



# **Cape Light Compact**

## **Annual Report on Energy Efficiency Activities in 2009**

**Submitted to the  
Massachusetts Department of Public Utilities  
and the Massachusetts Department of Energy Resources**

**August 2, 2010**

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# I. Executive Summary

## A. Introduction

Since July 2001 the Cape Light Compact has delivered energy efficiency programs to all member towns on Cape Cod and Martha's Vineyard. This Annual Report provides detailed information on the Compact's energy efficiency activities and savings during the course of calendar year 2009.

The Compact's 2009 Energy Efficiency Plan (referred to henceforth as the "2009 EEP") was approved on May 29, 2009. Using the 2009 funding as approved by the Department, the Compact implemented the following set of efficiency programs and non program-related pilots in 2008:

- The Residential ENERGY STAR<sup>®</sup> New Construction Program, which provides home buyers, home builders, and construction trade allies with technical assistance and financial incentives to increase the efficiency of homes that are newly built or undergo major renovations. Results of this program are shown in the Residential Lost Opportunity row of Table 2 and in Section III. Results of the Low-Income New Construction Program, which provides low-income housing development agencies and residential construction trade allies with incentives to increase the home energy rating of new low-income housing, are also included.

Green Affordable Housing Initiative: In 2007, the Massachusetts Technology Collaborative approved a \$1.5 million grant to the Cape Light Compact in support of the Green Affordable Housing Initiative. \$1.2 million of the total funds are earmarked for renewable energy systems to be installed on newly constructed affordable homes. The remainder of the funds is for advanced building technology. The Compact was one of six grantees throughout the state.

The grant funds are for new construction homes that are designated affordable, consistent with the state guidelines. This program builds on the Cape Light Compact's already successful Residential New Construction Demonstration Pilot, which supported four homes built to "green" standards in Chatham, Orleans, and Falmouth in 2003-2004. The Compact's program will help affordable housing developers find ways to shrink the "environmental footprint" of homes and result in lower greenhouse gas emissions, including the cost of energy for those homes. The Green Affordable Housing Initiative aims to catalyze the affordable housing financing, development, and builder communities to include more green design and renewable energy in future developments.

Between 2008 and 2010, the program is expected to help build as many as 55 affordable housing units on Cape Cod and Martha's Vineyard. While there were no home completions in 2009, the Compact worked on 39 units over the course of the year.

Major Renovations Pilot: In December 2007, the Cape Light Compact began working with a homeowner who expressed interest in an addition that was eligible for neither the ENERGY STAR<sup>®</sup> Homes program nor the single-family retrofit program. To address this gap in program offerings, Cape Light Compact worked with a local HERS rater to identify measures in existing and new home programs that would address the structure. As a result of this effort, the major renovations pilot, addressing additions affecting 500 sq. ft or more, was created in 2008 and formalized in 2009. One test home was completed in 2008, and four were completed in 2009. The pilot has now extended to the other electric program administrators in Massachusetts, and the EPA has developed protocols for a renovation program based on the experience in Massachusetts.

- Residential High Efficiency Central Air Conditioning Program, which was reintroduced in 2009 (the Cape Light Compact closed the program in March 2006 due to budget constraints), promotes the purchase and installation of ENERGY STAR<sup>®</sup> qualified central air conditioning systems in new construction and market conversion of older heating, ventilation and air conditioning (“HVAC”) units. The program also is designed to increase the number of trained technicians in the state and to improve the quality of installations. Results of this program are shown in the Residential HVAC row of Table 2 and in Section III.
- The Residential Mass Save<sup>®</sup> Program, which provides all interested residential customers with energy savings education, the opportunity for a home energy audit and financial incentives for numerous electric and non-electric efficiency measures. Results of this program are shown in the Residential Retrofit 1-4 row of Table 2 and in Section III.

Deep Retrofit Pilot: In 2009, Cape Light Compact investigated the potential of achieving approximately 30% to 50% in energy savings through a pilot program focusing on deep retrofits of existing residential buildings.

The goal of the pilot program was to assess the costs and benefits of deep energy retrofits in Massachusetts residences. The design included a plan to support deep retrofits and to gather information on customer satisfaction, behavior modification, and energy savings. The pilot was designed to help the Commonwealth begin to develop information on appropriate measures for deep retrofits, approaches for different housing types, ways to educate customers and appropriate marketing materials, and the types of financing mechanisms and incentive levels to drive participation. Additionally, the Commonwealth would gain experience modeling the energy savings and training energy-retrofit contractors. Pilot program services were delivered through the existing Mass Save<sup>®</sup> network, with possible energy modeling and other assistance provided through the Residential New Construction Program.

The Compact’s participation goal was to reach out to and engage 3 homeowners who were planning to undergo major exterior renovations (e.g., siding and/or window replacements). The Compact received 12 inquires on the pilot from

October 2008 through December 2009 and had one project move forward in December 2009 with work to begin in the spring of 2010. The difficulties inherent in getting interested parties to participate in this pilot program include the fact that homeowners need to commit a considerable amount of upfront capital to the project and major renovation timeframes are homeowner-driven. As a result, program results will likely be available in conjunction with 2010 reporting.

- The Residential ENERGY STAR<sup>®</sup> Lighting Program, which seeks to increase the availability and use of ENERGY STAR<sup>®</sup> qualified lighting. This program is used to implement the Northeast Energy Efficiency Partnership (“NEEP”) initiatives and other regional market transformation efforts. Results of this program are shown in the Residential Lighting row of Table 2 and in Section III.
- The Residential ENERGY STAR<sup>®</sup> Appliances Program, which seeks to increase the availability and use of ENERGY STAR<sup>®</sup> qualified appliances, including: room air conditioners, dehumidifiers and refrigerators as well as consumer electronics such as Advanced Power Strips. This program is used to implement the Northeast Energy Efficiency Partnership (“NEEP”) initiatives and other regional market transformation efforts. Results of this program are shown in the Residential Appliances row of Table 2 and in Section III.
- Non Program-Related Pilots, which seek to investigate new approaches and measures. The following non program-related pilots were conducted in 2009:

Smart Home Energy Monitoring Pilot: Cape Light Compact designed and implemented a Residential Smart Energy Monitoring Pilot program in 2009 to evaluate potential energy savings from in-home energy monitoring systems, gain insight to behavioral aspects of energy use, and inform future residential Smart Grid projects. This pilot program was evaluated in 2009 and results are discussed in Section III. Evaluation of the pilot is ongoing through the end of calendar year 2010, at which point further information regarding the persistence of the identified energy savings will be further measured and evaluated. As a result of the findings in the report, Cape Light Compact will expand the pilot by offering Phase 2 which will include residential and commercial participants. An RFP for Phase 2 will be available in August 2010.

Additional results are available in a report that is available at <http://www.capelightcompact.org/reports.html>. Click on the report titled, Residential Smart Home Energy Monitoring Pilot Final Evaluation Report, dated March 31, 2010.

Energy Pay and Save Pilot: The Massachusetts program administrators, including the Cape Light Compact, designed and implemented a Energy Pay and Save Pilot program in 2009 to determine the extent to which on-bill financing motivates customers to install energy efficiency measures. This pilot program was evaluated in 2009 and results are discussed in Section III.

- The Low-Income Single Family Program, which provides low-income customers in single-family dwellings with assistance in installing efficient lighting, appliances, and weatherization measures. These services are similar to, but more extensive in ability to leverage program benefits and offer higher incentives to eligible customers, than in the Mass Save<sup>®</sup> program. Results of this program are shown in the Low-Income Retrofit 1-4 row of Table 3 and in Section III.
- The Low-Income Multi-Family Program, which provides owners and managers of low-income multi-family dwellings with assistance in purchasing and installing efficient lighting, appliances and space heating measures. Results of this program are shown in the Low-Income Retrofit Multi-Family row of Table 3 and in Section III.
- The Commercial and Industrial New Construction Program, which provides technical assistance and financial incentives to increase the efficiency in the construction, renovation, and/or remodeling of all commercial, industrial, government and multi-family housing facilities. Results of this program are included in the C&I Lost Opportunity row of Table 4 and in Section III.
- The Medium and Large Commercial and Industrial Retrofit Program, which provides technical and financial assistance to medium and large commercial and industrial (“C&I”) customers seeking to do discretionary replacements of existing operating equipment and processes in their facilities with high-efficiency alternatives. Results of this program are included in the C&I Large Retrofit row of Table 4 and in Section III.
- The Small Commercial and Industrial Retrofit Program, which provides technical assistance, financial incentives and direct installation to small C&I customers to replace existing operating equipment and systems with high-efficiency equipment. Results of this program are included in the C&I Small Retrofit row of Table 4 and in Section III.
- The Government Agencies Program, which provides technical assistance and financial incentives<sup>1</sup> to all government facilities, including municipal, state and federal facilities. For the purposes of reporting the results of this program in this Annual Report, in Table 4 and in Section III, the results of efficiency activities with small government customers are included in the C&I Small Retrofit row, while the results of efficiency activities with large government customers are included in the C&I Large Retrofit row. The results of government new construction activities are included in the C&I Lost Opportunity row.
- The Commercial and Industrial Products and Services Program, which seeks to increase the availability and use of more efficient motors, lighting designs, and HVAC systems. This program is used to implement NEEP and other regional

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<sup>1</sup> Unlike the Compact’s other C&I Programs, where a customer co-pay is required, the Government program covers the entire cost of eligible energy efficiency services resulting from an audit up to a cap of \$150,000 per project.

market transformation initiatives. The results of this program are included in the C&I Lost Opportunity row of Table 4 and in Section III.

## B. Report Organization

This Executive Summary provides an overview of the Compact's energy efficiency programs' (referred to as BCR Activities) benefits and costs. For each sector there are tables summarizing the lifetime energy savings, lifetime capacity savings, the non-electric benefits (NEBs), and the dollar values of the total benefits<sup>2</sup> and the total costs.

The savings data are presented in terms of both "preliminary" and "reported" data.

- The preliminary data refers to savings estimates that are based on the evaluation impact factors that were used in the 2009 EEP.<sup>3</sup>
- The reported data refers to savings estimates that are based on evaluation impact factors from all of the program evaluations that have been prepared since the 2009 EEP was filed. Thus, the reported data presents our best estimate of the efficiency savings, based on all the evaluation information available at this time.

Section II of this Annual Report provides a discussion of the methodology that is used for program monitoring and evaluation. It presents a brief summary of the types of evaluations that are used, and a description of the methodology for estimated net energy savings. It also includes a list of the evaluation studies that were used to prepare the 2009 reported efficiency savings results. These evaluation studies are also used to inform program design and delivery.

