with Home Performance with ENERGY STAR due to program advertising and incentives
Homes retrofitted (shell, infiltration, ducts, HVAC, ENERGY STAR products)
Sales of ENERGY STAR products (outside of program)
Direct program energy and demand savings and environmental benefits from these
Contractors recognize value in advertising whole house ee services and BPI certification to provide these services (w/o program)
Bill savings and home performance
Contractors promote whole house assessments (w/o program)
More ENERGY STAR products sold
Consumer demand for greater home energy and comfort performance
Purchasers recognize benefits and create positive word-of-mouth
Existing homes undergo home performance services
Homeowners have recommendations implemented
Existing homes more efficient
kWh, kW, therms and oil savings and environment benefits
External Influences: Weather; Positive - National ENERGY STAR program, DOE ENERGY STAR products, Rebuild America; Negative - Recession, Other competing attention draws and investments

Multifamily Building Performance Logic Model

Inputs: Funds, staff, allies, awareness and credibility of NYSERDA, trade ally and contractor knowledge, market knowledge



5

Research and Development Programs

5.1 Overview of the Research and Development Programs

NYSERDA's Research and Development (R&D) activities are organized into five primary program areas: energy resources, transportation and power systems, environment, industry, and buildings. Projects in each of these program areas address technologies and mechanisms that affect the energy supply and meet the needs of end users. As a result, crosscutting areas such an environmental protection, waste management, energy product development, and renewable energy technologies are addressed in several programs.

Public Benefit Power Transmission and Distribution Research. The new Public Benefit Power Transmission and Distribution Research Program will support transmission and distribution (T&D) research that has broad statewide benefits. Projects will provide improvements to power reliability, quality and security, and reduce the cost of energy and energy delivery. The New York State Independent System Operator (NYISO) and the New York State Reliability Council (NYSRC) are key stakeholders in the T&D research program, and NYSERDA will coordinate with both of these entities.

Clean Energy Infrastructure. The previous End-Use Renewables (EUR) Program has provided the foundation for the creation of the Clean Energy Infrastructure Program. Clean Energy Infrastructure efforts will be closely integrated with other SBC-funded efforts, such as Distributed Energy Resources, to develop and commercialize clean energy technologies. The ultimate goal of these programs is to reach a point where the value of the technology is worth the investment required by the consumer, and the market infrastructure is in a position to deliver and support the technology over the long term. This program will also complement efforts under the Renewable Portfolio Standard (RPS) by supporting training, education and market development for RPS-eligible technologies such as photovoltaics. The Clean Energy Infrastructure funds may also be used to reduce the installation and operating cost of systems not eligible for RPS funding.

Power Systems Product Development. The goal of this program is to work with New York technology companies to develop distributed generation and storage products and expand the number of marketable competitive products that reduce peak load, improve power quality, and provide improved cost-effective environmental performance. The Power Systems Product Development Program supports New York State business in all aspects of product development necessary to create and commercialize power generating products that are clean, efficient, reliable, and cost effective, as well as other products that reduce peak demand or improve end user power quality. Additionally, the program focuses on New York State specific issues such as economic development and job creation in the State; targets technologies and opportunities that are not being addressed by the market; addresses regulatory barriers to the adoption of

superior new technologies; and, emphasizes the development of economically competitive options for end users.

DG-CHP Demonstration. The DG-CHP Demonstration Program will contribute to the growth of combined heat and power and other distributed generation applications in New York. The program provides funding for site-specific feasibility studies and demonstrations and seeks to improve awareness of end-users and project developers of DG-CHP. The program also seeks to address DG-related issues such as DG permitting; Standard Interconnection Requirements (SIR); utility standby service; tariffs; technology risk; renewable fuel options such as anaerobic digester and landfill gas; and the impact of fluctuating prices of natural gas. The program uses financial incentives to encourage customer-sited DG using commercially available DG technologies such as reciprocating engines. The program will be coordinated with similar offerings from RPS Customer-Sited tier and Consolidated Edison's System Wide Demand Reduction programs.

Demand Response and Innovative Rate Research. This new initiative supports participation by small customers in the NYISO's wholesale demand response and time-sensitive retail electric pilots. Residential and small commercial loads constitute a small percentage of participants in these programs because of their relatively small loads, the high cost of aggregation, and the lack of flexible metering options and other load control technologies. The program promotes the development, demonstration, and use of end-use technologies that have flexible load capabilities, such as air conditioners and lighting that are enhanced with features that allow remote access and group control for easier load reduction in response to peak demand and price signals. Additionally, the program's time-sensitive pilots promote the development of innovative electric service rates by energy services companies. The program concentrates on the New York City metropolitan area where capacity is particularly constrained and value propositions for load reductions are most desirable.

Electric Transportation. The program supports emerging technologies from inception through field testing and pre-commercial deployment. The benefits of the electric transportation program will include peak load reduction in the New York City load pocket and permanent energy use reductions. These reductions will result in cost reductions to the subway and commuter rail systems and reduced transmission congestion in the region. Additionally, many projects are expected to reduce transportation costs and emissions from petroleum fueled vehicles.

Environmental Monitoring, Evaluation, and Protection. The Environmental Monitoring, Evaluation and Protection Program (EMEP) commenced in the late 1990s in an effort to increase understanding of the environmental impacts of electricity production. EMEP initiatives are building on past efforts and evolving to support research in three primary areas: ecosystem response to sulfur, mercury and nitrogen deposition; health and energy-related research on air quality, particulate matter, ozone and co-pollutants; and crosscutting environmental science, technology and policy projects. The program is guided by a steering committee comprised of major stakeholder groups. In addition a separate science advisory committee continues to provide technical review. The program has maintained a robust science and policy communication component to deliver program findings to policy-makers, scientists, and the public. The EMEP program closely collaborates with regional and national entities to leverage funds for pertinent research projects.

Industrial Research, Development, and Demonstration. The Industrial Research, Development, and Demonstration (IRDD) program supports feasibility studies and technology demonstrations that: (1) improve energy productivity and competitiveness of New York manufacturers (minimize cost per unit output), (2) encourage capital investment and employment growth in New York State facilities, (3) introduce New York State-manufactured goods into new markets, and (4) encourage adoption of process changes that minimize waste. Cost-shared demonstration projects reduce risk and encourage

manufacturers to adopt innovative and underutilized process alternatives. IRDD is a collaborative effort of Industrial and Environmental R&D and Energy Efficiency Services.

Municipal Water and Wastewater Efficiency. The Municipal Water and Wastewater Efficiency initiative is a collaborative effort between NYSERDA's R&D and Energy Efficiency Services programs. Since 2000, the ongoing water and wastewater initiative has supported projects that accelerate the use of energy-efficient and innovative technologies by municipal water and wastewater systems in New York through demonstrations, technology transfer, and feasibility studies. The program's latest solicitation is a sector-based initiative, under the Energy Smart Focus Program, where municipal water and wastewater is one of the five sectors selected to receive services. All activities to date have had strong technology transfer components, and municipal water and wastewater treatment is also integrated with the Enhanced Commercial/Industrial Performance program.

Next Generation and Emerging Technologies. This program emphasizes discrete and integrated end-use technologies for buildings; daylighting applications; solar thermal applications; and emerging technologies for industry and buildings not covered elsewhere in NYSERDA's **New York Energy $mart**SM portfolio of programs. The bulk of funds for this program are being administered through narrowly defined competitive solicitations possibly focusing on advanced building demonstrations, discrete building technologies, solar thermal applications, daylighting applications, and emerging technologies. The program emphasis is on funding developers and producers of energy-efficient technology which would be commercially available to end users. Demonstration solicitations are open to all end-use customers, particularly those with high electric loads.

5.2 R&D Program Evaluation Activities

The R&D program evaluation activities conducted this year are shown in Table 5-1. The table includes only new evaluation activities conducted in 2006. However, findings from earlier evaluations are also discussed in this section to the extent that they contribute to the cumulative assessment of these programs.

Table 5-1. 2006 R&D Program Evaluation Activities

Program Name	Predecessor Program (if applicable)	Theory & Logic	Measurement and Verification (M&V)	Market Characterization, Assessment and Causality (MCAC)	Process Evaluation
Public Benefit Power Transmission and Distribution Research		-	-	-	-
Clean Energy Infrastructure	End-Use Renewable Energy Market	-	Database review for End-Use Renewables	-	-
Power Systems Product Development		-	-	-	-

Program Name	Predecessor Program (if applicable)	Theory & Logic	Measurement and Verification (M&V)	Market Characterization, Assessment and Causality (MCAC)	Process Evaluation
DG-CHP Demonstration	Distributed Power Generation/CHP CHP Demonstrations Power Systems Technology – Product Development Strategic Energy Reliability	Value/Cost (Peer Review) Assessment	Database review for DG/CHP	-	-
Demand Response and Innovative Rate Research		-	-	-	-
Electric Transportation		-	-	-	-
Environmental Monitoring, Evaluation and Protection		Value/Cost (Peer Review) Assessment	-	-	-
Industrial Research, Development and Demonstration		-	-	-	-
Municipal Water and Wastewater Efficiency		-	-	-	-
Next Generation and Emerging Technologies	Next Generation of Energy-Efficient End-Use Technologies	-	-	-	-

5.3 R&D Program Evaluation Findings

Significant progress is being made as the Research & Development portfolio transitions to the new set of program offerings. This section summarizes key evaluation findings from the latest set of evaluation activities, and from the cumulative body of work conducted by NYSERDA and its evaluation contractors over the past several years.

5.3.1 Energy, Peak Demand and Fuel Savings and Clean Generation

NYSERDA's Measurement and Verification (M&V) contractor assessed the energy and peak demand savings and clean generation reported for its R&D programs. Methods used in this assessment included on-site verification of equipment installation and functionality, and review of NYSERDA's files for reasonableness and accuracy. Based on this review, the M&V contractor adjusted the savings reported by NYSERDA. In turn, the Market Characterization, Assessment & Causality (MCAC) contractor further adjusted these figures to account for freeridership and spillover. Table 5-2 summarizes the estimated

electricity savings and clean generation for each of the applicable R&D programs. Table 5-3 summarizes peak demand reductions. Table 5-4 shows other fuel savings for the R&D programs.

As reported earlier in Section 2, overall, NYSERDA's M&V and MCAC contractor teams have found that savings for the R&D sector should be adjusted as follows:

- Electricity savings were adjusted upward by 2%.
- Peak demand savings were adjusted downward by 29%.[1]
- Other fuel savings were adjusted downward by 5%.

These adjustments include changes in program reported savings due to database reviews and field work to measure and verify savings, as well as survey research and other activities to quantify freeridership and spillover. Most of the adjustment, however, is due to the measurement and verification work since any freeridership that exists is outweighed by spillover on all but one R&D program.

Table 5-2. R&D Program Electricity Savings through December 31, 2006 and Progress toward One-Year Goals

Program	Energy Savings (GWh)	
	Savings Achieved through	
	June 30, 2006	Dec. 31, 2006
DG-CHP Demonstration Program[1] (ConEdison)	82.7 (42.0)	96.7 (42.0)
Renewable Energy Production (ConEdison)	103.8 (0.5)	104.6 (0.5)
Overlap Removed	6.6	7.7
ConEdison R&D Total	**42.5**	**42.5**
Statewide R&D Total	**179.9**	**193.6**

[1] Because the electricity saved by the DG/CHP projects replaces electricity formerly purchased from the grid, the program has reduced fuel used at central generating stations, for a net decrease statewide due to greater efficiency of the DG/CHP systems at sites where imported fuel is used. The fuel avoided at the central generating plant is determined from the electricity generated by the DG/CHP installations. Furthermore, at additional projects such as wastewater treatment plants, electricity generation is powered fully or partially by digester gas produced on site. Such fuel switching achieves natural gas conservation above and beyond what is achieved through efficiency alone.

[1] The Demand Response and Innovative Rate Research Program does not require that enabled demand reductions be maintained. This large downward adjustment for the R&D programs is due to M&V results indicating the portion of enabled demand reduction that has been maintained.

Table 5-3. R&D Program Peak Demand Reductions through December 31, 2006 and Progress toward One-Year Goals

Program	Demand Reductions (MW)	
	Savings Achieved through	
	June 30, 2006	Dec. 31, 2006
DG-CHP Demonstration Program (ConEdison)	18.1 (8.5)	21.1 (8.5)
Demand Response and Innovative Rate Research (ConEdison)	137.2 (68.6)	137.2 (68.6)
Renewable Energy Production (ConEdison)	8.1 (0.3)	8.4 (0.3)
Overlap Removed	1.3	1.5
ConEdison R&D Total	77.4	77.4
Statewide R&D Total	162.1	165.2

Table 5-4. R&D Program Fuel Savings through December 31, 2006 and Progress toward One-Year Goals

Program	Fuel Savings (MMBtu)	
	Savings Achieved through	
	June 30, 2006	Dec. 31, 2006
DG-CHP Demonstration Program[1] (ConEdison)	-571,310 (-266,937)	-738,327 (-296,521)
ConEdison R&D Total	-266,937	-296,521
Statewide R&D Total	-571,310	-738,327

[1] Because the electricity saved by the DG/CHP projects replaces electricity formerly purchased from the grid, the program has reduced fuel used at central generating stations, for a net decrease statewide due to greater efficiency of the DG/CHP systems at sites where imported fuel is used. The fuel avoided at the central generating plant is determined from the electricity generated by the DG/CHP installations. Furthermore, at additional projects such as wastewater treatment plants, electricity generation is powered fully or partially by digester gas produced on site. Such fuel switching achieves natural gas conservation above and beyond what is achieved through efficiency alone.

5.3.2 Summary of Other Key Program Impacts

Across the programs, numerous near-term goals were set for other key metrics besides energy savings such as: the number of solicitations, studies, and projects; the number of workshops; the number of companies doing business in New York; new products developed and launched; and other important logic model-driven knowledge creation, information dissemination and commercialization progress metrics. Overall, the programs are also performing well with respect to these other goals. Results of each program's progress toward its stated goals are shown in table format in the subsequent sections.

Key areas of progress in the past six months include the following:

- Contracts are being negotiated with four firms intending to manufacture clean energy products in New York.
- The Power Systems Product Development Program awarded five contracts for product development.
- Performance data on 21 DG/CHP projects is now available on the Internet, allowing performance monitoring and promoting technology transfer.
- Thirteen publications (including research reports and peer-reviewed journal articles) resulted from the Environmental Monitoring, Evaluation and Protection Program activities.
- Four Technical Assistance projects were completed for water and wastewater facilities.
- Seven solicitations were issued for the Next Generation and Emerging Technologies Program, and the new Public Benefit Power Transmission and Distribution Research Program identified priority research areas and will release its first solicitation in the first quarter of 2007.

5.4 Public Benefit Power Transmission and Distribution Research

5.4.1 Program Description

The new Public Benefit Power Transmission and Distribution Research Program will support T&D research that is not utility specific and has broad statewide energy efficiency and reliability benefits. Projects will be selected to provide improvements to power reliability, quality and security, and reduce the cost of energy and energy delivery. Examples of such T&D projects funded through the R&D program include:

- The Albany High Temperature Superconducting (HTS) Cable Project resulted in the world's first demonstration of a superconducting cable operating underground in a live utility grid. The demonstration continues to operate as part of the National Grid system between its Riverside and Menands substations located in Albany, New York. Because HTS cables are able to carry three to five times more power than conventional cables of the same size, they offer the potential to serve the growing electricity demands in high density urban areas without the need to build more power lines. The project is on schedule to replace a 30-meter section of the existing HTS cable with a 2nd generation HTS cable capable of higher performance.
- A manufacturer of power line carrier (PLC) technology is demonstrating an application to provide real-time monitoring of a utility distribution system to identify incipient faults and avoid interruption of customer service. PLC technology allows transmission and reception of high frequency signals over power lines. The interpretation of the noise in such communications can be used to detect conditions that may precede failure of lines, transformers and other equipment. The technology has been installed on several miles of feeders serving Con Edison residential and commercial customers in Westchester County.