Section III of this Annual Report provides more detailed results of the program activities. The tables in this section include information regarding the number of program participants, the annual efficiency savings and non-electric benefits, the benefit-cost ratio of the program, and the savings impacts by type of end-use (lighting, HVAC, motors, refrigeration, hot water, and end-user behavior). This section also summarizes recent evaluation report findings where relevant.

Finally, the Appendices provide more detail regarding program design and implementation, monitoring and evaluation results and the program savings. The following is a list of the Appendices and the content available in each Appendix:

Appendix 1 provides a glossary of terms and abbreviations;

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<sup>2</sup> The Compact is submitting benefit-cost ratios for its 2009 energy efficiency programs with additional capacity and energy benefits in the form of a demand reduction induced price effect ("DRIPE"). This is consistent with its 2009 EEP (see page 12 stating, "On average, all of the Compact's efficiency programs in the Proposal combined are estimated to have a benefit-cost ratio of roughly 3.82 (using the TRC test without adders) and 4.14 (taking into account capacity and energy Demand Reduction Induced Price Effects). Exhibit B, Appendix A5.) and other Program Administrators practice in 2009.

<sup>3</sup> D.P.U. 07-47, The Cape Light Compact's Proposed Second Amendment to its Approved Energy Efficiency Plan: 2007-2012 (the "2009 EEP").



Appendix 2 provides tables showing the impact factors used to calculate reported savings by sector, program, and measure;

Appendix 3 provides greater detail on program budgets, savings and benefits;

Appendix 4 provides a comparison of planned and reported outsourced and in-house expenditures;

Appendix 5 provides a calculation of the Program Administrator's incentive;<sup>4</sup>

Appendix 6 provides the executive summaries as well as full reports for all of the evaluation studies that are applicable to this program year;

Appendix 7 provides performance metrics-related documents and reports;<sup>5</sup>

Appendix 8 provides the detailed inputs into the savings calculations;

Appendices 9 and 10 are new to the 2009 Annual Report. In 2009, the Department of Public Utilities (D.P.U.) requested the following in conjunction with the 2009 Annual Report filing:<sup>6</sup> 1) "progress reports and updates" on a number of initiatives and 2) "sections identifying (1) all programs for which savings, costs, or benefits vary by more than 20 percent from planned values; (2) all programs with a benefit/cost ratio less than one; and (3) all programs that the Program Administrator intends to discontinue."

Appendix 9 provides the Progress Report Updates on Compliance Items Consistent with the Department's Order in D.P.U. 09-119 for the Progress Report;

Appendix 10 provides the Variance Analysis Consistent with the Department's Memorandum dated June 22, 2010 for the Variance Analysis;

Appendix 11 is also new to the 2009 Annual Report. During the Cape Light Compact's 09-119 proceeding, the D.P.U. requested that the Cape Light Compact submit the Year End 2009 Town Program Activity Reports with the 2009 Annual Report. Therefore, Appendix 11 provides these reports.

## **C. Summary of Results**

Table 1 provides a summary of the program expenses and savings. It also presents the percent change between the final reported results and (a) the preliminary reported results, and (b) the estimates of expenses and savings targets in the 2009 EEP. The values in the "Amount" column are the 2009 results, based on all evaluations available at this time.

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<sup>4</sup> As the Cape Light Compact does not receive a performance incentive, there is no content in this Appendix.

<sup>5</sup> As the Cape Light Compact does not receive a performance incentive, there is no content in this Appendix.

<sup>6</sup> Hearing Officer Memorandum, RE: 2009 Annual Reports, June 22, 2010.

TABLE 1				
SAVINGS AND EXPENSES FOR 2009				
Measurement	Amount	Units	Percent Change Comparison	
			(Report-Pre)/Pre	(Report-Plan)/Plan
Program Implementation Expenses	\$8.726	\$ - Millions	0%	-10%
Total Expenses	\$8.901	\$ - Millions	0%	-12%
Annual Energy Savings	14.079	GWh	-24%	-32%
Annual Summer Demand Savings	2.788	MW	-9%	-25%
Annual Winter Demand Savings	4.581	MW	-18%	3%
Lifetime Energy Savings	163.637	GWh	-16%	-21%
Lifetime Demand Savings	41.587	MW-Years	-4%	-23%
Total Resource Cost Test	3.85	Benefit / Cost	-9%	-7%
Performance Incentive - After Taxes	-	\$ - Millions	0%	0%

*Program implementation expenses include all of the costs incurred by the Compact, except for monitoring and verification costs. Total expenses include program implementation costs, plus monitoring and verification costs, plus customer contributions.*

The Compact's 2009 program implementation expenses were roughly 10% lower than the budgets in the 2009 EEP. The lower program implementation expenses were due to lower marketing, incentives, and sales, technical assistance and training costs, despite higher program planning and administrative costs.

- The lower marketing, incentives, and sales, technical assistance and training costs were due to delays in plan approval and RGGI fund receipts. As a result of these delays, the Compact did not have enough time to ramp up the programs and thus expend all of the funds in 2009.
- The higher program planning and administrative costs were due to additional legal and technical support services. The 2010-2012 Statewide & Individual Plans required greater legal and technical support services than planned.

The Compact's 2009 total expenses were roughly 12% lower than the budgets in the 2009 EEP. The lower total expenses were due to lower evaluation costs, in addition to lower marketing, incentive, and sales, technical assistance, and training costs.

- The lower evaluation costs were due to the continued benefits of shared costs among all program administrators participating in joint statewide and regional studies.

The annual and lifetime energy savings achieved in 2009 were lower than those estimated in the 2009 EEP (by 32% and 21%, respectively). The annual summer and lifetime capacity savings achieved in 2009 were lower than those estimated in the 2009 EEP (by -25% and -23%, respectively). The annual winter capacity savings achieved in 2009 were slightly higher (3%) than those estimated in the 2009 EEP. This was due to a greater uptake of measures with annual winter capacity savings, relative to measures with annual summer capacity savings.

Savings declines were primarily experienced in the Residential Lost Opportunity, ENERGY STAR<sup>®</sup> HVAC, Residential Lighting, and Low-Income Retrofit Multi-Family programs. Please see Appendix 10 (Variance Analysis Consistent with the Department's Memorandum dated June 22, 2010) for more details on the variance in expenditures, savings and benefits relative to the 2009 EEP and reasons for this variance.

The benefit-cost ratio of the 2009 programs in total was 3.85, including capacity and energy DRIPE. This indicates that the Compact's programs in total are highly cost-effective, where every \$1.00 spent reduces the net cost of electricity by \$3.85.

## D. Summary of Results by Sector

### 1. Residential Programs

Table 2 presents the lifetime energy savings, lifetime capacity savings, and lifetime non-electric benefits for each of the residential programs. It also presents the total cumulative benefits and costs, in 2009 present value dollars. These total benefits and costs are used to determine whether each program is cost-effective, based on the total resource cost (TRC) test.

Benefit-Cost Ratio Activity	Lifetime MWh		Lifetime kW		Lifetime \$ NEB		TRC Values	
	Preliminary	Report	Preliminary	Report	Preliminary	Report	\$-Benefits	\$-Costs
A02a Residential Lost Opportunity	2,023	2,023	942	942	\$710,143	\$710,143	\$1,163,373	\$443,560
A02b Residential HVAC	498	498	704	704	\$0	\$0	\$264,201	\$62,539
A03a Residential Retrofit 1-4	29,838	29,838	14,522	14,522	\$6,510,300	\$6,510,300	\$13,745,762	\$3,334,379
A03b Residential Retrofit Multifamily	NA	NA	NA	NA	NA	NA	NA	NA
A03c Residential Load Response	NA	NA	NA	NA	NA	NA	NA	NA
A04a Residential Lighting	43,165	12,885	2,829	958	\$322,614	\$111,745	\$1,775,504	\$412,799
A04b Residential Appliances	4,684	4,684	405	405	\$971,454	\$971,454	\$1,513,556	\$228,457
<b>Total</b>	<b>80,208</b>	<b>49,928</b>	<b>19,403</b>	<b>17,531</b>	<b>\$8,514,511</b>	<b>\$8,303,642</b>	<b>\$18,462,396</b>	<b>\$4,481,734</b>

Figures 1 through 4 present the same information as Table 2. They indicate that most of the residential energy and capacity savings are obtained from the Residential Retrofit 1-4 and Residential Lighting programs; that most of the non-electric benefits come from the Residential Retrofit 1-4 program; and that all residential programs are cost-effective.

The Results of the Multistate CFL Modeling Effort<sup>7</sup> based on 2009 program results and Residential Lighting Markdown Impact Evaluation<sup>8</sup> based on 2008 program results had the following impact on the Residential Lighting program results:

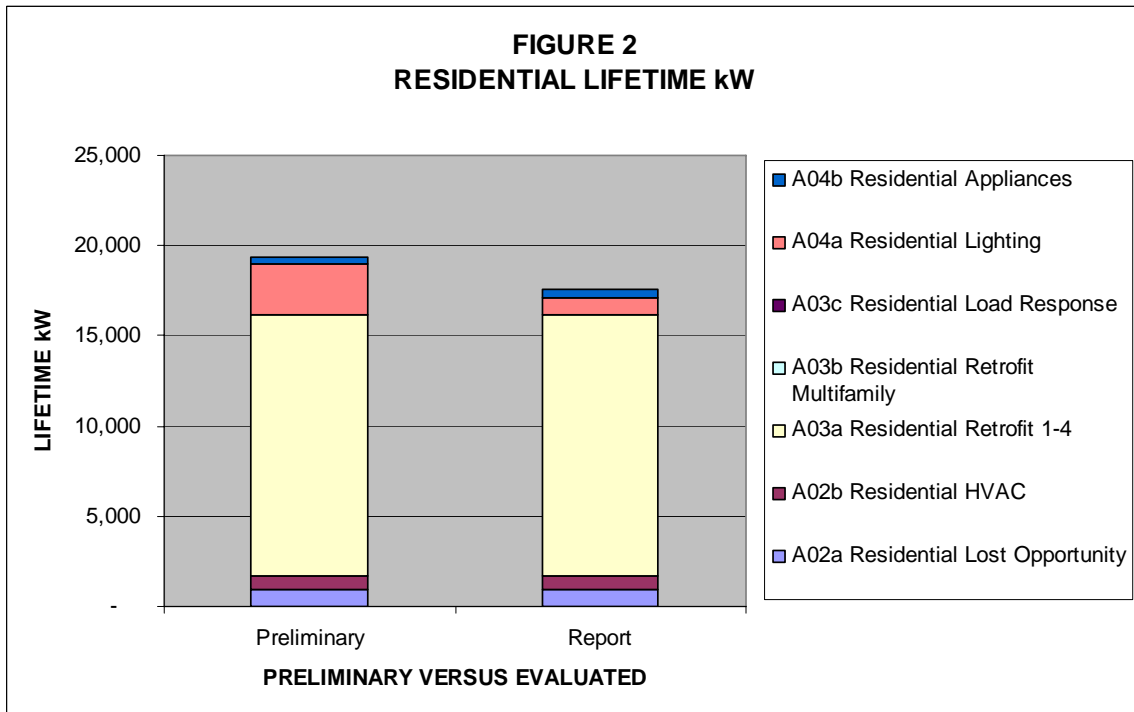
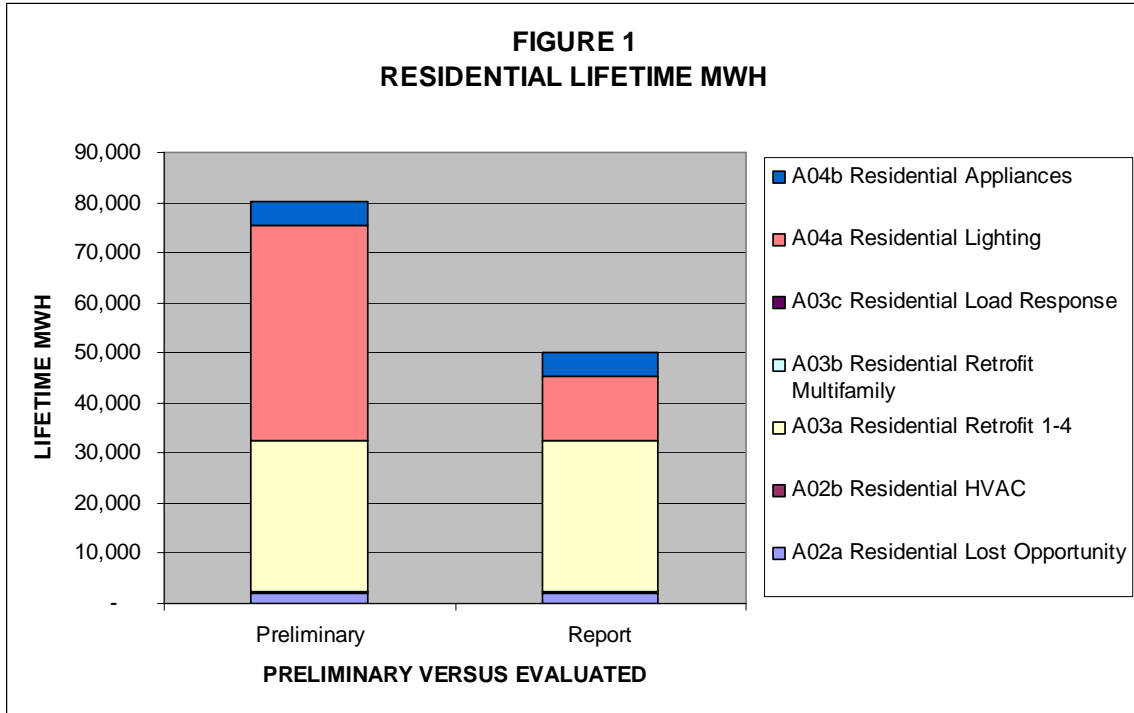
- Reduced the reported lifetime MWh savings relative to the preliminary lifetime MWh savings;
- Reduced the reported lifetime kW savings relative to the preliminary lifetime kW savings; and,
- Reduced the reported lifetime non-energy benefits relative to the preliminary lifetime non-energy benefits.

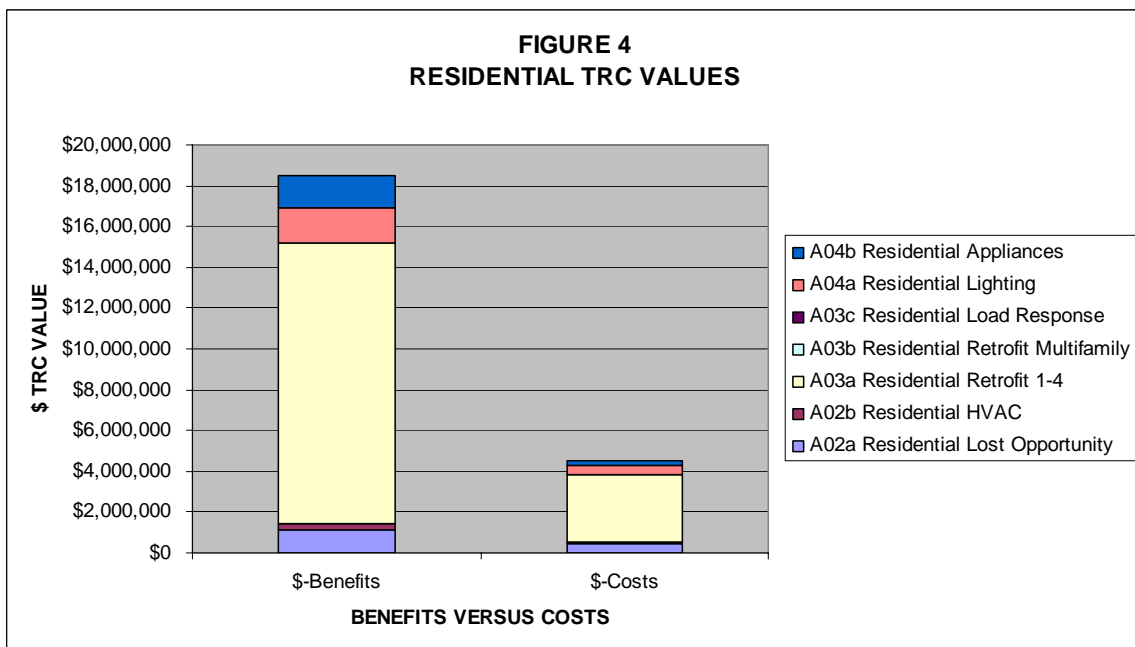
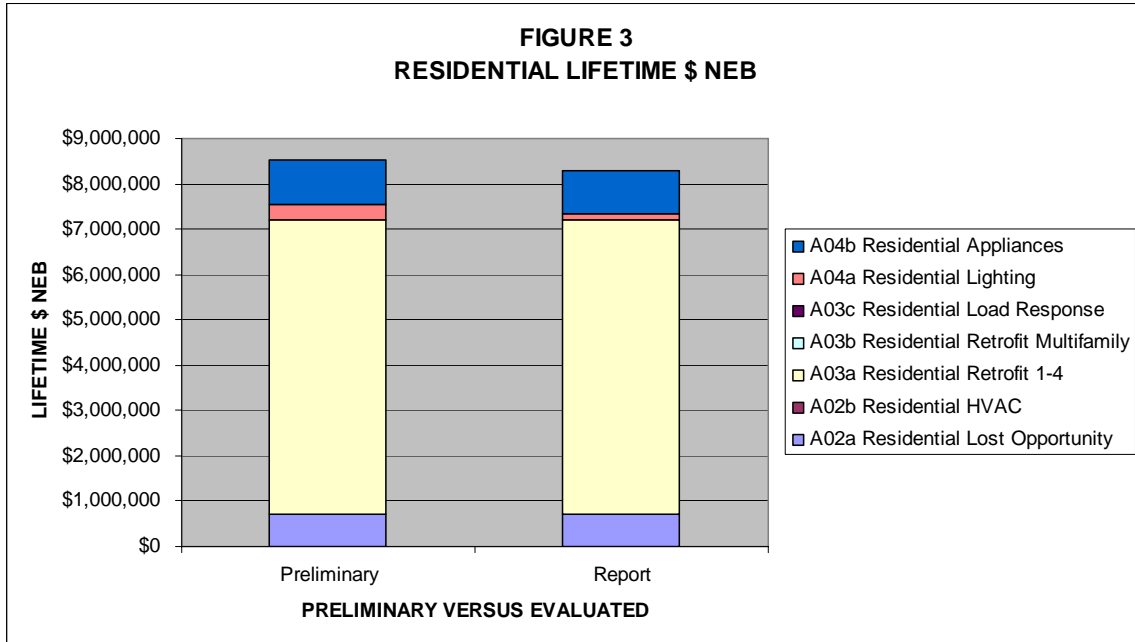
This is due to the fact that the in-service rate changed from 117% to 40%, gross annual kWh savings changed from 57 to 47, and gross annual kW savings changed from 0.049 to

<sup>7</sup> *Results of the Multistate CFL Modeling Effort*, NMR Group, Inc., February 4, 2010.

<sup>8</sup> *Residential Lighting Markdown Impact Evaluation* by Nexus Market Research, RLW Analytics, Inc, and GDS Associates, January 20, 2009.

0.046. Please see section III.A.3 for the Results of the Multistate CFL Modeling Effort study within the Residential ENERGY STAR® Lighting Program for more details.