The NYISO and the NYSRC are key stakeholders in the T&D research program. NYSERDA will coordinate with the NYISO and the NYSRC to implement projects that provide significant statewide benefits for electric ratepayers. A T&D strategic plan was recently prepared by Electric Power Research Institute (EPRI) and identified several projects that should be initiated in cooperation with the NYISO and the NYSRC. These include:

- Developing fast simulation modeling systems to rapidly assess grid stability and anticipate and respond to power disturbances,
- Analyzing system modeling data, phasor measurements, and historical trends to develop real-time grid performance indices that can be displayed through a simplified graphical user interface,
- Monitoring of electric power frequencies to pinpoint and analyze disturbances, and
- Creating business models to promote sustainable investment in transmission and distribution infrastructure.

The five-year budget for this program is $10 million.

5.4.2 Recent Program Accomplishments

The recent program accomplishments are presented in Table 5-5.

Table 5-5. Public Benefit Power Transmission and Distribution Research Program Goals achieved from July 1, 2006 through September 30, 2006

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006
Strategy and coordination meeting	Identification of priority R&D areas by spring 2006	Priority areas in two tracks — Policy and Technology — have been identified. Policy aspects could include business strategies, regulatory issues, public policy, and advanced concepts. Technology aspects could include monitoring and diagnostics, data processing and analysis, optimized visualization, secure communication, and improved control and system performance.
Issue annual solicitations	Select and fund five or more projects and studies aimed at the priority R&D areas by fall 2006	Staff anticipate issuing solicitation PON 1102 in the first quarter of 2007. Current efforts are devoted to harmonizing concepts with the recently-launched M&V logic model.

5.4.3 Program Logic[2]

Problems and Barriers

New York faces a range of T&D system security, reliability and power quality issues that affect the country's entire northeast region and in some cases, much of the Eastern Interconnection. These include:

- Lack of long-term T&D planning
- Increased stress due to load growth in certain areas and potential load growth from clean technologies such as electrified vehicles

[2] The program logic is a work in progress. The final program logic will be available in the March 31, 2007 quarterly report.

- Lack of incentives for private investment

Other issues related to the above include the following:

- New York is importing more electricity and exporting less electricity. At the same time, New York has a desire to be less dependent on other States for its power.
- Power system operational issues, such as the need to improve situational awareness of operators, cut across New York's boundaries.
- An increasing need for reactive power reserves and voltage support, and a need for improved power system integrity protection.
- Shifting wholesale power transfer patterns that have resulted from industry restructuring.
- The Federal Energy Regulatory Commission (FERC) has entrusted independent system operators (ISOs)/regional transmission organizations (RTOs) such as the NYISO with significant regional planning responsibilities.[3] [4]
- The Energy Policy Act of 2005 has also made fundamental changes to the investment incentives related to many types of energy resources and the T&D infrastructure.
- The adoption of the RPS and RGGI may require changes in the transmission system due to the requirement for increased renewable power.
- In addition, the importance of maintaining high T&D system reliability will increase with the formation of the Electricity Reliability Organization (ERO), which will have legal authority.
- As the industry continues to change, research plans must be developed and implemented to address these issues and must adapt to the changing conditions.

Program Outputs

Table 5-6 identifies near-term accomplishments anticipated to come directly from program activities. Associated measurement indicators are also presented. The source for this information should come directly from program records.

[3] After transmission developers obtain approvals from the NYISO, these developers must also apply for approval from the New York State Public Service Commission under Article VII of the Public Service Law [1].

[4] Third paragraph from EPRI Plan

Table 5-6. Anticipated Near-Term Accomplishments

Anticipated Accomplishments	Indicators	Data Sources and Potential Collection Approaches
Policy, Planning and Coordination Activities		
R&D gaps identified, priorities specified, projects leveraged (i.e., identification of policy-relevant, interdisciplinary/multi-media critical research usable for New York State that takes advantage of related national research plans and programs to address regional/State needs, with research projects supported at various New York Institutions)	Planning documents created. Technical reports.	Program records
Coordination of stakeholders	Dates and locations of meetings. Names of participants and organizations represented. Topics of discussion.	Program records
Studies funded	White papers, recommendations.	Program records
Technology Development Activities		
Product development projects funded	Innovative solutions	Program records
New technologies demonstrated	Credible data on performance, cost and impacts	Program records
Technology Transfer and Information Dissemination Activities		
Information dissemination	Dates and locations of meetings. Names of participants and organizations represented. Topics of discussion.	Program records
Synthesis and translation of results into forms useful for a broad audience. Data and technical findings made accessible to the public.	Magazine articles and conference presentations. List of web site addresses to enhance technology transfer.	To be determined.

5.5 Clean Energy Infrastructure

5.5.1 Program Description

The success of the previous End-Use Renewables Program has provided the foundation for the creation of the Clean Energy Infrastructure Program. Clean Energy Infrastructure efforts will be closely integrated with other SBC-funded efforts, such as Distributed Energy Resources, to develop and commercialize clean energy technologies. The ultimate goal of these programs is to reach a point where the value of the technology is worth the investment required by the consumer, and the market infrastructure is in a position to deliver and support the technology over the long term. This program will also complement efforts under the RPS by supporting training, education and market development for RPS-eligible technologies such as photovoltaics. The Clean Energy Infrastructure funds may also be used to reduce the installation and operating cost of systems not eligible for RPS funding.

The former End-Use Renewables Program placed significant emphasis on training renewable energy professionals, establishing voluntary certification standards for photovoltaic system installers, establishing and promoting accredited training programs in New York, establishing an internship program to give students from the training programs the experience necessary to sit for the certification exam, developing a series of specialized workshops and training tools, and creating a program to integrate photovoltaic systems on schools with lesson plans that meet New York State learning standards for math, science, and technology. The Clean Energy Infrastructure Program will continue the work begun under the End-Use Renewables Program to develop a vibrant, sustainable market for renewable and clean energy technologies using the following strategies:

- Market actor education, consumer awareness and market development,
- Targeted research, analysis and education to address technical and information barriers to renewable and clean energy market development, and
- Clean energy technology business development and manufacturing.

The 13-year program budget is $77.5 million.

5.5.2 Recent Program Accomplishments

Several near-term annual goals have been set for the new Clean Energy Initiative Program. These goals and progress for the six month period ending 12/31/06 are presented in Table 5-7.

Table 5-7. Clean Energy Infrastructure Program Goals achieved from July 1, 2006 through December 31, 2006

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006	
Education, Consumer Awareness and Market Development			
New accredited training institutions	1	0	Workshops held: 4 KidWind Teacher Training workshops 2 small wind training 1 NABCEP[1] prep
New certification exams	1	0	
Training workshops	5	7	
Renewable Resource Applications			
Stakeholder workshops	2	0	4 solicitations were issued 2 focused on wind generation and wildlife interactions 2 promote business expansion
Competitive research solicitations	3	4	
Clean Energy Technology Manufacturing and Business Development			
Companies expanding renewable business networks	5	7	Contracts are being negotiated with 4 firms intending to manufacture clean energy products in New York.
Companies expanding manufacturing	2	4	

[1]North American Board of Certified Energy Practitioners (NABCEP).

Other program highlights include:

- A Renewable Energy Workforce Conference in November 2006, sponsored by NYSERDA, attracted 200 attendees from 30 states and four countries, to learn and share innovative workforce activities.
- A Technical workshop on wind energy's impacts on wildlife brought together national experts and stakeholders to develop siting guidelines for wind energy resources.
- Several programs provided support for local governments and communities including a wind workshop, a wind toolkit, and outreach to local organizations.

5.5.3 Long-Term Program Accomplishments

This section highlights key program outputs, as identified through earlier logic model development work, and related market progress. All values reported are cumulative since program inception. Thus, they include accomplishments of the farmer Wholesale Renewables Program, as well as from the End-Use Renewables activities both prior to and after the adoption of New York's RPS. Table 5-8 presents the key

outputs for the Clean Energy Initiative through December 31, 2006. Table 5-9 presents a sample of key logic model-driven indicators of program success, especially those related to market progress, as tracked by the evaluation and program activities. Together, these tables indicate the most important ways that program progress is being measured, and report how those values are changing due to program activities.

Table 5-8. Clean Energy Infrastructure – Key Program Outputs

Outputs	Value (Cumulative through December 2006)
Number of PV and small wind systems installed (PON 716)	438 PV/15 Wind
Dollar value of incentives paid for PV (PON 716) and small wind systems installed (PON 792)	$9,929,611 PV/ $333,712 Wind
Total cost of installed PV systems (PON 716)	$20,110,235
Average cost per kW DC of PV installed per sector	$8,601 Residential, $8,093 Commercial, $9,101 Industrial

Table 5-9. Clean Energy Infrastructure – Key Market Indicators and Program Cumulative Progress

Topic	Indicator	Data Value--2003	Data Value -- 2004	Data Value -- 2005	Data Value -- 2006
Energy Generation	Net MWh and MW generated from installed systems	1,012 MWh 0.6 MW	2,012 MWh and 1 MW	2,833 MWh and 1.3 MW	4,619 MWh 2.1 MW
Availability of Services	Number of participating installers	14	27	32	26
	Average full-time equivalents employed by PV installer firms	3.3	7.7	8.0	-
Awareness and Knowledge	Installer estimates of residential and commercial customer awareness of PV systems	Residential – 18% Commercial – 6%	Residential – 5% Commercial - 4%	Residential – 6% Commercial - 7%	-
Market Share and Sales	EUR Program installations as a percentage of total capacity of PV and small wind systems installed in New York *(Data in this row represent only SBC-funded projects. NYSERDA, NYPA and LIPA have supported other projects outside of the SBC program.)*	-	-	EUR Program has funded 29% of the total PV installed capacity on record with PSC EUR Program has funded 25% of the state's total small wind energy capacity on record with PSC	-

Topic	Indicator	Data Value--2003	Data Value -- 2004	Data Value -- 2005	Data Value -- 2006
Pricing/Cost	Average total PV system cost per watt (PON 716)	$8.26/watt (DC)	$8.31/watt (DC)	$8.43/watt (DC)	$8.52/watt (DC)
	Installer estimate of market sustainable price for PV systems	$4/watt for both residential and commercial customers	$3/watt for residential and $4/watt for commercial	-	-

5.5.4 Program Impact Evaluation

Gross Energy Generation

In 2004, Nexant, Inc. conducted a review of the savings impacts reported by NYSERDA for the former EUR Program. The objective of the review was to verify the estimate of the program's cumulative energy generation. Based on Nexant's review, as of December 31, 2006, the program has resulted in energy generation and peak demand reductions shown in Table 5-10.

Net Energy Generation

The Summit Blue MCAC team addressed attribution as part of the in-depth evaluation conducted in 2003. The 2003 evaluation involved surveys with 23 PV installers, 32 PV system owners, two PV training institutions, and others. In both 2004 and 2005, the aspects of the in-depth evaluation were revisited through an Integrated Data Collection (IDC) approach whereby surveys are administered to PV system owners at the time of project completion and PV system installers at the time of program application. Both evaluation updates, in 2004 and 2005, corroborated the original results and suggest that NYSERDA should use a net-to-gross ratio of 1.0 for the EUR Program. Net energy generation is shown in Table 5-10.

Table 5-10. Clean Energy Infrastructure Program Cumulative Annual Clean Generation (through December 2006)

	Program-Reported Savings	Realization Rate	Adjusted Gross Energy Generations	Net-to-Gross Ratio	Net Energy Generation
MWh/year	4,441	1.04	4,619	1.0	4,619
MW	2.5	0.85	2.1	1.0	2.1

Non-Energy Impacts

The MCAC team examined non-energy impacts for the EUR Program in 2003. At that time, customers valued the non-energy impacts at approximately 1.6 times the value of the displaced generation from their PV systems.

5.6 Power Systems Product Development

5.6.1 Program Description

The goal of this program is to work with New York technology companies to develop distributed generation and storage products and expand the number of marketable competitive products that reduce peak load, improve power quality, and provide improved cost-effective environmental performance.

The Power Systems Product Development Program supports New York business in all aspects of product development necessary to create and commercialize power generating products that are clean, efficient, reliable, and cost effective, as well as other products that reduce peak demand or improve end user power quality. Additionally, the program focuses on New York specific issues such as economic development and job creation in the State; targets technologies and opportunities that are not being addressed by the market; addresses regulatory barriers to the adoption of superior new technologies; and, emphasizes the development of economically competitive options for end users.

The program areas of focus include:

- Developing products with superior performance relative to decreased grid-supplied energy consumption, peak demand and improved environmental impact
- Addressing New York-specific issues such as economic development and job creation in the state
- Targeting those technologies and devices that are not currently being addressed by the market
- Reducing environmental impacts of energy production
- Providing economic development opportunities for New York power system firms
- Improving system-wide reliability and peak demand reduction
- Addressing institutional impediments including absence of applicable codes and installation standards

Activities supported under this program element include:

- Product development from concept studies to prototype production and product testing
- Technology transfer through conferences, papers and internet accessible data
- Market sector research and support addressing institutional barriers to commercialization

The five-year program budget is $25 million.

5.6.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Power Systems Product Development Program. These goals and progress for the first six month period ending 12/31/06 are shown in Table 5-11.

Table 5-11. Power Systems Product Development Program Goals achieved from July 1, 2006 through December 31, 2006

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006
Product development contracts awarded	10	5
New products commercially launched	1	-
Successful new product field tests and demonstrations	2	-
Projects successfully completing milestones	4	6
Assessments and studies of new technologies completed	3	1

5.6.3 Long-Term Program Accomplishments[5]

This section highlights key program outputs and program benefits since program inception through June 2006. The projects summarized here were initiated during a five year period ending June 2006.

Starting in June 2006, the Power Systems Product Development Program shifted the focus to include solar and wind product development activities previously funded from other programs. The program will emphasize ultra-clean and other renewable technologies and deemphasize fossil fuel efficiency and emission improvement technologies previously encouraged.

Key program outputs for the time period 2001 to 2006 are presented in Table 5-12.

Table 5-12. Power Systems Product Development Program – Key Program Outputs

Outputs	Value (Cumulative through December 2006)
Number of Solicitations	12
Number of proposals reviewed/Recommended for funding	248/102
Number contract actions	85
Number of unique projects	52
Funds Encumbered	$22 million
Co-funding by Project Participants	$34 million

[5] The information contained in the Long-Term Accomplishments Section was obtained from the Power Systems Program Accomplishments Packet developed by GDS Associates in 2006.

Key logic model-driven program outcomes, or indicators of program benefits, are presented in Table 5-13.