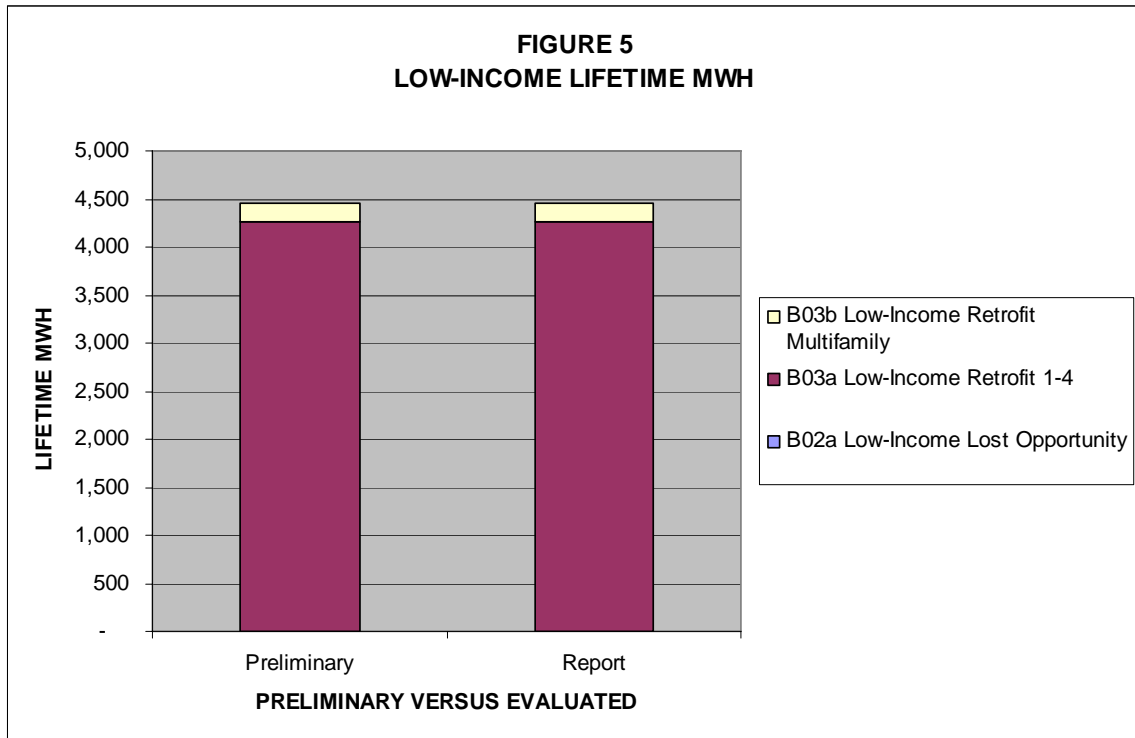


## 2. Low-Income Programs

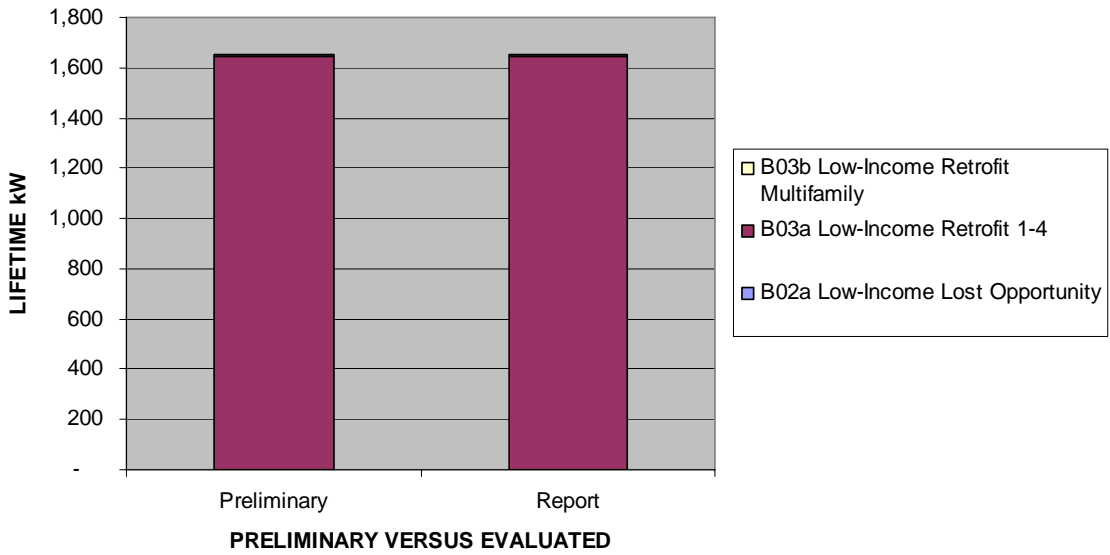
Table 3 presents the lifetime energy savings, lifetime capacity savings, and lifetime non-electric benefits for each of the low-income programs. It also presents the total cumulative benefits and costs, in 2009 present value dollars. These total benefits and costs are used to determine whether each program is cost-effective, based on the total resource cost test.

Benefit-Cost Ratio Activity	Lifetime MWH		Lifetime kW		Lifetime \$ NEB		TRC Values	
	Preliminary	Report	Preliminary	Report	Preliminary	Report	\$-Benefits	\$-Costs
B02a Low-Income Lost Opportunity	NA	NA	NA	NA	NA	NA	NA	NA
B03a Low-Income Retrofit 1-4	4,259	4,259	1,642	1,642	\$2,556,586	\$2,556,586	\$3,454,183	\$824,610
B03b Low-Income Retrofit Multifamily	193	193	11	11	\$889,419	\$889,419	\$909,542	\$169,814
<b>Total</b>	<b>4,451</b>	<b>4,451</b>	<b>1,654</b>	<b>1,654</b>	<b>\$3,446,006</b>	<b>\$3,446,006</b>	<b>\$4,363,725</b>	<b>\$994,424</b>

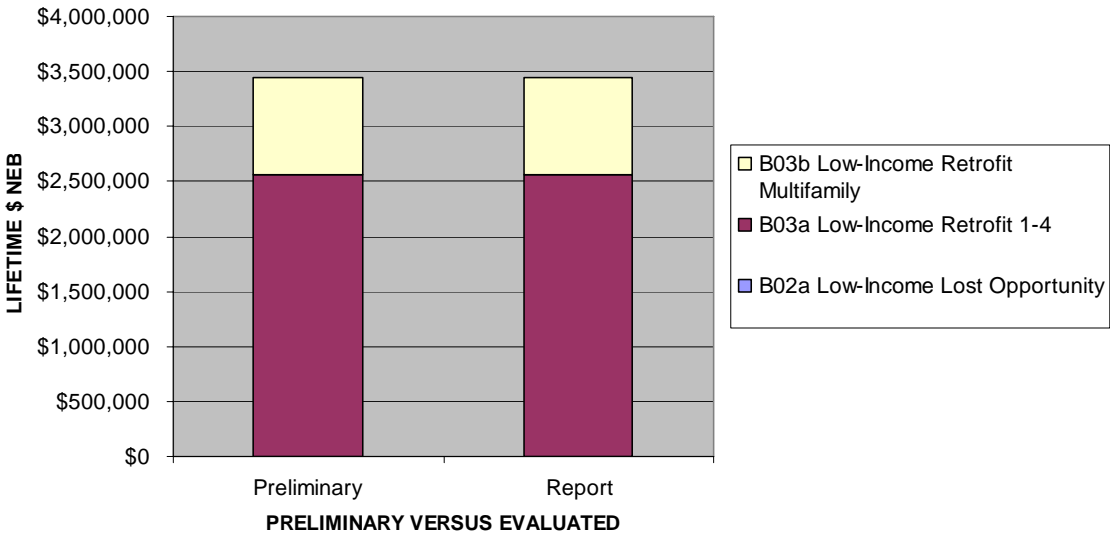
Figures 5 through 8 present the same information graphically as listed in Table 3. They indicate that most of the energy and capacity savings and non-electric benefits are coming from the Low-Income Retrofit 1-4 program and all of the programs are cost-effective. There is no difference between the reported and preliminary results for Low-Income programs since there were no updates from evaluation studies this year.

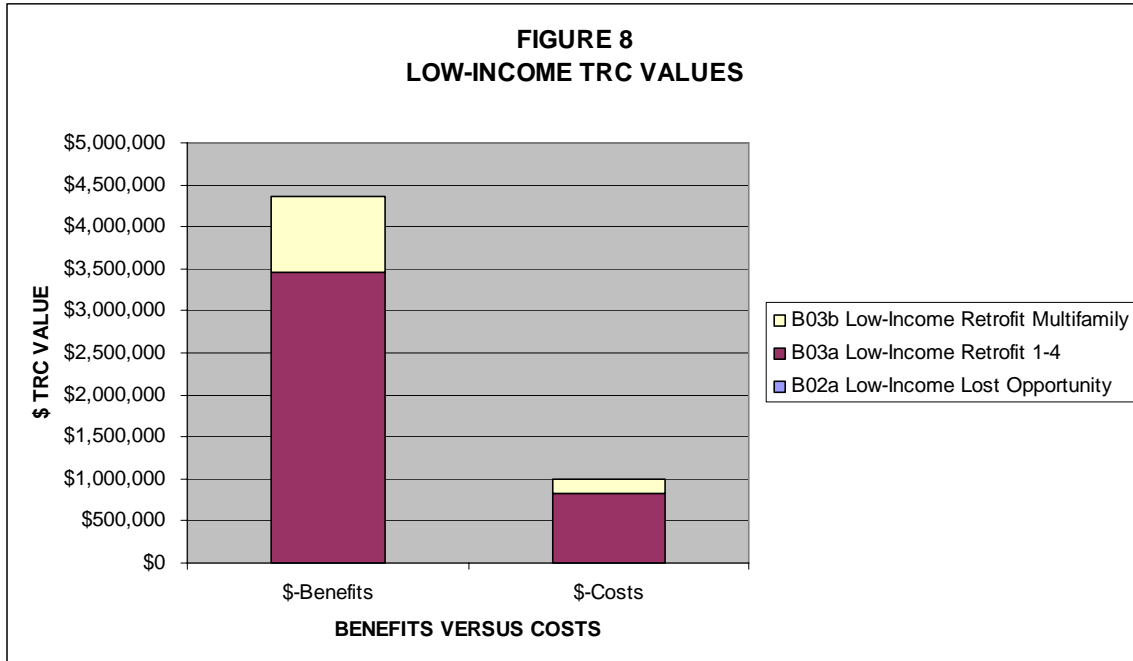


**FIGURE 6  
LOW-INCOME LIFETIME kW**



**FIGURE 7  
LOW-INCOME LIFETIME \$ NEB**





### 3. Commercial & Industrial Programs

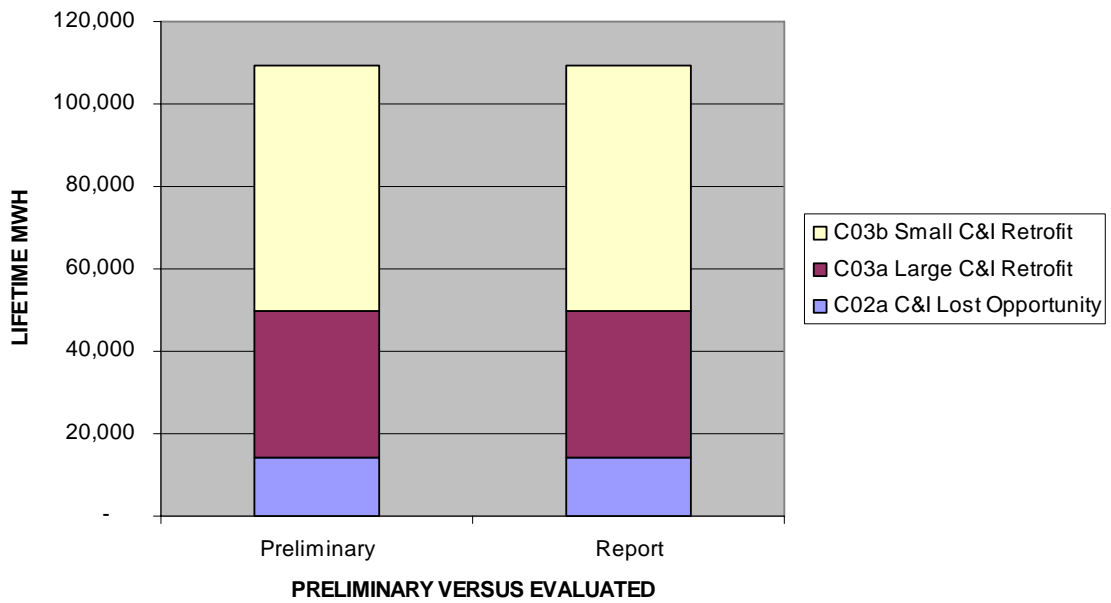
Table 4 presents the lifetime energy savings, lifetime capacity savings, and lifetime non-electric benefits for each of the Commercial & Industrial programs. It also presents the total cumulative benefits and costs, in 2009 present value dollars. These total benefits and costs are used to determine whether each program is cost-effective, based on the total resource cost (TRC) test.