Table 5-13. Power Systems Product Development Program – Key Outcomes

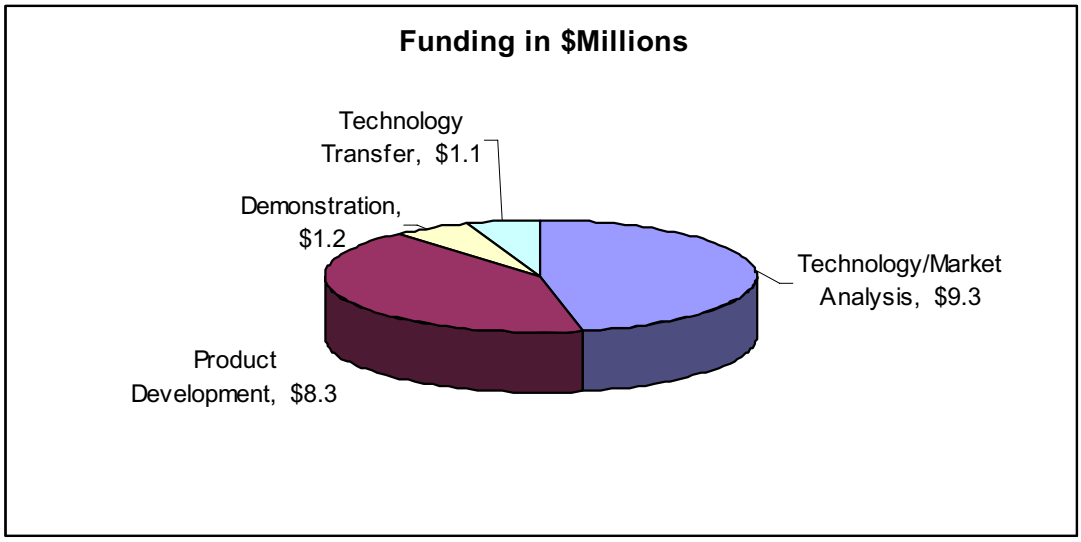
Outcomes	Value (Cumulative through December 2006)
Knowledge Creation and Dissemination	
Number of completed final reports	18
Number of published articles	86
Number of Conference Presentations	52
Field tests initiated/completed	65/63
Lab tests initiated/completed	71/69
Web sites where reports are available	TBD
Commercialization Progress	
Number of projects with recoupment provisions	20
Number of projects with enhanced business plans/ UL or other listings/patents	16/5/6
Number of New Products Developed	6
Economic Benefits	
Number of projects with sales/jobs/investments	6 projects with sales 16 projects with job creation 7 projects with known new investments

Program Portfolio

Projects funded through the program can be categorized as (1) Technology/Market Analysis Studies; (2) Product Development, (3) Demonstration, and (4) Technology Transfer. The Technology/Market Analysis Studies consists of projects that analyze market potential and technological feasibility, designed to benefit policy makers and supply-side market actors. Product Development projects are focused on a clearly defined product and benefits New York manufacturers. Product Development activities include prototype development, product testing, and development of commercialization plans. Demonstration projects consist of projects that demonstrate the performance of products that are commercially available. Technology Transfer projects provide information to the general public and other market actors and are designed to support the market infrastructure.

The cumulative encumbered funding by project type is presented in Figure 5-1.

Figure 5-1. Power System Program Funds Encumbered through 2005



The program was implemented through a total of 11 solicitations. Six solicitations having broad based eligibility in power systems, and five solicitations directly focused on alternative fuels for secure power generation and electricity storage. A total of 216 proposals were received with 88 recommended for funding with 80 completed contract actions. In many cases proposals were received for second or third phases of a product development effort, as projects were required to recompete for funding of additional phases based on progress to date. A total of 47 unique product development or individual study efforts were funded.

Technology development projects were funded at an average of $5 million per year ($4 million from the SBC and an additional $1 million from NYSERDA's Statutory program). The portfolio of SBC funded projects evaluated here has a total value of $50 million with $20 million provided via NYSERDA and $30 million provided as project cofunding primarily by contractors.

Knowledge Creation and Dissemination

Data were collected for each project in the Power Systems portfolio regarding the knowledge creation indicators. The number of field and lab tests are shown in Table 5-14 by technology area. A total of 63 field tests have been completed and 69 lab tests have been completed.

Table 5-14. Number of Field and Lab Tests Initiated and Completed

Technology Area	Field Tests Initiated	Field Tests Completed	Lab Tests Initiated	Lab Tests Completed
Emissions	0	0	8	8
Energy Storage	11	10	11	11
Engine	2	2	3	3
Fuel Cell	10	10	31	31
Hydropower	1	1		
Inverter	1	0	15	15
Motor Generator	0	0	2	0
DG Performance Testing	20	20	1	1
Remote Monitoring	20	20		
Total	65	63	71	69

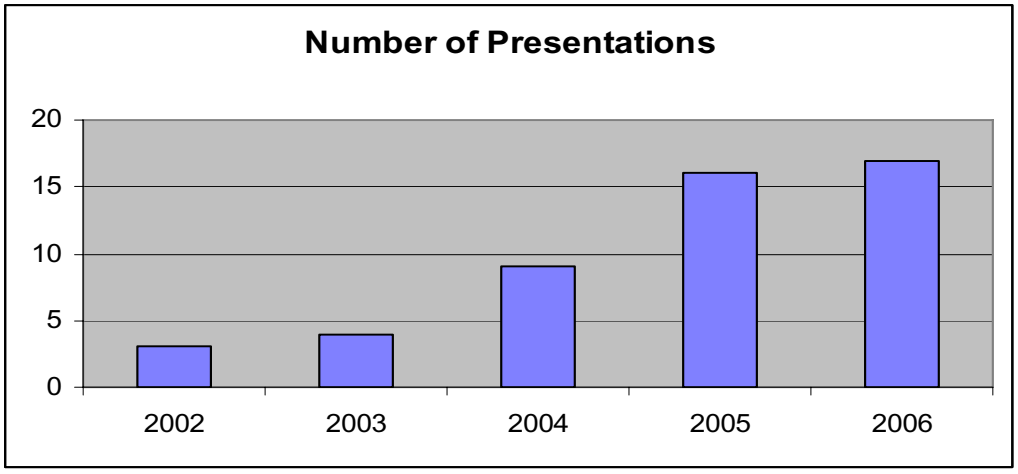
A total of 86 articles and news stories are associated with the portfolio of projects. The number of articles and stories by technology area is presented in Table 5-15. The majority of publications resulted from the hydropower projects. Articles were published in conference proceedings, print magazines, internet magazines, journals and newspapers.

In addition, final reports have been completed for 18 power systems projects. Conferences and presentations is another pathway for dissemination information. Presentations regarding NYSERDA's power systems projects have been given at various conferences and forums, including those sponsored by: the American Society of Mechanical Engineers (ASME), American Solar Energy Society, Association of State Energy Research and Technology Transfer Institutions (ASERTTI), Association of the United States Army (AUSA), CleanTech, Electrical Energy Storage Applications and Technology (EESAT), Electrical Storage Association (ESA), Mid-Atlantic Renewable Energy Fair, Midwest Renewable Energy Fair, and Next Generation Energy. The number of presentations at conferences has increased over the past five years, as shown in Figure 5-2.

Table 5-15. Number of Articles by Technology Area

Technology	Number of Articles/News Stories
Energy Storage	4
Fuel Cell	8
Hydropower	70
Inverter	1
Other	3
Grand Total	86

Figure 5-2. Conference Presentations



Commercialization Progress

The number of projects with commercialization progress by technology area is presented in Table 5-16.

Table 5-16. Number of Projects with Commercialization Progress

Technology Area	Business Plans Enhanced	UL or Other Listings	Patents
Aggregation	1		
Emissions	1		
Energy Storage	3	1	1
Engine	1		
Fuel Cell	5	3	4
Hydropower	2		
Inverter	1	1	1
Motor Generator			
MSW	1		
Remote Monitoring	1		
Total	16	5	6

Products developed include:

- 2.5 kVA inverter
- Computer controlled monitoring and control system
- Central Operation Management System (COMSYS)
- Direct Methanol Fuel Cell

- GAIA Power Tower
- DC Backup Fuel Cell System
- Motor generator component

Economic Benefits

Economic benefits include sales, jobs, and new investments. The number of projects with these benefits is shown in Table 5-17. Six projects have produced sales, 16 projects have resulted in jobs, and seven projects have resulted in new investments.

Table 5-17. Number of projects with Economic Benefits

Technology Area	Sales	Jobs	Investments
Aggregation		1	
Emissions		1	
Energy Storage	1	4	1
Engine		1	
Fuel Cell	3	5	4
Hydropower		1	1
Inverter	1	1	1
Motor Generator		1	
MSW			
Remote Monitoring	1	1	
Total	6	16	7

Examples of economic development achieved through the program's activities include:

- The fuel cell research and development resulted in the development of 320 jobs at the new headquarters R&D and manufacturing facility constructed in New York by Plug Power. There was also $217 million of cash investment from Interros and Norilsk Nickel.
- The Direct Methanol Fuel Cell project brought in $1 million dollars in capital investment from Samsung and Gillette/Duracell. Additionally this product resulted in a 6% equity investment by E.I. Dupont. The Samsung investment was to develop this technology for their portable cell phone product line.
- The 2.5 kVA Utility-Interactive Inverter study has provided subcontracts to New York vendors for manufacturing of various components such as printed circuit boards, enclosures, and Certification testing by Itertek Testing Service.
- The Energy Storage Distributed Load Leveling with Utility Control product - GAIA Power Tower has resulted in four investments in New York for a total $3 million. GHO ventures invested $2.25 million, and three separate $250,000 investments were provided by NY Community Investment Company, NJTC Venture Fund and the Small Business Technology Investment Fund of the Empire State Development Corporation.

- The Roosevelt Island Tidal Energy Project: resulted in setting up of an office at the Cooper Union in New York City.

5.7 DG-CHP Demonstration

5.7.1 Program Description

The goal of the DG-CHP Demonstration Program is to contribute to the growth of combined heat and power and other distributed generation applications in New York. The program provides funding for site-specific feasibility studies and demonstrations and seeks to improve awareness by end-users and project developers of DG-CHP. The program also seeks to address DG-related issues such as DG permitting; SIR; utility standby service; tariffs; technology risk; and renewable fuel options such as anaerobic digester and landfill gas; and impact of fluctuating prices of natural gas.

The program uses financial incentives to encourage customer-sited DG using commercially available DG technologies such as reciprocating engines. The incentive approach will co-exist along with similar offerings from RPS Customer-Sited tier and Consolidated Edison's System Wide Demand Reduction programs.

The total program budget is $67.1 million.

5.7.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the DG-CHP Demonstration Program. These goals and progress for the six month period ending December 31, 2006 are shown in Table 5-18.

Table 5-18. DG-CHP Demonstration Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Initiate DG-CHP incentive program	Develop and implement a CHP incentive program in cooperation with other DG-CHP programs	Staff are observing activity under NYSERDA's recently launched CHP subscription program using ConEd System Wide Program funds.
Issue annual solicitations and incentive offers	Fund up to 10 CHP demonstration projects with a cumulative capacity of 20 MW and with 10 MW downstate	PON 1043 was issued, and thirty-four proposals were received by the due date of August 22, 2006. Seven demonstration projects were selected for funding with a total of 38.2 MW installed capacity (1.8 MW of which is in ConEd territory).
Technology transfer	Require performance monitoring of all demonstration projects and export data to the CHP website	Data for 21 projects are posted on http://chp.nyserda.org.

5.7.3 Long-Term Program Accomplishments

This section highlights key program outputs as identified through the logic model development work and associated market progress. All values reported are cumulative since program inception, unless otherwise noted. Table 5-19 presents the key outputs for DG-CHP Demonstration through December 31, 2006. Table 5-20 presents a sample of key logic model-driven indicators of program success, especially those

related to market progress, as tracked by the evaluation and program activities and documented most recently as part of a value/cost peer review assessment conducted specifically for this program. Together, these tables indicate the most important ways that program progress is being measured, and report how those values are changing due to program activities.

Table 5-19. DG-CHP Demonstration Program – Key Program Outputs

Outputs	Value (Cumulative through December 2006)
Number of operational DG/CHP systems	28
Total funds awarded for operational DG/CHP systems	$8.9 million
Total cost of operational DG/CHP systems	$39.4 million

Table 5-20. DG-CHP Demonstration Program – Key Market Indicators and Program Cumulative Progress

Topic	Indicator	Initial Value (2004, unless noted)
Awareness and Knowledge	End-use customer familiarity with DG/CHP systems	83% of participants and 100% of partial non-participants said they were at least somewhat familiar
	Developer familiarity with DG/CHP systems	90% said they were extremely familiar, and all developers considered themselves at least somewhat familiar
Market Share and Sales	DG/CHP Program penetration in terms of base case and accelerated case estimate of market potential	7% of base case 3% of accelerated case
Change in practices	Role of energy efficiency in consideration of DG/CHP systems	More than half of program participants and 85% of partial non-participants noted an increase in the role of energy efficiency

Funded Projects[6]

Seventeen feasibility studies have been funded of which eight are completed. In addition to natural gas, the studies address various fuel sources including bio-waste, coal gasification, and wood.

[6] Except for Figures 5-3 and 5-4, the analyses contained in this section are from the Accomplishments Packet for the CHP Demonstration Program which was developed by GDS Associates and HMG Group, Inc. as apart of the Peer Review Assessment conducted in 2006.

Figure 5-3 presents the peak capacity of projects in the portfolio by prime mover type. Figure 5-4 shows the same by utility service area.