Benefit-Cost Ratio Activity	Lifetime MWH		Lifetime kW		Lifetime \$ NEB		TRC Values	
	Preliminary	Report	Preliminary	Report	Preliminary	Report	\$-Benefits	\$-Costs
C02a C&I Lost Opportunity	14,425	14,425	3,992	3,992	\$17,083	\$17,083	\$2,716,446	\$469,945
C03a Large C&I Retrofit	35,170	35,170	4,844	4,844	\$11,137	\$11,137	\$5,098,054	\$1,248,429
C03b Small C&I Retrofit	59,663	59,663	13,565	13,565	\$117,242	\$117,242	\$10,178,248	\$3,394,506
<b>Total</b>	<b>109,258</b>	<b>109,258</b>	<b>22,402</b>	<b>22,402</b>	<b>\$145,462</b>	<b>\$145,462</b>	<b>\$17,992,748</b>	<b>\$5,112,881</b>

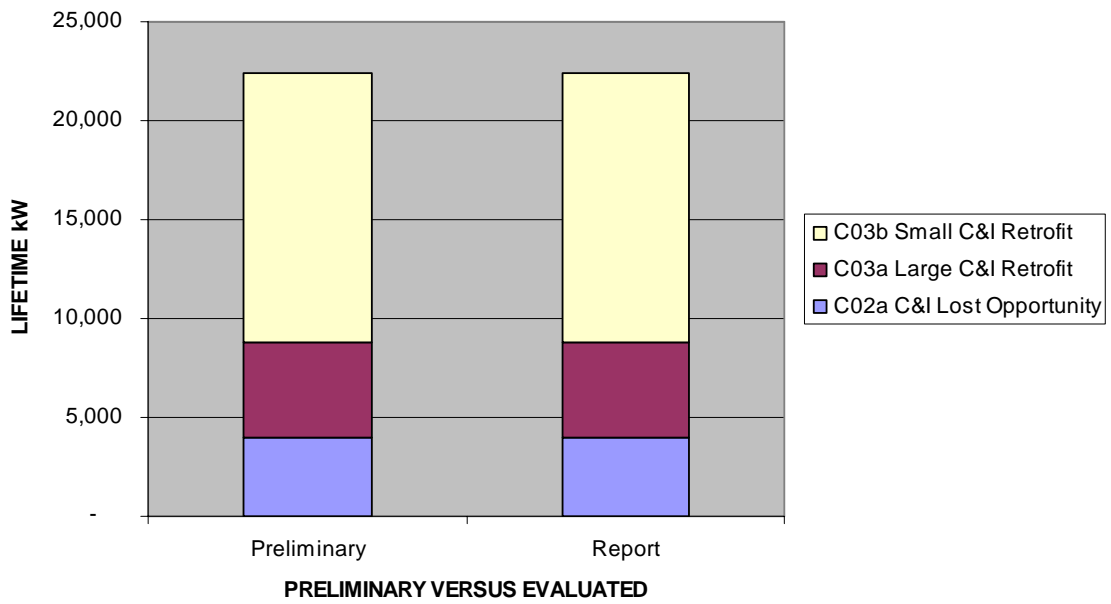
Figures 9 through 12 present the same information as Table 4. They indicate that much of the energy and capacity savings and non-electric benefits come from the Small C&I Retrofit program; and that all of the programs are cost-effective. There is no difference between the reported and preliminary results for C&I programs since there were no updates from evaluation studies this year.

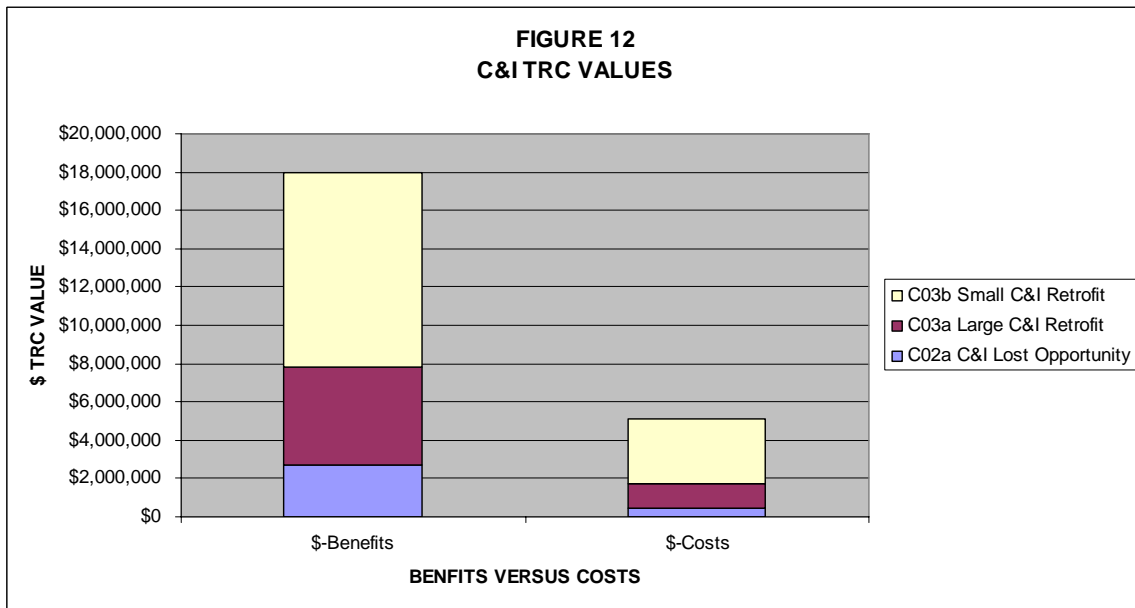
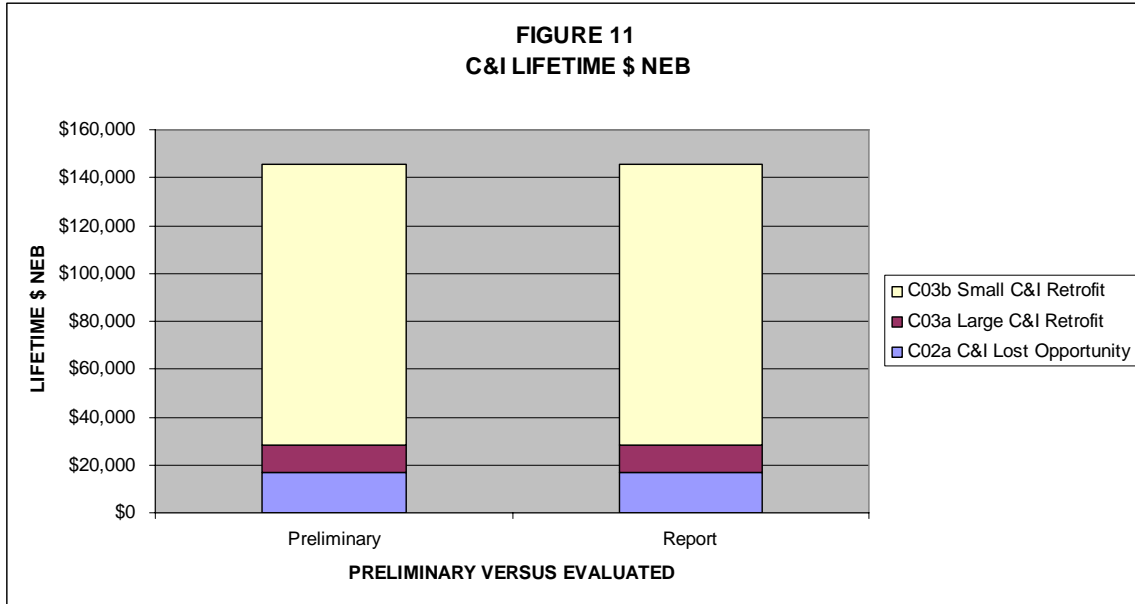


**FIGURE 9  
C&I LIFETIME MWH**



**FIGURE 10  
C&I LIFETIME kW**





## II. Overview of Evaluation Methodology

### Preliminary versus Reported Results

As noted above, the savings data in this report are presented in terms of both “preliminary” and “reported” data.

- The preliminary data refers to savings estimates that are based on the evaluation impact factors that were used in the 2009 EEP.<sup>9</sup>
- The reported data refers to savings estimates that are based on evaluation impact factors from all of the program evaluations that have been prepared since the 2009 EEP was filed. Thus, the reported data presents our best estimate of the efficiency savings, based on all the evaluation information available at this time.

## **Evaluation Studies Used in Preparing 2009 Reported Results**

Since its inception in July 2001, the Compact has participated in many statewide and regional monitoring and evaluation studies, along with other energy efficiency Program Administrators. The Compact has also conducted several evaluation studies specific to its own programs. It is common for energy efficiency program evaluators to update parameters on a multi-year cycle, unless significant program changes warrant more frequent study.