Figure 5-3. Peak KW Reduction by Prime Mover for Encumbered Projects (through 2006)

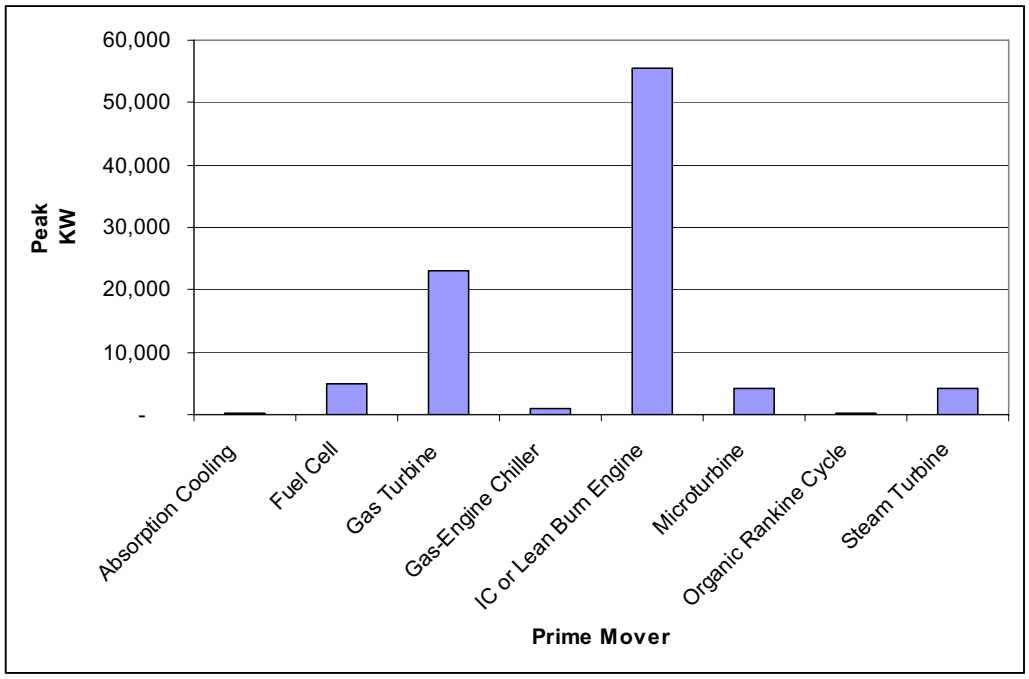
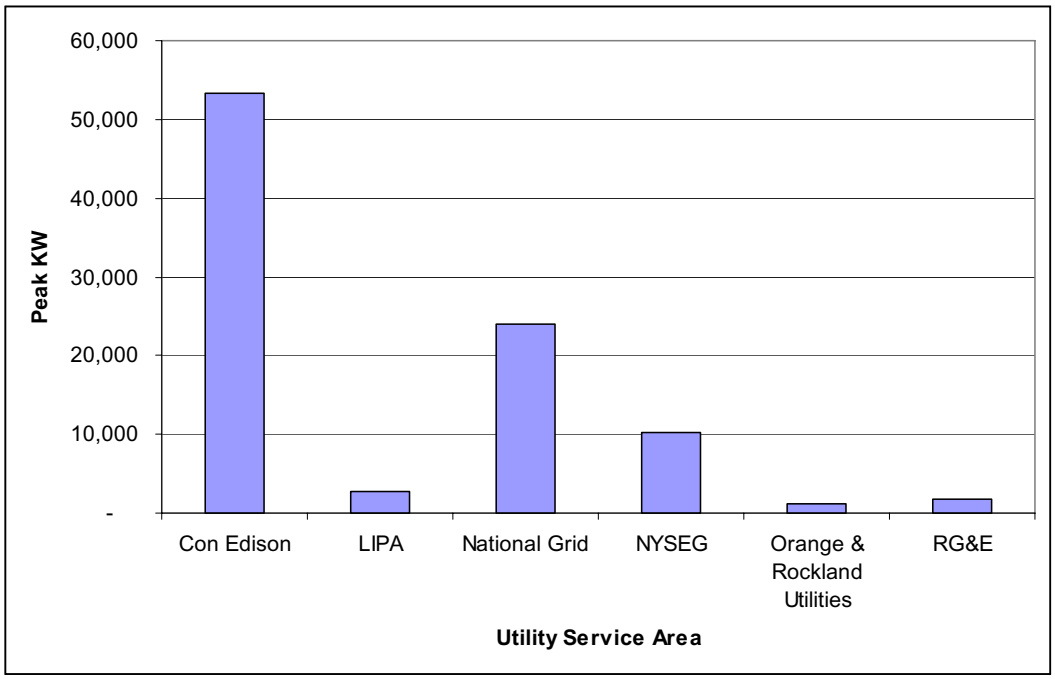


Figure 5-4. Peak KW Reduction by Utility Service Area for Encumbered Projects (Through 2006)



Progress toward Commercialization

Capital Attraction

- Private investment in CHP has increased in New York. The total project cost for all projects funded through the CHP program as of December 2005 is $273.5 million. Of this total, 80 percent represents funds from project participants.

Technical achievements

- As a result of the program, demonstration of innovative electrical interconnection designs has occurred. The system installed at Equity Office Properties at 717 5th Avenue in Manhattan was the first installation of a synchronous interconnection system in New York City.

- As a result of the program, several grid-connected CHP systems that have dual-mode operation (operates in grid-parallel mode during normal conditions and operates in stand-alone mode during grid outage) were successfully demonstrated. For example, during the Northeast Blackout of 2003, the CHP system installed at Greater Rochester International Airport operated in stand-alone mode. The project received an award from the U. S. Environmental Protection Agency (http://www.epa.gov/chp/awards/winners2004.htm).

- As a result of the program, effective use of non-standard fuel sources (e.g., anaerobic digester gas) for CHP has been demonstrated.

- As a result of the program, third-party financing for CHP is being demonstrated in several settings, including New York City at 230 Park Avenue.

Market Progress

Market progress, such as increased awareness and knowledge of CHP and increased promotion by CHP trade allies, was measured in 2004. Details of the findings are presented in the "DG-CHP Market Characterization and Market Assessment and Causality Study."[7]

ECONOMIC AND ENVIRONMENTAL BENEFITS

Economic Benefits

- Economic benefits to facility owners include lower energy costs as well as economic impacts from non-energy benefits such as increased reliability and cleaner air. Economic benefits to New York arise when dollars saved on energy are available to spend on other goods and services, promoting economic growth. Past research by ACEEE[8] has shown that savings are retained in the local

[7] "DG-CHP Market Characterization and Market Assessment and Causality Study," by Skumatz Economic Research Associates, Inc., Summit Blue Consulting, LLC, and Quantec, LLC, Project Number 7721, May 2005.

[8] Elliot, R. Neal and Mark Spurr. Combined *Heat and Power: Capturing Wasted Energy*. American Council for an Energy–Efficient Economy. May, 1999.

economy and generate greater economic benefit than the dollars spent on energy.[9] Recovery and productive use of waste heat from power generation is a critical component of energy efficiency.

Environmental and Other Benefits

- The program has produced ambient air emission reductions. Every proposer is required to submit an emissions analysis and undergo the State Environmental Quality Review Act (SEQRA) process. NOx emissions information was compiled for a subset of projects representative of the program's portfolio of projects. For each project, the NOx reduction was estimated based on (1) the NOx emissions for the installed prime mover, (2) the NOx emissions of the generation facility serving the facility, and (3) the NOx emissions of the thermal equipment. On average, each facility reduced NOx emissions by 50%, or nearly 13,000 lbs. per year, or 1.1 lbs. per megawatthour of electricity produced.

- The program supports the use of renewable energy sources. Of the 115,000 MWh per year currently being generated by operating facilities funded through NYSERDA's DG-CHP program, approximately 29,000 MWh per year are from renewably fueled systems.

- The program has supported efforts to improve the reliability of New York's electric transmission and distribution system. New York Independent System Operator Zones J (New York City) and K (Long Island) are considered key in terms of congestion and system reliability.[10] Table 5-21 shows that approximately 43% of the CHP capacity that has been installed or in progress are in Zones J and K.

Table 5-21. Location of NYSERDA CHP Projects by New York Independent System Operator Zone

Location by NYISO Zone	Number of Projects*	Capacity (kW)
Zones J or K	30	12,635
All Other	28	17,264
Total	58	29,899

* Projects beyond the design phase.

5.7.4 Cumulative Impacts

This section presents cumulative impacts for the program from inception through December 31, 2006.

Gross Savings

The objective of the M&V evaluation review is to verify the estimate of the program's cumulative savings. Based on Nexant's review, as of December 31, 2006, the program has resulted in the energy

[9] Spurr, Mark. 1999. *District Energy Systems Integrated with Combined Heat and Power: Analysis of Environmental and Economic Benefits*. Report to the U.S. Environmental Protection Agency. March. Minneapolis, Minn.: International District Energy Association.

[10] *NYISO Electric System Planning Working Group Meeting April 15, 2004, Draft Minutes.*

savings and demand reductions shown in Table 5-22. Note that the realization rate shown is applicable to the entire program period.

Net Savings

The final step to determining net energy savings is attribution analysis. Attribution analysis determines, through various methods, whether the gross savings estimate from the M&V activities should be adjusted downward or upward for freeridership or spillover. Adjustments for freeridership and spillover, and the ultimate program net-to-gross ratio and net savings are shown in Table 5-22.

Table 5-22. CHP Cumulative Annual Energy and Peak Demand Savings (Through December 2006)

	Program-Reported Savings	Realization Rate	Adjusted Gross Savings	Freerider-ship	Spillover	Net-to-Gross Ratio[1]	Net Savings
MWh/year	100,054	0.90	90,391	15%	26%	1.07	96,718
MW	20.0	0.98	19.7	15%	26%	1.07	21.1
MMBtu/year[2]	-777,721	0.89	-690,025	15%	26%	1.07	-738,327

[1] Net-to-Gross Ratio = (1-Freeridership) * (1+Spillover).

[2] Because the electricity saved by the DG/CHP projects replaces electricity formerly purchased from the grid, the program has reduced fuel used at central generating stations, for a net decrease statewide due to greater efficiency of the DG/CHP systems at sites where imported fuel is used. The fuel avoided at the central generating plant is determined from the electricity generated by the DG/CHP installations. Furthermore, at additional projects such as waste water treatment plants, electricity generation is powered fully or partially by digester gas produced on site. Such fuel switching achieves natural gas conservation above and beyond what is achieved through efficiency alone.

Non-Energy Impacts

The MCAC team examined non-energy impacts for the DG-CHP Program in 2004. At that time, customers valued the non-energy impacts at approximately 32-64% of the value of the energy savings from their systems.

5.8 Demand Response and Innovative Rate Research

5.8.1 Program Description

Demand Response and Innovative Rate Research Program, a new initiative, supports participation of small customers in the NYISO's wholesale demand response and time-sensitive retail electric pilots. Residential and small commercial loads constitute a small percentage of participants in these programs because of their relatively small loads, the high cost of aggregation, and the lack of flexible metering options and other load control technologies.

The program promotes the development, demonstration, and use of end-use technologies that have flexible load capabilities. Flexible load technologies are end-use devices, such as air conditioners and lighting, enhanced with features that allow remote access and group control thereby allowing easier load reduction in response to peak demand and price signals. Additionally, the program's time-sensitive pilots promote the development of innovative electric service rates by energy services companies with the ultimate goals of:

- Realizing load shifting and reductions during peak and expensive time periods,
- Creating cost avoidance opportunities for customers, and
- Creating sustainable businesses for providers.

The program concentrates on the New York City metropolitan area where capacity is particularly constrained and value propositions for load reductions are most desirable.

The program budget is $10 million.

An R&D initiative begun in 2000, Enabling Technology for Price-Sensitive Load Management (ET), was a precursor to this new R&D program, Demand Response and Innovative Research. ET, a series of projects in the Next Generation Program has ended; however, energy savings are still being realized from its projects. ET sought projects that demonstrated advanced technologies and commercialized new methods of aggregating load. The advanced technologies enabled electricity load reduction in response to emergency and market-based signals.

5.8.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Demand Response and Innovative Rate Research Program. These goals and progress for the first six months are shown in Table 5-23.

Table 5-23. Demand Response and Innovative Rate Research Program Goals achieved from July 1, 2006 through December 31, 2006

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006
Increase small customer participation in wholesale and local demand response programs (MW)	33	Modeled buildings using advanced window air conditioner control technology to determine the impact on load.
Increase the number of multifamily apartment units participating in real-time and other time-sensitive electric rate pilots	500 apartment units	Finalized a pilot program plan to demonstrate real time pricing rates and advanced load technologies in multifamily buildings in New York City. The solicitation will be released as PON 1151 in 2007.

Additional program highlights from the last six month period ending December 31, 2006 include:

- Time Sensitive Price Pilots, a time-based, behind-the-master-meter rate, is being implemented in New York City at three multifamily building sites containing 3,000 apartments. The current short-duration shadow-bill trial will be followed by education and training pending acceptance of the new rate plan by renters and management.

5.8.3 Program Impact Evaluation

This section presents cumulative annual energy savings for Enabling Technologies, the precursor to Demand Response and Innovative Rate Research. Savings are from program inception through December 31, 2006.

Gross Savings

The objective of the M&V evaluation review is to verify the estimate of the program's cumulative savings. Based on Nexant's review, as of December 31, 2006, the program has resulted in the energy savings and demand reductions shown in Table 5-24.

Net Savings

The final step to determining net energy savings is attribution analysis. Attribution analysis determines, through various methods, whether the gross savings estimate from the M&V activities should be adjusted downward or upward for freeridership or spillover. Adjustments for freeridership and spillover, and the ultimate program net-to-gross ratio and net savings are shown in Table 5-24. All ranges reflect 80% confidence intervals.

Table 5-24. Demand Response and Innovative Rate Research Program Cumulative Annual Energy and Peak Demand Savings (Through December 2006)

	Program-Reported Savings	Realiza-tion Rate	Adjusted Gross Savings	Net-to-Gross Ratio	Net Savings
MW	208.1	0.69	144.4	0.95	137.2

5.9 Electric Transportation

5.9.1 Program Description

Analysis has shown that development, qualification, and deployment of advanced technologies for the electrified rail system could reduce peak load by as much as 100 MW in the highly constrained New York City T&D load pocket. New York's electrified commuter rail and subway system alone uses over 2 billion kWh a year and represents a 1,100 MW demand on the Consolidated Edison distribution system.[11]

The program will fund projects in all stages of technology advancement; and higher risk projects will be funded in phases. Successful completion of milestones will be required before beginning the next phase. Two competitive solicitations are anticipated. The first will target improving energy efficiency in the State's current electrified transportation infrastructure. This solicitation will be administered in collaboration with the New York City Metropolitan Transit Authority and the New York Power Authority. Activities will target conductor rails, regenerative braking systems, and propulsion efficiency. The second will target improving energy efficiency through the use of off-peak power in the transportation sector. This solicitation will target electrified anti-idling, plug-in hybrid vehicles, and reduced on-peak demand associated with producing and fueling alternative fuel vehicles.

The program supports emerging technologies from inception through field testing and pre-commercial deployment. Once a product is commercialized and has reliably demonstrated energy benefits, continued support is frequently available through deployment programs and from State and Federal tax allowances. Helping to develop products that will make this transition is a fundamental goal of the program.

[11] The subway system pays an SBC fee as do the private sector suppliers.

The ultimate goals of the program are:

- Improve the energy efficiency of the New York's current electrically powered commuter rail and subway system in the New York City load pocket.
- Reduce costs of power transmission by allowing unused off-peak capacity to generate revenue and reduce transportation petroleum use, green house gases, and criteria emissions.

The benefits of the electric transportation program will include peak load reduction in the New York City load pocket and permanent energy use reductions. These reductions will result in cost reductions to the subway and commuter rail systems and reduced transmission congestion in the region. Additionally, many projects are expected to reduce transportation costs and emissions from petroleum fueled vehicles.

The program budget is $5.0 million.

5.9.2 Recent Program Accomplishments

Six months of accomplishments toward the program's one-year goals are shown in Table 5-25.

Table 5-25. Electric Transportation Program Goals achieved from July 1, 2006 through December 31, 2006

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006
Solicitations released	2	1
Proposals reviewed	N/A	11
Projects funded	N/A	5
Funding/Co-funding	$1,000,000/$1,000,000	$807,097/$1,000,000

5.9.3 Long-Term Program Accomplishments

Long-term success indicators and goals are presented in Table 5-26.

Prior SBC-funded projects focused on improving the State's energy efficiency through the use of off-peak power to reduce the use of petroleum-based transportation fuels. The Electric Station Car Project leased small neighborhood electric cars to the public and provided charging stations in reserved parking slots at commuter rail stations. Demand for the vehicles exceeded supply by nearly three to one. Thousands of gallons of gasoline consumption were replaced by off-peak power.

A second successful project, the Truck Stop Electrification Project, developed infrastructure technology, sponsored initial demonstrations and created a New York State based business that allows long haul trucks to eliminate sleeper cab engine idling during mandatory rest periods. Systems developed for the program are currently being sold nationally and are eligible for State and federal incentives.

Table 5-26. Long-Term Success Indicators

Activity	Achieved through December 31, 2006
Number of projects contracted/Completed	4/0
Funds Encumbered/Associated Co-funding	$157,600/$237,600

5.10 Environmental Monitoring, Evaluation, and Protection

5.10.1 Program Description

The EMEP commenced in the late 1990s in an effort to increase understanding of the environmental impacts of electricity production. EMEP initiatives are building on past efforts and evolving to support research in three primary areas:

- Ecosystem response to deposition of sulfur, nitrogen, and mercury, including continued support of the Adirondack Lake Water Quality monitoring program with the Adirondack Lake Survey Corporation and the NYS Department of Environmental Conservation.
- Health and energy-related research on air quality, particulate matter, ozone and co-pollutants to support continued development of sound air quality management plans for attainment of new ozone and fine particle standards.
- Crosscutting environmental science, technology and policy projects, such as research on regional climate change, environmental impacts of alternative energy resources (e.g., wind and tidal), and mitigating environmental impacts of electricity generation critical for fuel diversity.

The program is guided by a steering committee comprised of major stakeholder groups. In addition a separate science advisory committee continues to provide technical review. The program has maintained a robust science and policy communication component to deliver program findings to policy-makers, scientists, and the public. As with previous efforts, NYSERDA is collaborating with regional and national entities to leverage funds for pertinent research projects.

The 13-year budget is $39.0 million.

5.10.2 Recent Program Accomplishments

The recent program accomplishments for the six month period ending 12/31/06 are presented in Table 5-27.

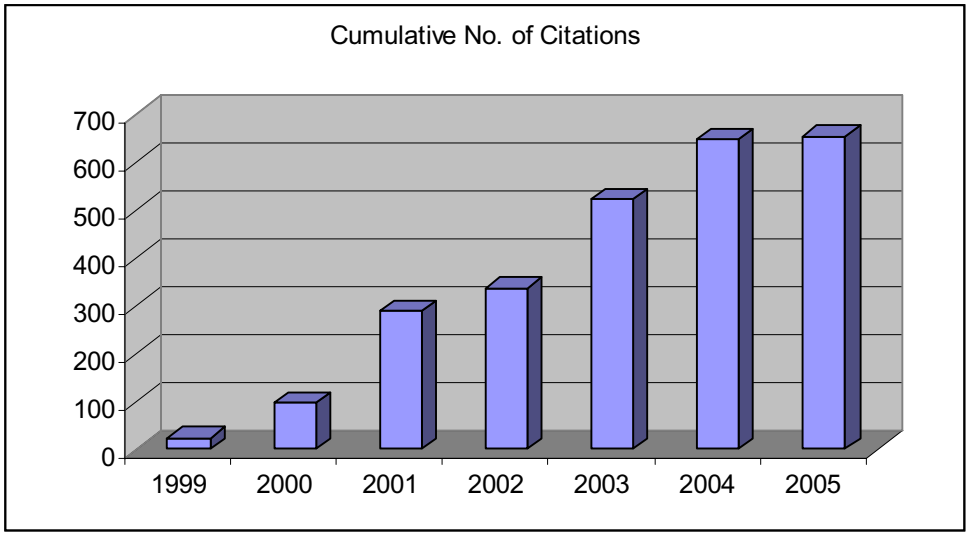
Table 5-27. Environmental Monitoring, Evaluation, and Protection Program Goals achieved from July 1, 2006 through December 31, 2006

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006
Develop detailed multi-year EMEP research plan with input from policymakers, scientists, and stakeholders	Complete EMEP research plan in year 1	One planning meeting was held with the EMEP advisors, and two other major program advisory meetings were held in the fall. NYSERDA has signed a contract with the New York Academy of Sciences to help develop a 5 year technical research plan.
Develop, contract, and manage research projects aimed at priority energy-related environmental research areas	Issue 1 solicitation for outreach and science-policy analysis in year 1 Issue 1 solicitation addressing priority research needs Contract 8 projects	Three contractors were selected for the EMEP Outreach and Technical Assistance PON.
Disseminate information:		
Sponsor workshops, conferences, and seminars	2	NYSERDA held a one-day conference with environmental organizations to exchange information and ideas concerning environmental issues and initiatives in New York State.
Provide web-based EMEP data and information	40,000 customer "visits," inquiries, and downloads from EMEP's web page	During these six months, hits on EMEP web sites totaled nearly 115,000 and downloads totaled more than 11,000.
Publish NYSERDA research reports	5	4 research reports and 1 executive summary were published on: urban heat island, source apportionment, health effects of ambient air pollutants and asthma, and clinical health studies on air ultrafine particles, and ambient air ultrafine particles in Rochester
Publish peer-reviewed journal articles	15	8 articles were published in the area of Air Quality & Health in technical journals.
Provide briefings to decision makers	2	NYSERDA sponsored a meeting with policymakers concerning the effect of wind generation installations on wildlife.

Long-Term Program Accomplishments

Under SBC I and II, $21 million in NYSERDA funds were used to support 46 EMEP research projects and an additional $22 million in funding was leveraged. More than 125 peer-reviewed papers were published on EMEP findings and, as shown in Figure 5-5, EMEP research was cited 655 times in peer-reviewed journals. More than 80 organizations were involved in EMEP research projects, and EMEP fostered collaboration with scientists in 13 different countries to address New York environmental issues. Several advanced pollution measuring devices were developed and commercialized. A web page was launched in 2005, which received an average of 19,000 visits per month over the past year (up from 540 in its first month), and is routinely one of the top three NYSERDA web pages. Most importantly, EMEP research was cited as providing the scientific basis for several important environmental policies in air quality and health advisories.

Figure 5-5. Citations of Journal Articles from EMEP Projects



Accomplishments of the EMEP Program's progress since its inception have been documented as part of a peer review value/cost assessment conducted in 2006. Highlights include:

- Environmental monitoring data from hundreds of field sites throughout New York have been collected to support program goals.
- Achievements in knowledge dissemination have been significant, with over 125 articles published in peer-reviewed journals.
- Researchers supported by EMEP have provided dozens of briefings to State and Federal policymakers in a variety of forums including Congressional briefings/testimony, one-on-one briefings, and workshop and conference briefings.
- EMEP-sponsored research has affected energy-related policy at the New York State level, including:
    - the Acid Deposition Reduction Program,
    - the recent State mercury regulations for power plants,
    - and the New York State Department of Health fish consumption advisories for mercury, as well as at the Federal level, including:
    - the Clean Air Mercury Rule,
    - the U.S. EPA's assessment of the Clean Air Interstate Rule,
    - and the U.S. EPA's review of the SO_2 National Ambient Air Quality Standard.

5.10.3 Program Impact Evaluation

A value-cost analysis was conducted for EMEP in 2006. Guided by a logic model, the evaluation team assembled a variety of performance data for EMEP for the following seven outcomes:

1. Knowledge Creation
    - Significance of Knowledge Created
    - Quantity of Knowledge Created
2. Knowledge Dissemination
    A. Availability of Knowledge Products
    B. Target Audience
3. Commercialization Progress
    - Capital Attraction
    - Technical Achievement
    - Market Advancement
4. Realized and Potential Energy Benefits
5. Realized and Potential Economic Benefits
6. Realized and Potential Environmental and Health Benefits
7. Value versus Cost
    - Value vs. NYSERDA and Participant Cost
    - Value vs. NYSERDA Cost

For the EMEP Program, four outcomes were deemed relevant – knowledge creation, knowledge dissemination, realized and potential environmental and health benefits, and value versus cost. All the scores for the four relevant outcomes were above 3.5, out of a possible 4. The overall score across all outcomes was also quite high at 3.7. Knowledge creation included program planning, research project selection and development, and project funding and management. Knowledge dissemination encompassed relevance, acceptance, and use by the scientific community and by policymakers, which included peer-reviewed publications and citations and impact of EMEP research on promulgated regulations. It is clear that EMEP is making noteworthy progress toward achieving significant long-term environmental benefits. Finally, the external peer review panel concluded that the value of the EMEP program significantly exceeds NYSERDA's costs as well as the combined costs of NYSERDA and its research partners, and the reviewers felt that few research programs in the country can claim the variety and significance of accomplishments as EMEP.

5.11 Industrial Research, Development, and Demonstration

5.11.1 Program Description

The IRDD program supports feasibility studies and technology demonstrations and commercialization that (1) improve energy productivity and competitiveness of New York manufacturers (minimize cost per unit output), (2) encourage capital investment and employment growth in New York facilities, (3) introduce New York-manufactured goods into new markets, and (4) encourage adoption of process changes that minimize waste. Cost-shared demonstration projects reduce risk and encourage manufacturers to adopt innovative and underutilized product and process alternatives. IRDD is a new program that combines two Industry programs, Industrial Process and Productivity Improvement (IPPI) and Industrial Product Development, to better serve the industrial sector's needs. IRDD is a collaborative effort of Industrial and Environmental R&D and Energy Efficiency Services.

The five year program budget is $15 million.

5.11.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Industrial Research, Development and Demonstration Program. These goals and progress for the first six month period ending December 31, 2006 are shown in Table 5-28.

Table 5-28. Industrial Research, Development and Demonstration Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Issue annual solicitations	*By fall 2006,contract for 6 to 10* demonstrations and feasibility studies of innovative and under-utilized technologies that save energy and improve productivity in the industrial sector	PON 998 was issued with two rounds of due dates (June 8 and October 5, 2006) with total funding of $4 million ($2M SBC + $2M Statutory funding). NYSERDA selected 6 projects to receive SBC funding in round 1 and 5 projects to receive SBC funding in round 2.
Program metrics	Document realized energy efficiency, environmental, and economic benefits	Projects are being contracted with requirements for documentation of performance metrics. Projects have not been completed; therefore, metrics cannot be ascertained at this time.

Program Highlights

During the third quarter of 2006, NYSERDA solicited proposals for IPPI (which was the precursor to the IRD&D Program). Eleven projects have been selected for funding.

Over the past ten years NYSERDA Industrial Process and Productivity Improvement Program has averaged $1.75 million in annual funding, and resulted in cumulative energy savings of almost $20 million, non-energy benefits in excess of $21 million, project-related incremental sales of almost $40 million, and approximately 85 new jobs. This program combined statutory R&D funds and EES federal funds.

5.11.3 Long-Term Program Accomplishments

This section highlights key program outputs and market progress. All values reported are cumulative since program inception. Table 5-29 presents the key outputs for IPPI and Industrial Product Development (IRDD predecessor) through December 31, 2006. In addition to the key outputs, several long-term success indicators will also be tracked including: energy, demand and fossil fuel savings, cost savings from productivity improvements, processes developed, and processes deployed.

Table 5-29. Industrial Research, Development and Demonstration Program – Key Program Outputs

Outputs	Goal through 2011	Value (Cumulative through December 2006)
Number of Solicitations	5 PONs, 14 due dates	1 PON, 2 due dates
Number of proposals reviewed/Recommended for SBC funding	300/40	40/11
Number SBC contract actions	40	11
Number of unique SBC projects	35	11
SBC Funds Encumbered	$10,000,000	$1,513,547
Co-funding by Project Participants	$20,000,000	$3,155,688

5.12 Municipal Water and Wastewater Efficiency

5.12.1 Program Description

Since 2000, the ongoing water and wastewater initiative has supported projects that accelerate the use of energy-efficient and innovative technologies by municipal water and wastewater systems in New York through demonstrations, technology transfer, and feasibility studies. Approximately three to four billion kWh are consumed by municipal water and wastewater treatment plants in New York every year. On average, the sector consumes 35% of a typical municipality's energy budget.

There are currently 16 SBC-funded water and wastewater projects, derived from eight solicitations developed jointly by NYSERDA's Energy Efficiency Services and R&D staffs. Five of the eight solicitations were PONs, which solicited proposals to demonstrate and evaluate innovative or underutilized energy-efficient water and wastewater technologies. A sixth was an RFP, which solicited proposals to demonstrate real-time monitoring of energy and environmental performance at wastewater treatment plants, attempting to attract the energy service sector into the municipal wastewater market. The seventh was another RFP, which solicited proposals to benchmark energy use and evaluate the potential for energy efficiency and energy production improvements in the sector. The eighth solicitation is a sector-based initiative, the Energy Smart Focus Program, where municipal water and wastewater is one of the five sectors selected to receive services. A separate technology transfer project is helping to increase the utilization of a specific energy-efficient filtration technology by providing technical assistance to up to 10 wastewater treatment plants. In addition, NYSERDA's long-standing Technical Assistance (TA) Program has served municipal water/wastewater customers since 1997, including 70 site-specific analyses. All activities to date have had strong technology transfer components, and municipal

water and wastewater treatment is also integrated with the Enhanced Commercial/Industrial Performance program.

Going forward, the Municipal Water and Wastewater Efficiency Program will focus on providing municipalities with information, resources and services to increase the standard of energy efficiency in the sector. To that means, the program will continue to provide cost-shared demonstration projects to reduce risk and encourage adoption of innovative or underutilized energy-efficient technologies and practices. Energy management training will be offered for treatment plant operators, municipal decision makers, consultants, and product vendors. Technical assistance will continue to be emphasized for municipalities seeking to upgrade or improve the energy efficiency of their equipment and operations. Energy efficiency incentives will continue to be offered to move the market to more efficient equipment. In support of these efforts, technology transfer and outreach will be provided to encourage adoption of innovative and energy-efficient technologies and practices. The program will continue to be a collaborative effort between NYSERDA's R&D and Energy Efficiency Services staff.

The Municipal Process Efficiency Program is funded out of the Commercial/Industrial sector budget. SBC funds are leveraged in this sector for Technical Assistance and from the Enhanced Commercial and Industrial Performance Program.

5.12.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Municipal Water and Wastewater Program. These goals and progress for the first six month period ending December 31, 2006 are shown in Table 5-30.

Table 5-30. Municipal Water and Wastewater Efficiency Program Goals achieved from July 1, 2006 through December 31, 2006

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006
Issue annual solicitation	Select and fund 5 or more projects, provide assistance to a minimum of 5 municipal wastewater and water treatment facilities.	PON 1040 was issued and 17 proposals were received requesting $3.9 million in NYSERDA funding. These proposals were recommended for SBC funding. These contracts are being negotiated.

Activity	First Year Goal through June 30, 2007	Achievements from July 1, 2006 through December 31, 2006
Technology transfer	Provide critical information on technologies and strategies that will optimize energy production and use at municipal wastewater and water treatment facilities. Provide information to 100 treatment facilities in New York.	NYSERDA sponsored an energy management training session for the target sector was co-developed by EPRI and the New York Water Environment Association (NYWEA). Approximately 70 individuals representing consultants, engineers and municipalities attended the two-day session. Additionally, the materials developed for the session will be offered through NYWEA in webcast format in the near future. Energy management presentations were given at four NYSEFC hosted Co-funding Committee conferences and as part of a webcast hosted by the Comptroller's Office. At a minimum, an additional 100 individuals participated in these presentations. The submetering and evaluation of 20 wastewater treatment plants has been completed. The final reports an summary of findings have been posted online. (In a related sector-based EES program, the Energy Smart Focus solicitation was developed to provide sectors with customized services and strategies in support of energy efficiency. Proposals supporting the Municipal Water and Wastewater Sector were reviewed by a Technical Evaluation Panel for technical merit.)
Technical Assistance	Develop six new projects while reviewing and approving six ongoing projects.	Two new Technical Assistance (TA) projects were approved to begin work totaling $12K in NYSERDA funds. Four TA projects, representing $76K in NYSERDA funds, were completed.