The evaluation studies completed in 2009 that were used to update impact factors or to inform the process of program delivery are listed below. In 2009, the studies included a mix of process and impact evaluation and other research. The executive summary and full versions of these reports are included in Appendix 6.

1. Evaluation of the Massachusetts New Homes with ENERGY STAR<sup>®</sup> Program 2009 Findings and Analysis, NMR Group Inc., May 26, 2010. Executive Summary.

Evaluation of the Massachusetts New Homes with ENERGY STAR<sup>®</sup> Program 2009 Findings and Analysis, NMR Group Inc., May 26, 2010. Full Report.

2. Massachusetts New Homes with ENERGY STAR<sup>®</sup> 2009 COOL SMART Quality Installation Verification Evaluation Report, ICF International, February 24, 2010. Executive Summary.

Massachusetts New Homes with ENERGY STAR<sup>®</sup> 2009 COOL SMART Quality Installation Verification Evaluation Report, ICF International, February 24, 2010. Full Report.

3. Energy Savings Analysis for the Massachusetts New Homes with ENERGY STAR<sup>®</sup>, ICF International, June 4, 2010. Executive Summary.

Energy Savings Analysis for the Massachusetts New Homes with ENERGY STAR<sup>®</sup>, ICF International, June 4, 2010. Full Report.

4. The Massachusetts New Homes with ENERGY STAR<sup>®</sup> Program, 2009 Progress Report, Dorothy Conant, May 26, 2010. Executive Summary.

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<sup>9</sup> D.P.U. 07-47, The Cape Light Compact's Proposed Second Amendment to its Approved Energy Efficiency Plan: 2007-2012 (the "2009 EEP").

- The Massachusetts New Homes with ENERGY STAR® Program, 2009 Progress Report, Dorothy Conant, May 26, 2010. Full Report.
5. Residential Central AC Regional Evaluation, ADM Associates, Inc., October 2009.
  6. Energy Pay and Save Pilot Program Survey & Analysis, Black & Veatch, March 2010.
  7. 2009 Massachusetts Multi-Family Program Assessment, Nexus Market Research, Inc., October 16, 2009.
  8. The Market for CFLs in Massachusetts, NMR Group, Inc., January 28, 2010.
  9. Results of the Multistate CFL Modeling Effort, NMR Group, Inc., February 4, 2010.
  10. Market Assessment and Best Practices for Delivering Plug-Load Energy Efficiency in Business-Final Report, PA Consulting Group, June 14, 2010.
  11. Cape Light Compact Residential Smart Energy Monitoring Pilot, PA Consulting, March 31, 2010.

### **Types of Evaluations**

The evaluation of 2009 energy efficiency program impacts reflects the Compact's efforts to apply appropriate methodologies and adjust them for individual program characteristics. The diverse nature of the programs, including the magnitude of preliminary kW and kWh impacts, the number of customers served, and the end uses affected, calls for the adoption of different evaluation approaches. Evaluations of some programs use several methodologies to develop overall impact results and provide meaningful feedback on program delivery and direction. Some of these methodologies are briefly described below.

Survey-Based Impact Parameter Studies. Survey-based impact parameter studies focus on the analysis of information collected through customer surveys. They are generally used to measure free-ridership and spillover. These studies provide timely feedback to program managers as well as input to the impact evaluations.

- The California Public Utilities Commission, the New York State Energy Research and Development Authority (NYSERDA), Wisconsin Public Service Commission, Consumers Energy in Michigan, Connecticut Energy Conservation Management Board, Connecticut Light and Power, Northeast Utilities, The United Illuminating Company, Cape Light Compact, NSTAR, National Grid (NGRID), Unitil, Western Massachusetts Electric Company (WMECO) and Xcel

Energy in Colorado funded a study to summarize a multi-state CFL modeling effort<sup>10</sup> to determine a net-to-gross ratio (NTG) for lighting products. This net-to-gross ratio was implemented within the Massachusetts Residential ENERGY STAR<sup>®</sup> Lighting Program.

Billing Analyses. Billing analyses involve the analysis of billing data, combined in some cases with survey data, to determine impacts for programs where a large number of participants install similar measures. Since billing data are available for all customers, billing analysis techniques may include representative samples of both participants and non-participants in an evaluation.

- The Massachusetts electric program administrators jointly funded an evaluation of the Energy Pay and Save Pilot<sup>11</sup>, to determine the extent to which on-bill financing motivates customers to install energy efficiency measures. While this study was primarily survey-based, it included a billing analysis.

Site Specific Measurement Analysis. Impact evaluations for many of the end uses and programs covered in this report rely on engineering estimates that are based on site-specific metering and on-site telephone assessments of measure performance and persistence. All of the following studies were conducted in 2010.

- The Joint Management Committee (JMC) completed an evaluation report focused on investigating the relationship between HERS ratings and energy savings in the Residential ENERGY STAR<sup>®</sup> New Construction Program.<sup>12</sup>
- The Joint Management Committee (JMC) completed an evaluation<sup>13</sup> of the quality of installations for central air conditioning (CAC) systems as well as adherence to the Massachusetts New Homes with ENERGY STAR<sup>®</sup> guidelines in a select number of homes.
- NSTAR Electric and Gas Corp., National Grid in Massachusetts and Rhode Island, Connecticut Light & Power, and United Illuminating jointly funded a study<sup>14</sup> to assess energy savings and demand impacts resulting from the installation of efficient central air conditioning (CAC) systems and collected baseline data on duct leakage and infiltration rates of houses.

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<sup>10</sup> *Results of the Multistate CFL Modeling Effort*, NMR Group, Inc., February 4, 2010.

<sup>11</sup> *Energy Pay and Save Pilot Program Survey & Analysis*, Black & Veatch, March 2010.

<sup>12</sup> *Energy Savings Analysis for the Massachusetts New Homes with ENERGY STAR<sup>®</sup>*, ICF International, June 4, 2010.

<sup>13</sup> *Massachusetts New Homes with ENERGY STAR<sup>®</sup> 2009 COOL SMART Quality Installation Verification Evaluation Report*, ICF International, February 24, 2010.

<sup>14</sup> *Residential Central AC Regional Evaluation*, ADM Associates, Inc. October 2009.

- The Massachusetts electric program administrators jointly funded an evaluation of the Energy Pay and Save Pilot<sup>15</sup>, to determine the extent to which on-bill financing motivates customers to install energy efficiency measures.

Process and Market Progress Evaluation Studies. Process evaluations review energy efficiency program design and implementation, and recommend modifications to program delivery. The scope of these evaluations includes all aspects of the program including administrative efficiency, the quality of service provided, and the databases used for program tracking and reporting. Process evaluations assess the early stages of energy efficiency programs. They specifically provide an assessment of (a) whether actual operations resemble the intended program design and operation plan, and (b) whether real-world experience shows that the original program design and implementation plan are appropriate given the existing field conditions. All of the following studies were conducted in 2010.

- The Joint Management Committee (JMC) completed the following two evaluations of the Residential ENERGY STAR<sup>®</sup> New Construction Program.
  - An evaluation<sup>16</sup> was conducted to develop a proposed attribution mechanism for codes and standards for Massachusetts, develop recommendations for streamlining the process by which builders participate in the program, document lessons learned from the Zero Energy Challenge Pilot, and investigate other approaches to estimating whole house savings for homes undergoing major renovations or additions.
  - A 2009 Progress Report<sup>17</sup> was prepared, to summarize 2009 Program activity.
- The Cape Light Compact funded an evaluation of its Smart Home Energy Monitoring Pilot<sup>18</sup>, to understand customer interest and satisfaction with the pilot as well as energy savings.
- The Massachusetts electric program administrators jointly funded an evaluation<sup>19</sup> to understand the current market conditions and possible new program approaches for common and specialty CFLs in the Residential ENERGY STAR<sup>®</sup> Lighting Program.

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<sup>15</sup> *Energy Pay and Save Pilot Program Survey & Analysis*, Black & Veatch, March 2010.

<sup>16</sup> *Evaluation of the Massachusetts New Homes with ENERGY STAR<sup>®</sup> Program 2009 Findings and Analysis*, NMR Group Inc., May 26, 2010.

<sup>17</sup> *The Massachusetts New Homes with ENERGY STAR<sup>®</sup> Program, 2009 Progress Report*, Dorothy Conant, May 26, 2010.

<sup>18</sup> *Cape Light Compact Residential Smart Energy Monitoring Pilot*, PA Consulting, March 31, 2010.

<sup>19</sup> *The Market for CFL's in Massachusetts*, NMR Group, Inc., January 28, 2010.

- The Massachusetts electric program administrators jointly funded an evaluation<sup>20</sup> to characterize the market for plug-load efficiency, including maximum achievable potential energy savings, and to identify best practices to deliver those savings within the Small Commercial and Industrial Retrofit Program.

Economic Modeling and Analysis Studies. The benefits and cost-effectiveness of energy efficiency programs are based on modeling and analysis that values energy efficiency in relation to the avoided costs of energy supply projected over the life of the programs and measures installed. Avoided costs are typically projected based on forecasting models.

- The Massachusetts electric and gas program administrators jointly funded a multi-family evaluation<sup>21</sup> to confirm or deny the findings of an April workshop, assess progress in overcoming barriers and identify strategies to make targeting, program design, and program implementation for Residential, Low-Income and Commercial and Industrial customers more successful.
- The Residential Central AC Regional Evaluation<sup>22</sup> also included an economic modeling analysis.

## Generic Impact Equations

The general form of the impact equation for most of the measures installed is:

Net Impacts = Gross Impacts \* Realization Rate\*(1-Free-Ridership + Spillover) \* Persistence Factor.

Realization Rates are study-specific parameters, which typically compare the energy or demand performance of installed equipment to initial estimates of performance. They are typically based on engineering or billing analysis.

Free-ridership includes both partial and pure free-ridership, where such information is available, as required by D.T.E 98-100.

In energy efficiency programs, spillover may occur among both participants and nonparticipants. Both participant and nonparticipant spillover were used in the calculation of savings for commercial and industrial programs, consistent with D.T.E. 98-100. The nonparticipant spillover impact used in this report is based on the combined results of National Grid<sup>23</sup> and Compact surveys<sup>24</sup>.

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<sup>20</sup> *Market Assessment and Best Practices for Delivering Plug-Load Energy Efficiency in Business – Final Report*, PA Consulting Group, June 14, 2010.

<sup>21</sup> *2009 Massachusetts Multi-Family Program Assessment*, Nexus Market Research, Inc., August 19, 2009.