5.12.3 Long-Term Program Accomplishments

As of December 2006, $3.2 million has been committed under the targeted water and wastewater initiative. An additional $1.1 million has been awarded for municipal water/wastewater projects under the TA Program. Table 5-31 summarizes the funding status of the programs.

Table 5-31. Project and Funding Status

	Proposals Received	Number of Projects	Number of Sites Approved	Funds Awarded ($ million)	Co-funding ($ million)
RFP 769 Energy Efficiency Improvements at Water & Wastewater Treatment Plants	10	1	n/a	$0.13	$0.05
RFP 601 (Submetering)[1]	17	2	20	$1.1	$0.4
Demonstration Projects (569, 786, 857, 935 and 1040)	99	12	12	$1.86	$2.4
Technical Assistance [2]	75a	70	70	$1.1	$1.1
Technology Transfer	1	1	3	$0.1	$0.1

[1] Funded in part under the general Technical Assistance Program.
[2] Funded under the general Technical Assistance Program.
a Number of viable projects.

5.12.4 Program Impact Evaluation

Energy Savings

On average, these projects take five to seven years from conception to implementation. However, once implementation is complete, the projects should lead to nearly 42,919 MWh of electricity savings and 14,774 kW of peak demand reduction. Depending on the effectiveness of information dissemination from knowledge created, the potential exists for substantial MWh savings and demand reductions due to replication across the broader New York municipal water/wastewater market sector.

5.13 Next Generation and Emerging Technologies

5.13.1 Program Description

The Next Generation and Emerging Technologies program emphasizes discrete and integrated end-use technologies for buildings; daylighting applications; solar thermal applications; and emerging technologies for industry and buildings not covered elsewhere in NYSERDA's portfolio of **New York Energy $mart**[SM] programs. The bulk of funds will be administered through narrowly defined competitive solicitations. Potential focus areas include:

- Advanced Building Products Program which concentrates on residential one- to four-family units. The advanced building demonstration element addresses the whole building – striving to reach a 92 or greater HERS rating (qualifying ENERGY STAR homes start at a HERS rating of 84). The discrete building technologies element targets development and demonstration of distinct technologies, *e.g.*, energy systems (production and recovery), heating and cooling, air quality, etc.

- Emerging technologies to support development and demonstration of discrete technologies that improve electrical end-use efficiency.

- Daylighting applications to support demonstration and provide technical assistance to advance daylight applications in commercial buildings.

- Solar thermal applications to support demonstration and provide technical assistance to advance economical collection and utilization of solar thermal energy.

- Lighting incubator program activities that develop and commercialize advanced lighting technologies.

- Power quality, energy management, controls and sensors activities that promote development of technologies that enable customers to monitor and control energy usage and power quality.

The program emphasis is on funding developers and producers of energy-efficient technology which would be commercially available to end users. Demonstration solicitations are open to all end-use customers, particularly those with high electric loads. For example, advanced building demonstrations will focus exclusively on residential homes of one to four units.

Past solicitations have addressed transportation, sensors, energy efficiency, superconductivity, power quality, energy management, and time sensitive pricing.

The thirteen-year program budget is $47.8 million.

5.13.2 Recent Program Accomplishments

Several near-term, annual goals have been set for the Next Generation and Emerging Technologies Program. These goals and progress for the first six month period ending December 31, 2006 are shown in Table 5-32.

Additional program highlights include:

- Two solicitations are under development for the Advanced Building Program. They are PON 1096 High Performance Residential Development Challenge (funded at $1.5 million) and PON 1126 Next Generation Emerging Technologies for Residential Buildings (funded at $2.5 million).

Table 5-32. Next Generation and Emerging Technologies Program – Near-Term Goals and Achievements

Activity	Program Goals (July 1, 2006 through June 30, 2007)	Achieved July 1, 2006 through December 31, 2006
Advanced Building Program	2 solicitations, 5 product development projects, 1 demonstration test bed	Proposals in response to PON 1062 *Advanced Building Envelopes and Energy Systems* were received on October 18, 2006. Total funding available is $1 million. Two proposals were funded for a total of $120,000. One proposal was funded for RFP 1032 *Reference Design Guide* with total funding of $100,000.
Daylighting Applications	5-10 design assistance projects, 1 daylighting implementation in buildings	Nine proposals were received in response to PON 1079 *Daylight Technical Services, Training and Demonstrations.* Total available funding is $675,000. RFP 1068 "Establishment of a Lighting Incubator Center to support lighting start-up companies in New York" was released. Proposals are due by January 25, 2007. Total funding available is $2 million.
Solar Thermal Applications	1 solicitation, 2 demonstrations	Submissions for PON 1085 *Solar Thermal Demonstrations* are due by February 5, 2007. Total available funding is $500,000.
Emerging Technologies	1 solicitation, 5 product development projects	Three projects involving emerging hydrogen technologies were selected to be funded with SBC funds through PON 957 Hydrogen Technology Development and Demonstration. PON 1105 has total funding of $4,000,000 for two rounds of proposals. First round proposals are due by January 22, 2007. The second round proposals are due by June 7, 2007.

5.13.3 Long-Term Program Accomplishments

In early 2007, project managers were asked to provide information on completed projects. The remainder of this section provides the results of this effort.

Program Portfolio

Since its inception in September 1998, the program has funded projects totaling over $25 million. There are currently 123 projects funded under the program. Of these, 71 are complete and 52 are ongoing. Projects were categorized into the following project types:

1. Research/Support Studies: include studies that analyze market potential, technological feasibility, and other studies designed to inform policy makers and supply-side market actors.

2. Product Development: projects that are focused on a clearly defined product and benefit New York manufacturers.

3. Demonstration: projects that demonstrate the performance of products that are commercially available.

4. Conference/Membership: projects support activities related to conferences and association membership.

The number of projects in each category is shown in Figure 5-6. Categories with the most projects are Research & Support at 35%, followed by Demonstration at 31%. The distribution of funding by project categories is shown in Figure 5-7. The largest categories in terms of funding are Demonstration with 50% of the funding, followed by Product Development with 21% of the funding. The distribution of funding by sector is shown in Figure 5-8. The industrial/manufaturing sector has been awarded the most funding at 39%.

Figure 5-6. Projects Distributed by Project Type

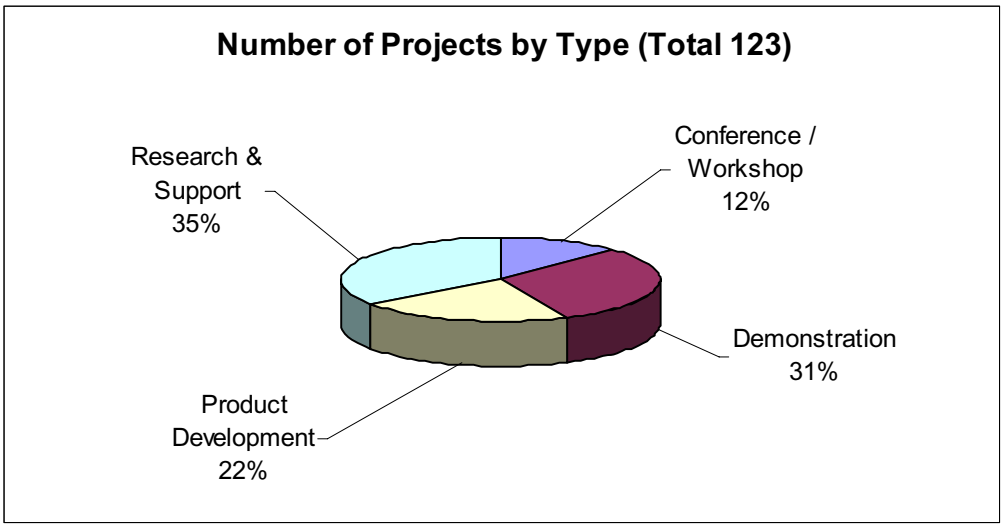


Figure 5-7. Distribution of Funding by Project Type

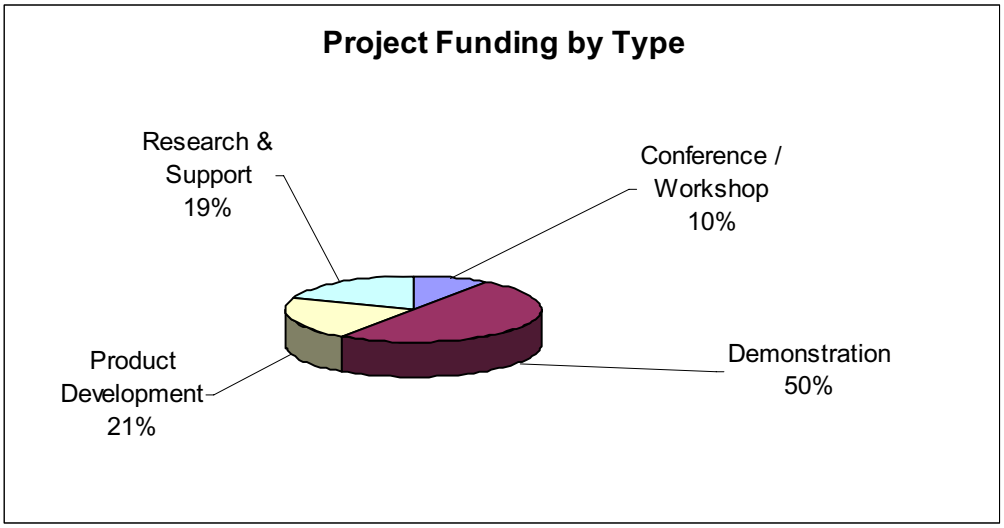


Figure 5-8. Encumbered Funding by Sector (through 2006)

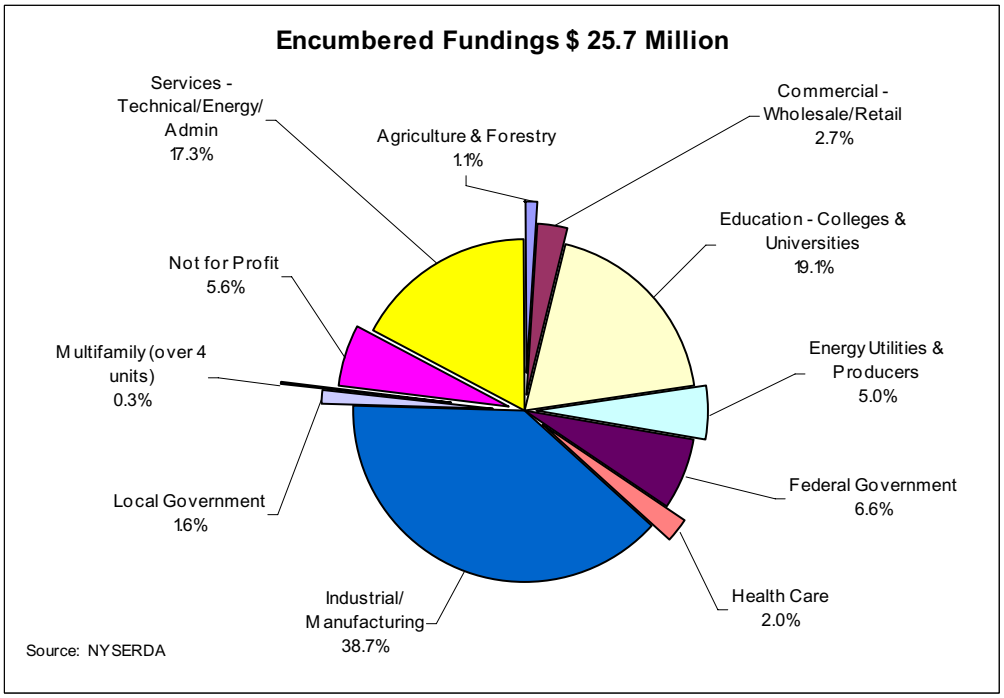


Table 5-33 presents results regarding the magnitude of knowledge creation, dissemination, and commercialization progress activities. For each project, project managers indicated whether a particular project resulted in 0, 1 to 5, 6 to 10, or 11 or more of specific outcomes such as published articles, websites reporting project information, conference presentations, etc. The number of projects with more than 1 instance of these outcomes is shown in Table 5-33 for the different response categories. Other program outcomes are shown in Table 5-34.

Table 5-33. Next Generation and Emerging Technologies Program – Number of Projects with Selected Outcomes (Through Year-End 2006)

Outcomes	Response Category		
	1 - 5	6 - 10	11 or more
Knowledge Creation and Disseminations			
Number of published articles	34	3	2
Number of websites where reports are available	28	0	0
Number of Conference Presentations	30	2	2
Number of field tests initiated	16	3	2
Number of lab tests initiated	14	1	1
Commercialization Progress			
Number of projects with UL listing, other Listings, patents, or patent applications	11	0	0

Table 5-34. Other Program Outcomes: Number of Projects with Attribute

Outcome	Result
Number of projects with recoupment provisions[1]	24
Number of new products developed	9
Number of projects with sales	4
Number of projects with job creation	7
Number of projects with new investments	17

1 Includes ongoing and completed projects

Nine new products were developed under the Next Generation Program and are in various stages of commercialization. These are shown in Table 5-35.

Table 5-35. Next Generation and Emerging Technologies Program: New Products Developed Since 1998.

Product Name	Development Objective
Ultra-Low Power Oil-fired Burner	Confirm fitness for full scale commercialization of the Ultra-Low Power system.
Voltage Sag Mitigation Device	Evaluate performance characteristics of an energy-efficient, voltage sag mitigation technology.
T 9000	Development and evaluation of a wall mounted, wireless thermostat control system for baseboard electric heaters and room air conditioners.
Power-Line-Carrier Controlled Fluorescent Lighting	To develop an ultra-efficient, electronic, sub-miniature dimming ballast (SMDB) for fluorescent lighting in the power range of 13W to 32W and a high power electronic dimming ballast (HPEDB) in the power range of 60W to 200W; both with 10-year reliabilities and on/off/dimming control functions through the use of power line carrier controls.
Online Lighting Education Training	To develop and conduct on-line educational seminars on energy efficient lighting systems for key lighting decision-makers in New York State.
Low electric power battery back up oil-fired heating system	Develop and laboratory test a self-powered, oil-fired, heating system for residential and small commercial buildings.
Hybrid Skylighting System	To design, evaluate and demonstrate a hybrid skylighting system combining a skylight with a photosensor to moderate electric light use.
HID Wallpack & Floodlight	To develop, manufacture and market high quality, affordable high intensity discharge (HID) wallpack and floodlight fixtures.
Revolutionary Power Cell	Design and develop a hybrid system including a high power density battery integrated with the contractor's high energy density power cell and demonstrate it in a small electric vehicle.

The primary technology investigated by each project was provided by the project managers. The technology categories are shown in Table 5-36. along with the number of projects in each category. The projects are further divided by project type, project status, and outcome attributes.