<sup>22</sup> *Residential Central AC Regional Evaluation*, ADM Associates, Inc. October 2009.

<sup>23</sup> *National Grid, Cape Light Compact, United Illuminating 2005 Commercial and Industrial Programs Free-ridership and Spillover Study*. Revised Final Report. PA Consulting Group. September 1, 2006.

<sup>24</sup> *Cape Light Compact 2007 Commercial and Industrial Programs Free-ridership and Spillover Study*. Final Executive Summary. PA Consulting Group. June 23, 2008.

Persistence indicates the continued presence of savings over time as indicated by follow-up surveys that confirm the measure remains installed, and verify it is operating as intended. As defined by the 2005 Measure Life Study<sup>25</sup>, “Savings persistence is the percent change in expected savings due to changed operating hours, changed process operation, and/or degradation in equipment efficiency relative to the baseline efficiency option”.

Measure lives are applied to net annual kW and kWh to calculate lifetime kW and kWh. As defined by the 2005 Measure Life Study<sup>26</sup>, measure life is “The median number of years that a measure is installed and operational. This definition implicitly includes equipment life and measure persistence, but not savings persistence...In addition, this definition conforms in letter or in spirit with the definition of measure life used by most national utilities.”

### **Performance Metrics**

As a not-for-profit inter-governmental organization, the Compact does not require shareholder performance incentives, and thus does not need to monitor or track any form of performance metrics.

## **III. Impacts by BCR Activity**

### **A. Residential**

#### **1. By BCR Activity**

Table 5 presents a summary of the number of customers served, the annual savings, the lifetime savings, and the costs incurred for the residential programs. It also presents the benefit-cost ratio, based on the total resource cost test. The costs and benefits used to derive this ratio are the same as those presented in Table 2.

The Residential Retrofit 1-4 and Residential Lighting Programs provide the greatest annual energy and capacity savings. All of the residential programs are cost-effective.

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<sup>25</sup> *Measure Life Study Report* prepared for the Massachusetts Joint Utilities by Energy Resource Solutions (ERS), October 10, 2005.

<sup>26</sup> *Measure Life Study Report* prepared for the Massachusetts Joint Utilities by Energy Resource Solutions (ERS), October 10, 2005.



Benefit-Cost Ratio  Activity	Participant	Annual				Lifetime			Cost		Benefit-Cost
		kWh	kWh per Cust	kW	\$-NEB	MWH	kW	\$-NEB	Activity	per Cust	TRC
A02a Residential Lost Opportunity	127	157,074	1,237	42.74	\$29,622	2,023	942	\$710,143	\$443,560	\$3,493	2.62
A02b Residential HVAC	107	27,644	258	39.09	\$0	498	704	\$0	\$62,539	\$584	4.22
A03a Residential Retrofit 1-4	3,959	3,269,252	826	772.88	\$319,050	29,838	14,522	\$6,510,300	\$3,334,379	\$842	4.12
A03b Residential Retrofit Multifamily	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A03c Residential Load Response	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A04a Residential Lighting	3,805	1,781,436	468	132.01	\$15,712	12,885	958	\$111,745	\$412,799	\$108	4.30
A04b Residential Appliances	1,994	308,400	155	33.14	\$48,573	4,684	405	\$971,454	\$228,457	\$115	6.63
<b>Total</b>	<b>9,992</b>	<b>5,543,807</b>	<b>555</b>	<b>1,019.86</b>	<b>\$412,956</b>	<b>49,928</b>	<b>17,531</b>	<b>\$8,303,642</b>	<b>\$4,481,734</b>	<b>\$449</b>	<b>4.12</b>

## 2. By End Use

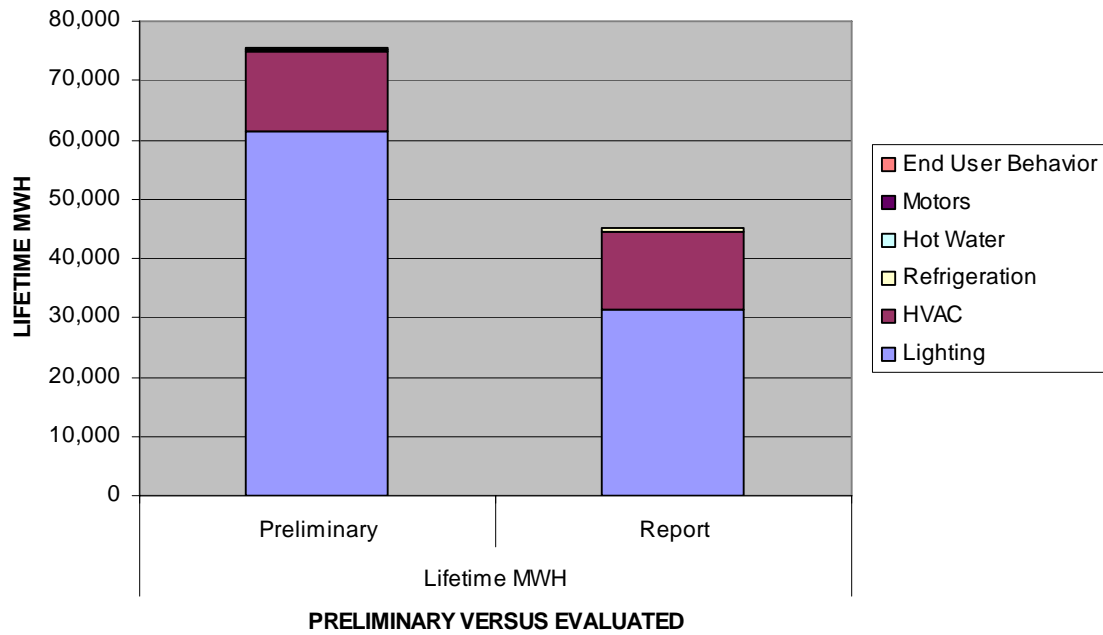
Table 6 presents a summary of the lifetime energy savings, capacity savings, and non-electric benefits, by the different end-uses addressed in the residential programs. Lighting and HVAC provide the majority of energy and capacity savings from the residential programs. Most of the residential non-electric benefits are from HVAC.

The residential impact factors were updated by evaluation studies. There are significant differences between preliminary and reported results for Lighting. The reported lifetime MWh and lifetime kW savings and non-electric benefits are substantially lower than the preliminary lifetime MWh and lifetime kW savings and non-electric benefits for Lighting measures due to adjustments to the in-service rate, energy savings and capacity savings.

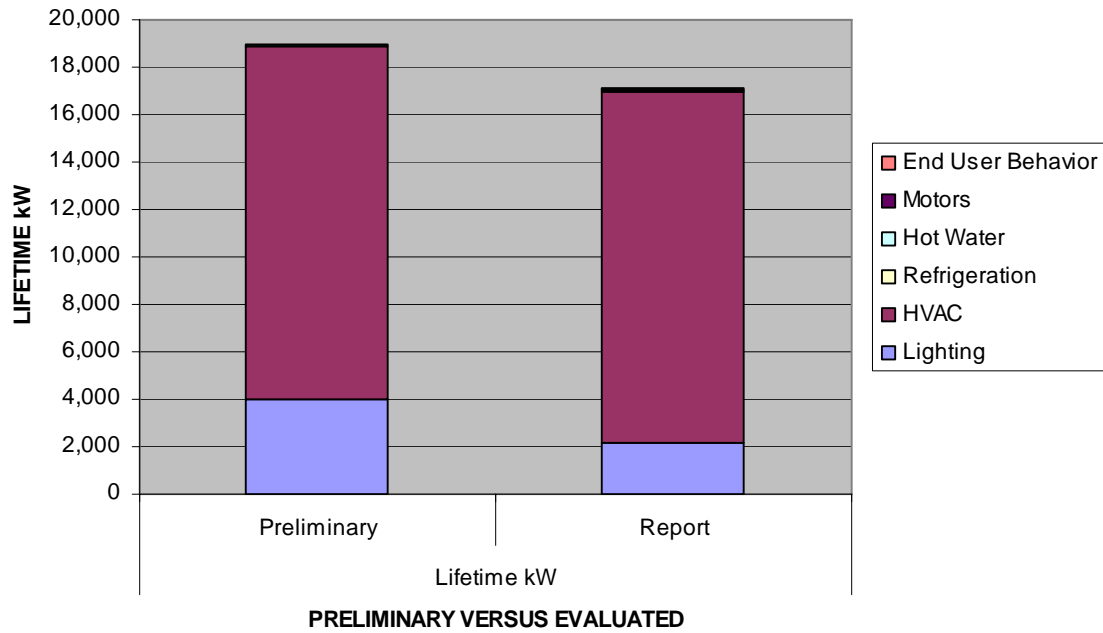
End Use	Lifetime MWH		Lifetime kW		Lifetime \$ NEB	
	Preliminary	Report	Preliminary	Report	Preliminary	Report
Lighting	61,561	31,281	4,031	2,160	\$461,715	\$250,847
HVAC	13,228	13,228	14,820	14,820	\$6,723,104	\$6,723,104
Refrigeration	499	499	47	47	\$0	\$0
Hot Water	236	236	99	99	\$358,237	\$358,237
Motors	0	0	0	0	\$0	\$0
Process	4,684	4,684	405	405	\$971,454	\$971,454
End User Behavior	0	0	0	0	\$0	\$0
<b>Total</b>	<b>80,208</b>	<b>49,928</b>	<b>19,403</b>	<b>17,531</b>	<b>\$8,514,511</b>	<b>\$8,303,642</b>