Table 5-36. Project Outcomes by Technology Type (Cumulative Through 2006)

Technologies	Project Type[1]					Status[1]		Knowledge Created, Disseminated, Commercialized[2]							Economic Benefits[2]			
	Research and Support	Product Development	Demonstration	Conference/Member-ship	Total number of projects	Ongoing	Completed	Lab tests initiated	Field tests initiated	Published articles	Conference Presentations	Websites where reports are available	Certifications or listings	Patents/patent applications	Recoupment Contracts	Products with Sales	Resulted in new jobs	Resulted in new investment
Aggregation/ Metering/Demand Management	10	3	15	2	30	7	23	1	3	16	13	10			5		3	9
Emissions/Clean Vehicles/Truck stop Electrification	2	1	2		5	2	3	1	2	2	3	3					1	2
Energy Generation/ Storage/CHP	4	5	1		10	3	7		2						5			
HVAC/R	8	5	2		15	8	7	5	1	6	6	6			4			
Industrial Processes	4	1	4		9	2	7	3	5	5	3						1	2
Lighting and Lighting Controls	6	7	8	5	26	14	12	4	5	7	6	7	2	3	6	3	1	2
Power Quality/Power Management/ Inverter/Control Systems	2	5	4		11	7	4	2	3	2	2	1	3	3	4	1	1	2
Residential Building Systems	3				3	3												
Technology Transfer	4			8	12	5	7			1	1	1						
Transmission & Distribution			2		2	1	1											
Totals	43	27	38	15	123	52	71	16	21	39	34	28	5	6	24	4	7	17

[1] Includes ongoing and completed projects [2] These numbers represent each instance of a range of 1 – 11 cumulative events per project

Appendix A: Glossary

ACRONYMS AND ABBREVIATIONS

AC: Air conditioner

A&E: Architecture and engineering firms

AD: Advanced diagnostics

AHP: Assisted Home Performance with ENERGY STAR®

AIA: American Institute of Architects

AMP: Assisted Multifamily Program

ASERTII: Association of State Energy Research and Technology Transfer Institutions

ASHRAE: American Society of Heating, Refrigerating, and Air Conditioning

ASME: American Society of Mechanical Engineers

AUSA: Association of the United States Army

B/C: Benefit-cost

B/I: Business and institutional

BPI: Building Performance Institute

Btu: British thermal unit

Cx: Commissioning

C/I: Commercial and industrial

CBO: Community-based organization

CEE: Consortium for Energy Efficiency

CEM: Residential Comprehensive Energy Management Program

CFL: Compact fluorescent light

CHG&E: Central Hudson Gas & Electric Corporation

CHP: Combined heat and power

CIPP: Commercial/Industrial Performance Program

CO: Carbon monoxide

CO_2: Carbon dioxide

Con Edison: Consolidated Edison Company of New York, Incorporated

CSG: Conservation Services Group, Inc.

CSP: Curtailment service provider

DCV: Demand control ventilation

DEC: New York State Department of Environmental Conservation

DEGI: Dispatchable Emergency Generation Initiative, a component of the Peak Load Reduction Program (PLRP)

DG: Distributed generation

DHCR: New York State Division of Housing and Community Renewal

DI: Low-Income Direct Install Program

DOE: United States Department of Energy

DPS: New York State Department of Public Service

DR: Demand response

DCV: Demand control ventilation

ECIPP: Enhanced Commercial/Industrial Performance Program

EDRP: New York Independent System Operator Emergency Demand Response Program

EES Energy Efficiency Services

EESAT: Electrical Energy Storage Applications and Technology

EMEP: Environmental Monitoring, Evaluation, and Protection Program

EMP: **ENERGY STAR®** Multifamily Building Program

EPA: United States Environmental Protection Agency

EPRI: Electric Power Research Institute

ERO Electricity Reliability Organization

ESA: Electrical Storage Association

ES: ENERGY STAR®

ESCO: Energy services company

ESPM: ENERGY STAR® Products and Marketing

ESS: Energy Smart Students

ET: Enabling Technology for Price-Sensitive Load Management

EUR: End-Use Renewables Program

FERC: Federal Energy Regulatory Commission

FlexTech: Flexible Technical Assistance Program

FR: Freeridership

GW: Gigawatt

GWh: Gigawatt hour

HEAP: Home Energy Assistance Program

HERS: Home Energy Rating System

HFI: Homeowner Financing Incentive

HPD: New York City Department of Housing Preservation and Development

HPwES: Home Performance with ENERGY STAR®

HTR: Hard-to-reach

HTS: High temperature superconducting

HUD: United States Department of Housing and Urban Development

HVAC: Heating, ventilation, & air-conditioning

ICAP: New York Independent System Operator Installed Capacity Program

ISO: Independent system operator

IDC: Integrated Data Collection

IM: Interval Meters Program, a component of the Peak Load Reduction Program (PLRP)

IRDD: Industrial Research, Development, and Demonstration Program

kW: Kilowatt

kWh: Kilowatt hour

LC/S: Load Curtailment and Shifting Program, a component of the Peak Load Reduction Program (PLRP)

LED: Light emitting diode

LEED™: Green Buildings Leadership in Energy and Environmental Design

LI: Low Income

LIFE: Low-Income Forum on Energy

LIHEAP: Low-Income Home Energy Assistance Program

LIPA: Long Island Power Authority

LNG: Liquefied natural gas

LSE: Load-serving entity

M&V: Measurement and verification

MCAC: Market characterization, assessment, and causality analysis

MF: Multifamily

MMBtu: Million British thermal units

MOU: Memorandum of Understanding

MW: Megawatt

MWh: Megawatt-hour

NAAQS: National Ambient Air Quality Standard

Nat'l Grid: National Grid

NBI: New Buildings Institute

NCP: New Construction Program

NCQLP: National Council on Qualifications for Lighting Professions

NEEP: Northeast Energy Efficiency Partnerships

NEI: Non-energy impacts

NEMA: National Electrical Manufacturers Association

NextGen: Next Generation of Energy Efficient End-Use Technologies Program

NOx: Nitrogen oxides

NSTAR: See Glossary of Terms.

NTG: Net-to-gross

NYC: New York City

NYCA: New York control area

NYE$: **New York Energy $mart**SM Program

NYE$C: **New York Energy $mart**SM Communities

NYESLH: New York ENERGY STAR® Labeled Homes

NYISO: New York Independent System Operator

NYPA: New York Power Authority

NYS: New York State

NYSEG: New York State Electric and Gas Corporation

NYSERDA: New York State Energy Research and Development Authority

NYSRC: New York State Reliability Council

NYWEA: New York Water Environment Association

O&M: Operations and maintenance

O&R: Orange and Rockland Utilities, Incorporated

OPC: Outreach project consultant

OTDA: New York State Office for Temporary and Disability Assistance

PDRE: Permanent Demand Reduction Effort, a component of the Peak Load Reduction Program (PLRP)

PEM: Premium-Efficiency Motors Program

PET: Program Efficiency Test

PLC: Power line carrier

PLRP: Peak Load Reduction Program

PM: Particulate matter

PON: Program Opportunity Notice

POP: Point-of-purchase

PSC: New York State Public Service Commission

PT/LM: Program Theory and Logic Modeling

PV: Photovoltaic

QA: Quality assurance

QC: Quality control

R&D: Research and development

RD&D: Research, development, and demonstration

RAC: Room air conditioner

RCx: Retrocommissioning

ResTech: Residential Technical Assistance Program

RFP: Request for Proposals

RG&E: Rochester Gas and Electric Corporation

RPS: Renewable portfolio standard

RTO: Regional transmission organization

RTP: Real time pricing

RTU: Rooftop unit

SBC: System benefits charge

SCLP: Small Commercial Lighting Program

SEC: Smart Equipment Choices Program

SEER: Seasonal energy efficiency ratio

SIR: Standard Interconnection Requirements

SO: Spillover

SO_2: Sulfur dioxide

TA: Technical assistance, Technical Assistance Program

T&D: Transmission and distribution

TECA: Training, Education, Certification and Awareness

TEP: Technical Evaluation Panel

TMET: Total Market Effects Test

TREAT: Targeted Residential Energy Analysis Tools

TSP: Technical service provider

TTW: Through-the-wall air conditioner

V/C: Value/cost analysis

VEIC: Vermont Energy Investment Corporation

VSD: Variable speed drive

WAP: U.S. Department of Energy Weatherization Assistance Program

WNI: Weatherization Network Initiative

GLOSSARY OF TERMS

A

Acid Deposition Reduction Program: Regulations issued by the New York State Department of Environmental Conservation that result in reducing emissions of the harmful acid rain pollutants sulfur dioxide and nitrogen oxides.

Adjusted gross savings: NYSERDA-reported savings adjusted with M&V realization rates.

Aggregator: An entity that brings customers together to (1) buy electricity in bulk to increase customers' buying power and (2) benefit from programs with participation requirements that exclude small customers.

Allies: Service providers involved in projects that are funded through the **New York Energy $mart℠** Program.

Attribution: The assertion that a program is responsible for observed or measured effects. **(**Used interchangeably with causality.**)**

Avoided cost: The cost of power that a load serving entity avoids by not generating or purchasing the power from another source.

Awarded funds: Funds that have been contracted, approved for contracting, or set aside as a result of incentive applications.

B

Base case: The first step in macroeconomic analysis. The base case is an estimate of the impacts that system benefits charge funds would have had on New York's economy if the funds had been retained by customers of the participating utilities.

Benefit/cost analysis (B/C): Estimating the benefits of programs relative to their delivery costs. The general B/C ratio is the cumulative net present value of benefits divided by the cumulative net present value of costs.

Biomass: Materials that are biological in origin, including living and dead organic material. Biomass can be used as fuel and is available on a renewable basis through natural processes and as byproducts of human activities.

Btu (British Thermal Unit): The standard unit for measuring quantity of heat energy necessary to raise the temperature of one pound of water one degree Fahrenheit.

C

Callable: Short term load curtailment that can be requested by the New York Independent System Operator to maintain system reliability when generation resources become scarce.

Capacity: The volume of electrical power measured in megawatts needed to meet the expected demand for electricity.

Carbon dioxide (CO_2): The primary greenhouse gas associated with climate change and produced from the combustion of all fossil fuels.

Causality: The assertion that a program is responsible for the observed or measured effects. (Used interchangeably with attribution.)

Clean Air Mercury Rule: On March 15, 2005, EPA issued the Clean Air Mercury Rule to permanently cap and reduce mercury emissions from coal-fired power plants. With this rule, the United States is the first country in the world to regulate mercury emissions from utilities.

Clean Air Interstate Rule: A federal program that will permanently cap emissions of sulfur dioxide (SO_2) and nitrogen oxides (NOx) in the eastern United States, including New York. When fully implemented, the Clean Air Interstate Rule will reduce SO_2 emissions in affected states by more than 70 percent and NOx emissions by more than 60 percent from 2003 levels.

Co-funding: Financial and in-kind services contributions to the **New York Energy $mart℠** Program by sources outside NYSERDA that are necessary to ensure the Program as designed achieves the expected benefits. It is assumed that the expenditures would not have been made by the external contributors in the absence of the Program.

Combined heat and power (CHP): The use of single sources to provide heat energy and generate electricity for industrial and commercial productions and processes.

Commissioning: The process of ensuring that systems in new construction projects are designed, installed, functionally tested, and capable of being operated and maintained according to the original design intent and the building's operational needs.

Committed funds: Funds that have been set-aside for a **New York Energy $mart℠** program or project but have not been awarded to a contractor or customer.

Confidence interval: Error is involved whenever an experiment is run or people are sampled for a survey. Confidence intervals estimate the amount of error involved in data. The larger the confidence interval the less precision is implied in the analysis.

Cost recovery fee: A fee assessed by New York State for services to public authorities. The fee is determined by the New York State Division of Budget and imposed and collected by the New York State Department of Taxation and Finance.

Cumulative annual savings: Savings realized in a single calendar year from all installed measures.

Cumulative program savings: The sum of the savings realized across the life of the program. For example, a measure completed in January 2001 that delivers 100 kWh per year of annual savings will have delivered 500 kWh of cumulative program savings through December 31, 2005. The measure will continue to deliver annual savings of 100 kWh per year in subsequent years for the life of the measure.

Curtail, curtailable, curtailment: A customer's deliberate short-term reduction in electricity use, usually in response to a call by the New York Independent System Operator (NYISO) to maintain system reliability.

Custom measure: An energy efficiency measure that has been designed to meet specific performance criteria and application requirements and for which no widely available commercial product or application is available.

Customer-sited Tier: The component of the Renewable Portfolio Standard that includes electricity generated "behind the meter" by facilities that are not economically competitive with Main Tier technologies. Customer-sited resources include fuel cells, photovoltaics, anaerobic digesters, and wind resources of 300 kW or less.

Cycle time: The interval between a solicitation's due date and the date of contract signing. The interval is spent reviewing proposals, selecting winning bidders, and reaching agreement with proposers on specific work scopes and contract terms.

D

Daylighting: Daylighting is an energy efficiency measure that involves placing windows and other transparent media and reflective surfaces so that, during the day, natural light provides effective internal illumination.

Deemed savings: Savings associated with commonly adopted measures and that do not require measurement and verification for individual projects.

Deemed-savings database: A database developed for NYSERDA by its M&V contractor and used by six **New York Energy $mart℠** programs. The deemed savings database contains results from a comprehensive review of stipulated savings of more than 400 measures.

Demand reduction: A lessening in the amount of energy drawn by end-use customers from the grid.

Demandside: See Market actor: Downstream or demandside.

Distributed generation (DG): Small generation facilities using a range of technologies, including reciprocating engines, small and micro-turbines, fuel cells, photovoltaic arrays, wind, and other renewable energy sources.

Dual enthalpy economizer: A type of economizer that restricts economizer cooling to times when the heat content (enthalpy) of the outside air is less than the heat content of the return air.

E

Economizer: Control systems that are installed on mechanical cooling systems such as packaged rooftop units and outdoor air handlers and that save cooling energy by using outside air as a first stage in cooling.

Electric energy savings: Reductions in customers' annual KWh consumption.

Encumbered funds: **New York Energy $mart℠** funding that has been awarded for an energy efficiency project but has not been paid to the contractor or customer under contract.

End user: A person or entity that purchases or uses electricity at a site.

Energy burden: The percentage of household income used to pay for energy.

Energy efficiency measures: Energy-efficient products that are promoted through the **New York Energy $mart℠** Program. Installing energy efficiency measures rather than standard products results in energy and cost savings.

Energy services company (ESCO): Load serving entities, retail load aggregators, providers of comprehensive energy services, and formal groups of such entities that provide various services for customers in New York such as: matching buyers and sellers of electric power, tailoring physical and financial instruments to suit customers' needs, and developing, installing, and financing projects that are designed to reduce customers' energy and maintenance costs. NYSERDA's ECIPP program includes A&E firms, contractors, and manufacturers among ESCOs eligible for incentives.

F

Freeridership: A term for in-program impacts (*e.g.,* energy savings) that would have occurred in the absence of the program and without program incentives.

Fuel cell: An electrochemical device to convert chemical energy directly into electricity.

G

Gigawatt: One billion watts.

Gigawatt hour: A measure of electricity consumption equal to 1,000,000,000 watts of power over a period of one hour.

Green marketing: The sale of green power in competitive markets where multiple suppliers offer diverse products and services.

Green power: Energy from indefinitely available resources and whose generation has zero or negligible environmental impacts, whether through reduced emissions or minimal environmental disruption. Such sources of energy include: wind, wave, tidal, small scale hydropower, biomass, landfill gas, geothermal power, and solar.

Grid: A network for the transmission of electricity.

Gross savings: The reduction in energy and power requirements enjoyed by customers participating the **New York Energy $mart℠** Program (Program). Gross savings do not account for secondary effects that occur outside the Program nor do they systematically consider degradation and removal of equipment.

I

Incentives: Monetary and non-monetary awards offered to encourage consumers to buy energy-efficient equipment and to participate in programs designed to reduce customers' energy use.

Incremental cost: The cost of energy-efficient equipment less the cost of comparable standard-efficiency equipment.

Infrastructure development: Increasing the supply of energy efficient products to facilitate competition among end-use customers.

Inputs: Resources available to a program that include money, staff time, volunteer time, and existing knowledge.

Installed Capacity Program (ICAP): A New York Independent System Operator (NYISO) demand-response program in which generators and load serving entities are capable of supplying and reducing their demand for energy to ensure that sufficient energy and capacity are available to meet the State's reliability rules.

Installed measures: Energy efficiency measures that have been installed in end-use applications as the direct result of one of the **New York Energy $mart℠** programs.

Integrated Data Collection (IDC): A survey technique that garners participation feedback in nearly real time on market characterization and attribution/causality. IDC is usually integrated with standard program implementation and program paperwork.

Interval meter: A meter that captures, stores, and communicates energy-use information.

K

Kilowatt: One thousand watts.

Kilowatt hour: A measure of electricity consumption equal to 1,000 watts of power over a period of one hour.

L

Leveraged funds: Financial expenditures and in-kind services made by sources outside NYSERDA that would have occurred in the absence of the **New York Energy $mart℠** Program. Leveraged funds supplement NYSERDA funds such that their effectiveness and benefits are increased beyond what **New York Energy $mart℠** Program funding alone could have achieved.

Load: The electric power consumed at one moment in time by customers.

Load curtailment: Instantaneous, short-term (*i.e.,* several hours) reductions in power used by customers.

Load management: Activities designed to influence the timing and magnitude of customers' use of electricity.

Load serving entity (LSE): Entities, including municipal electric systems, energy services companies, and electric cooperatives that are authorized and required by law, regulatory authorization or requirement, agreement or contractual obligation to supply energy, capacity, and ancillary services to retail customers located within the New York Control Area (NYCA), including entities that take service directly from the New York Independent System Operator (NYISO) to supply their own load in the NYCA.

Load shifting: A form of electricity load management that involves shifting energy use to different time periods of the day.

Logic model diagram: Documents that discuss the logical relationships among elements within programs through diagrams constructed with boxes and circles that (1) map the step-by-step process of inputs, activities, outputs, and outcomes embedded within programs, (2) identify hypotheses and key indicators, and (3) identify potential external influences.

Low-income customer: For purposes of the **New York Energy $mart℠** Program, low-income households are those having income less than or equal to 80% of the state's median income. Median income is determined by the number of persons in the household. In 2005, 80% of the state median income for a family of four was $55,488. The figure varies from year to year.

M

Macroeconomic benefits: The economic value added by the **New York Energy $mart℠** Program estimated by comparing the impacts of the program's expenditures and energy savings to the impacts that would have resulted had the program not been implemented and the money not been paid by ratepayers into the System Benefits Charge fund. Value added includes labor income (employee compensation and proprietor income), property income (interest, rental income, royalties, dividends, and profits), and indirect business taxes (primarily sales and excise taxes).

Main-Tier Technologies: The component of the Renewable Portfolio Standard that includes wholesale generation of electricity from renewable resources including wind, hydropower, and biomass.

Market actor: Persons, organizations, and groups that influence (*e.g.,* by buying, selling, providing services, providing information, distributing, transporting, manufacturing, consuming) the decision chain for energy-efficient and renewable products, services, technologies, and program endeavors. Types of market actors include:

- **Upstream or supply-side:** Market actors such as manufacturers, developers, and research and development organizations that provide the energy-efficient and renewable products, services, and technologies.

- **Mid-stream or market infrastructure:** Market actors who purchase energy-efficient and renewable products, services, and technologies from upstream actors and who sell them downstream to customers. Retailers, distributors, wholesalers, contractors, installers, energy services companies, designers, governmental units, building owners, commodity providers, aggregators, and architects and engineers are examples of mid-stream market actors.

- **Downstream or demandside:** Market actors who purchase and use energy-efficient and renewable products, services, and technologies. Downstream market actors include residential homeowners, small business customers, and power plant owners and operators.

Market barrier: Conditions and concepts that prevent and inhibit market adoption of energy efficient technologies, products, and services and inhibit implementation of energy efficient behaviors. Market barriers to the adoption of high efficiency and renewable measures can include: lack of awareness, knowledge, and information about technologies, products, and services; lack of availability of products and services; perceived and actual difficulty financing the higher incremental cost often associated with energy efficient and renewable products and services; and perceived risk associated with implementation of energy efficient and renewable products and services.

Market development: See, Market transformation.

Market effects: Changes in the structure of markets and in the behavior of participants in markets that reflect increased adoption of energy-efficient products, services, and practices.

Market infrastructure: See, Market actors: Mid-stream or market infrastructure.

Market price effects: Cost savings by rate payers caused by lower wholesale electricity prices.

Market sector: A group whose members display common activities and shared values. Examples include the residential buildings sector, the commercial buildings sector, and the small business sector.

Market transformation: Market states in which desired activities and behaviors have become standard practices due to the reduction in market barriers resulting from market interventions. Market transformation is apparent when market effects endure after interventions have been withdrawn, reduced, and changed. Market transformation programs are designed to induce lasting structural and behavioral changes in markets. **(**Used interchangeably with market development.)

Master metered: Commercial buildings with a single electric meter serving the entire building. The meter is owned by the utility company providing electricity to the building, and the building manager receives a single bill for the building's electricity use.

Measurement and verification (M&V): An evaluation modality used to: confirm that program baselines are accurately defined; ensure that energy measures are installed properly to generate the predicted savings and energy output; and determine the actual savings achieved by energy efficiency and renewable resource projects.

Megawatt: One million watts or one thousand kilowatts. Generally, one megawatt will power 1,000 homes.

Megawatt hour: A measure of electricity consumption equal to 1,000,000 watts of power over a period of one hour.

N

NSTAR: A private utility company, with the following operating units: Boston Edison Company, Cambridge Electric Light Company, Commonwealth Electric Company, and NSTAR Gas Company, that provides retail electricity and natural gas to customers in eastern and central Massachusetts .

National Ambient Air Quality Standard: The United States Environmental Protection Agency has established standards to control six "criteria" pollutants: carbon monoxide, lead, nitrogen dioxide, particulates, ozone, and sulfur oxides.

Net savings: The amount of energy savings attributable to a program after adjustments are made for freeridership and spillover market effects.

New York Energy $mart℠: New York's public benefits program was established by Order of the New York State Public Service Commission (PSC) in January 1998.[2] The program began July 1, 1998 with funds collected from customers by New York's electric utilities through a non-bypassable system benefits charge (SBC). The PSC designated the New York State Energy Research and Development Authority (NYSERDA) as the statewide administrator of most of the program funds. **New York Energy $mart℠** is the service mark name of the Program. Under this service mark, NYSERDA administers a portfolio of energy efficiency, low-income, and research and development programs.

---

[2] New York State Public Service Commission. In the Matter of Competitive Opportunities Regarding Electric Service., Opinion No. 98-3. *Opinion and Order Concerning System Benefits Charge Issues*. Issued and effective January 30, 1998. Cases 94-E-092 *et al.*

Nitrogen oxides (NOx): Gases produced from the combustion of fossil fuels including coal, oil, and natural gas, diesel fuel, and gasoline. Oxides of nitrogen are pollutants associated with a number of environmental problems including ground-level ozone (smog), acid deposition, formation of particles, and eutrophication or oxygen depletion of water bodies associated with excessive growth of algae.

Non-energy impacts (NEI): Difficult-to-measure effects that can nevertheless be monetized and included as a percentage of energy savings. NEIs include perceived improvements in comfort, safety, and productivity.

Non-participant: Customers who are eligible but do not participate in NYSERDA programs.

O

Off-peak: Time periods when the demand for electricity by customers is relatively low.

Opinion leader: Persons and organizations viewed by members of professions as demonstrating good professional practice.

Outcome: The results of the delivery of programs, services, and products and changes in knowledge, attitude, and behavior by program participants.

Output: The immediate products from the activities of programs.

P

Participant: Individuals and entities that receive services and incentives through the **New York Energy $mart℠** Program.

Payback: The ratio expressed in years of the estimated annual savings of new measures to estimated costs. Payback can be used to determine whether measures are cost effective.

Peak demand: Electricity demand during periods of high electricity use.

Portfolio: The term used for the totality of individual programs comprising the **New York Energy $mart℠** Program.

Portfolio level: Evaluation activities that address the **New York Energy $mart℠ Program** as a whole and the business and institutional, low-income, residential, and research and development program areas.

Pre-qualified measures: Energy efficiency measures with established, tested, and verified energy savings. Savings calculations for pre-qualified measures use deemed savings. See, deemed savings, deemed-savings database.

Program case: The second step in a macroeconomic analysis. The program case is the estimated economic effect on New York's economy of the complete portfolio of **New York Energy $mart℠** Program expenditures on goods and services.

Process evaluation: An evaluation modality that examines the extent to which programs are operating as intended by assessing ongoing program operations and determining whether the target population is being served.

Program Efficiency Test: The ratio of program benefits divided by NYSERDA's costs.

Program Opportunity Notice (PON): A NYSERDA solicitation approach for identifying and procuring multiple projects within specified technology areas.

Program summary: Program-specific information developed from secondary research.

Program theory: The assumptions underlying programs; descriptions of how programs fit within their market context. Program theory defines how programs are expected to work and identifies intended outcomes.

Public benefits programs: Programs that promote energy efficiency and renewable energy and are funded by surcharges on energy bills. See, **New York Energy $mart℠.**

R

Realization rate: Measured and verified energy and demand savings divided by energy and demand savings claimed by NYSERDA. A rate of 1.0 means that measured and verified savings align precisely with claimed savings. A rate greater than 1.0 means that savings are under-reported, while a rate less than 1.0 means the savings are over-estimated.

Real-time pricing: A pricing mechanism for selling power to consumers in which a consumer's price is based on the spot power market price at the time of consumption.

Recommissioning: An ongoing process in existing commercial buildings that seeks to resolve operating problems, improve comfort, optimize energy use, and identify promising retrofits. Sometimes called "continuous commissioning," the process focuses on improving overall building system controls and operations under actual conditions based on existing occupancy.

Renewable resources: Naturally replenished energy sources including: biomass, hydropower, geothermal, solar, wind, and tidal action.

Request for Proposals (RFP): A NYSERDA solicitation approach for identifying and procuring projects in specific areas of interest and with a high degree of specificity. A single award is typical. See, Program Opportunity Notice (PON).

Resource acquisition: Installation of energy efficiency measures to reduce demand.

Retrocommissioning: A systematic process used for optimizing performance of systems in existing buildings by identifying and implementing relatively low-cost operations and maintenance improvements.

S

Scenario 1: A benefit-cost test that includes only resource savings such as energy, demand, fuel, and water. Scenario 1 is prescribed by the New York State Public Service Commission in its total resource cost test.

Scenario 2: A benefit-cost test that includes resource savings and market price effect benefits.

Scenario 3: A benefit-cost test that includes resource savings, market price effect benefits, and non-energy impacts.

Sector: A group whose members display similarities including common activities and shared values. Examples include the commercial, industrial, institutional, government, non-profit, farm and agribusiness, multifamily, and residential sectors.

Solicitation: A device to publicly announce funding opportunities and seek proposals for specific program activities. See, Request for Proposals, Program Opportunity Notice.

Spillover: The proportion of impacts (*e.g.*, energy savings) that occur as a result of **New York Energy $mart**[SM] Program activities but without program incentives.

Submetering: The measurement and billing of electric use in individual apartments in a master metered building. The meters, or submeters, are owned by the building, and the utility continues to read the building master meter and issue a single bill to the building. Submetering allows residents to pay only for their individual electric use. See, Master metered.

Sulfur dioxide (SO_2): A gas emitted into the atmosphere largely through the combustion of fossil fuels, *e.g.,* coal and oil, and diesel and gasoline. SO_2 contributes to acid rain and the formation of particulate matter.

Supply-side: See, Market actor: Upstream or supply-side.

System benefits charge: A charge on consumers' bills from electric distribution companies used to pay for certain public benefits such as assistance to low-income consumers and the delivery of energy efficiency programs.

System-wide reliability: A measure of the ability of the electric delivery system to continue operating while some lines or generators are out of service.

T

Total-Market-Effects Test: The ratio of program benefits divided by NYSERDA's and customers' costs.

Total Resource Benefits: Avoided cost benefits including electric energy and demand, fuel, and water.

Total Resource Costs: The sum of program costs and customer costs.

U

Utility service area: Defined areas designated by the New York State Public Service Commission that define utility companies' boundaries and within which companies serve end-use customers.

V

Value/cost analysis: An analytic technique that assesses the cost effectiveness of research and development programs, which are difficult to monetize.

For information on other
NYSERDA reports, contact:

New York State Energy Research
and Development Authority
17 Columbia Circle
Albany, New York 12203-6399

toll free: 1 (866) NYSERDA
local: (518) 862-1090
fax: (518) 862-1091

info@nyserda.org
www.nyserda.org

New York Energy $mart℠ Program Evaluation and Status Report

Report to the System Benefits Charge Advisory Group

Final Report

State of New York
Eliot Spitzer, Governor

New York State Energy Research and Development Authority
Vincent A. DeIorio, Esq., Chairman
Peter R. Smith, President, and Chief Executive Officer

New York Energy $mart℠ Program Evaluation and Status Report

NYSERDA Final

CERTIFICATE OF SERVICE

I hereby certify that the following persons have been served with the Southern Environmental Law Center (SELC), Southern Alliance for Clean Energy (SACE), the South Carolina Coastal Conservation League (CCL), and Environmental Defense (ED) pre-filed expert witness testimony of Donald Gilligan:

Catherine E. Heigel , Assistant General Counsel
Duke Energy Carolinas, LLC
Post Office Box 1006, EC03T
Charlotte, NC, 28201-1066
Email: ceheigel@duke-energy.com

Nanette S. Edwards, Counsel
Office of Regulatory Staff
Post Office Box 11263
Columbia, SC, 29211
Email: nsedwar@regstaff.sc.gov

Frank R. Ellerbe III , Counselor
Robinson, McFadden & Moore, P.C.
P.O. Box 944
Columbia, SC, 29202
Email: fellerbe@robinsonlaw.com

Lawrence B. Somers, Assistant General Counsel
Duke Energy Carolinas, LLC
Post Office Box 1244, PB05E
Charlotte, NC 28201-1244

Robert E. Tyson, Jr.
Sowell Gray Stepp
Post Office Box 11449
Columbia, SC 29211

Jeremy Hodges, Counsel
Nelson Mullins, Riley & Scarborough, LLP
1320 Main Street, 17th Floor
Columbia, SC 29201
Email: jeremy.hodges@nelsonmullins.com

Scott Elliot, Counsel
Elliott & Elliott, P.A.
721 Olive Street
Columbia, SC, 29205
Email: selliott@elliottlaw.us

Bonnie D. Shealy , Counsel
Robinson, McFadden & Moore, P.C.
Post Office Box 944
Columbia, SC, 29202
Email: bshealy@robinsonlaw.com

James H. Jeffries IV, Counsel
Moore & Van Allen PLLC
Bank of America Corporate Center
100 North Tryon Street, Suite 4700
Charlotte, NC 28202-4003
jimjeffries@mvalaw.com

This 17th day of January, 2008.

_____
S/Kate Double
Administrative Legal Assistant