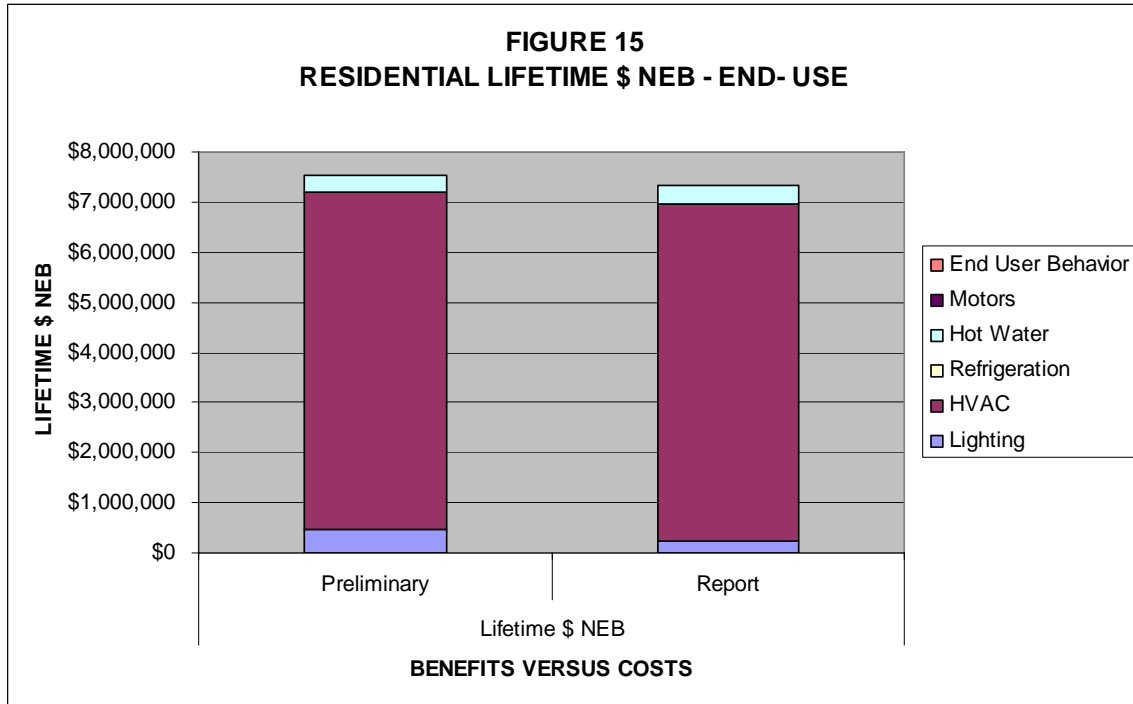
Figures 13 through 15 present the same information as Table 6.

**FIGURE 13  
RESIDENTIAL LIFETIME MWH - END-USE**



**FIGURE 14  
RESIDENTIAL LIFETIME kW - END-USE**





### 3. Program Evaluation

#### **Residential ENERGY STAR® New Construction Program**

*Evaluation of the Massachusetts New Homes with ENERGY STAR® Program 2009 Findings and Analysis, NMR Group Inc., May 26, 2010.*

In 2010, the Joint Management Committee (JMC) completed a program design, implementation, and measurement evaluation report. The evaluation included:

- An evaluation of California’s mechanisms for claiming savings from code-related activities and proposed attribution framework for Massachusetts;
- Recommendations for streamlining the process by which builders participate in the Massachusetts New Homes with ENERGY STAR® Program;
- Identification of lessons learned from the Zero Energy Challenge Pilot;
- Other approaches to estimating whole house savings for homes undergoing major renovations or additions.

Codes and Standards: An extensive review of the California protocols for attribution of a portion of the savings from C&S activities to Program Administrator efforts was completed. Using these as a template, a proposed attribution mechanism was developed for Massachusetts which will cover savings from both upgrades to state codes and increased compliance with both state code and stretch codes for homes that do not participate in the Program. The principal recommendation is to use the California Delphi panel approach to assure an independent assessment of how much of the resulting savings to attribute to Program Administrator efforts.

Streamlining the Process: Interviews were conducted with 26 builders, 10 HERS raters, 3 rating companies listed on the web site, and 3 ICF account managers. Additionally, four builders who did not participate were interviewed. Principal conclusions include, flexibility among market players in program implementation is important, builders are very satisfied with the raters, ICF account managers are used mainly when an issue needs resolution and HERS raters screen out marginally interested builders. One issue that needs to be addressed is getting checks to the builders sooner.

Zero Energy Challenge: Two builders who built such homes achieved negative HERS ratings meaning that the homes are net producers of energy. Both builders have incorporated what they learned in building these homes into their standard building practice. Creating home buyer demand will be the key to getting more builders involved. Builders want to know how they can recover the significant additional costs involved in building these homes.

Major Renovations: Very few programs have provisions that cover additions to existing structures. The major renovations pilot program will assess the merits of blending parts of the residential retrofit program, such as are offered thru Mass Save<sup>®</sup>, with the unique features associated with the services offered with the pilot for large additions to existing houses.

Results from this study are informing future program design, implementation, and measurement. For example, the results from the investigation into streamlining the process are leading program administrators to design a fully market-based program. Results from this study did not drive changes to the reported savings and benefits for the Residential ENERGY STAR<sup>®</sup> New Construction Program.

***Energy Savings Analysis for the Massachusetts New Homes with ENERGY STAR<sup>®</sup>, ICF International, June 4, 2010.***

Also in 2010, the Joint Management Committee (JMC) completed an evaluation report focused on investigating the relationship between HERS ratings and energy savings.

Historically the New Homes with ENERGY STAR<sup>®</sup> program has used a tiered approach to encourage participants to build to higher levels of energy efficiency. Greater incentives were paid for greater energy efficiency and higher tier levels. Higher tiers were assumed to equate to greater energy savings, and were based on the Home Energy Rating System (HERS). HERS ratings were, therefore, assumed to be a sufficiently accurate predictor of energy savings. Program results, however, lead the Joint Management Committee (JMC) to question that relationship. The JMC went on to determine that a low HERS rating does not necessarily guarantee greater energy savings.

The JMC then undertook an analysis that resulted in expanding the tier structure from three to four tiers, and identifying new criterion for achieving various tier levels. The new criterion is based on a percentage savings above a User Defined Reference Home (UDRH) baseline. The old tier levels were structured as follows: Code+, HERS 85 and HERS 65. The new tier levels are structured as follows: Code+, HERS 85, HERS 85 plus 30% improvement over the UDRH baseline, and HERS 85 plus 60% improvement over the UDRH baseline.

The results of this analysis are being used in the statewide working group to enhance implementation and energy savings derived from the program moving forward. For example, the savings calculations were restructured to better align with the way savings data inputs are structured. In particular, savings are now based on the User-Defined Reference Home, or a baseline home, instead of the model home within the REMRate tool. Results from this study did not drive changes to the reported savings and benefits for the Residential ENERGY STAR® New Construction Program.

***The Massachusetts New Homes with ENERGY STAR® Program, 2009 Progress Report, Dorothy Conant, May 26, 2010.***

The Massachusetts New Homes with ENERGY STAR® Program 2009 Progress Report is a summary of 2009 Program activity. Program performance information includes historical as well as current information to show the growth of the Program over time. In preparing the report, the vendor looked at the following aspects of the New Homes with ENERGY STAR® Program:

- Permits, Completions, and ENERGY STAR® Penetration Rates
- HERS Ratings
- ENERGY STAR® Lighting, Windows, Heating and Central Air Conditioning
- Envelope and Duct Leakage
- HERS Raters
- New Homes Recruited

All findings included in this report are taken into consideration by the statewide working group in an effort to enhance the program implementation, participation, and derived savings. The key finding from this year's Progress Report was that the program administrators gained market share, despite the down economy. Results from this study did not drive changes to the reported savings and benefits for the Residential ENERGY STAR® New Construction Program.

**Residential High Efficiency Central Air Conditioning Program**

***Massachusetts New Homes with ENERGY STAR® 2009 COOL SMART Quality Installation Verification Evaluation Report, ICF International, February 24, 2010.***

The intent of this study was to evaluate the quality of installations for central air conditioning (CAC) systems as well as adherence to the Massachusetts New Homes with ENERGY STAR® guidelines in a select number of homes.

A sample of fifty (50) new homes that participated in the program in 2008-09 was selected for this study. The findings indicate that most of the homes in the sample did not meet the standards for a quality installation. For example, very few would meet "ACCA Quality Installation Specifications", 50% of the AC systems were oversized, 70% had out-of-spec measured air flow, 40% had incorrect refrigerant charges, 30% lacked thermal expansion valves and, 26% had unverified indoor-outdoor cooling equipment

matches. Most homes had installed equipment that barely met the code requirement for efficiency (13 SEER).<sup>27</sup>

Program changes have been adopted as a result of these findings and identified shortcomings. For example, the requirements and training for Quality Installation Specifications for central air systems were refined. Results from this study did not drive changes to the reported savings and benefits for the Residential High Efficiency Central Air Conditioning Program.

***Residential Central AC Regional Evaluation, ADM Associates, Inc. October 2009.***

The purpose of this study is to assess energy savings and demand impacts resulting from the installation of efficient central air conditioning (CAC) systems. The study also collects baseline data on duct leakage and infiltration rates of houses.

Data for the study was collected through post-installation monitoring of the CAC systems installed in existing and new homes in Massachusetts, Connecticut and Rhode Island. Results are derived using Typical Meteorological Year (TMY) weather data, as well as actual 2008 weather data, and grouped into the following ISO Load Zones: Northeastern Massachusetts, Southeastern Massachusetts, Western/Central Massachusetts, Connecticut and Rhode Island.

Results of the study indicate that higher efficiency CAC systems provide a sizeable reduction in annual kWh usage. Using TMY data, for example, savings for Southeastern Massachusetts are estimated to be 95 kWh annually. Study results are intended to provide a basis for regulatory reporting as well as application to the Forward Capacity Market. Results from this study did not drive changes to the reported savings and benefits for the Residential High Efficiency Central Air Conditioning Program.

**Residential ENERGY STAR® Lighting Program**

***Results of the Multistate CFL Modeling Effort, NMR Group, Inc., February 4, 2010.***

This report summarizes the analyses conducted in support of the multistate CFL modeling effort, highlighting the results as they pertain to the net-to-gross ratio (NTG) for the Massachusetts Residential ENERGY STAR® Lighting Program. Thirteen companies in 7 states sponsored 9,300 household phone surveys and 1,400 on-site visits in 15 states to estimate the net-to-gross (NTG) ratio of sales and penetration of compact fluorescent light bulbs (CFLs). The 15 surveyed states ranged from 4 states with established CFL programs to 7 states with no CFL program or emerging CFL programs. . The working penetration / market transformation model is that each CFL sold via a program would induce several non-program CFL sales in the early years. As the market matured, and as sales spilled over into other states, according to plan, the ratio of non-program sales to program sales would fall, eventually to zero.

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<sup>27</sup> As a point of clarification, the study concentrated on central air conditioning systems within homes that met the performance path for ENERGY STAR Homes. This does not mean that these home received incentives for equipment or quality installation.

NMR Group built a variety of regression models that used demographics in the various study areas, plus measures of program strength and history, to explain (1) purchases of CFLs in the past 3 and 12 months and (2) cumulative penetration of CFLs in homes. The modeling suggested that CFL programs had a statistically significant net positive effect on CFL purchases in 2008, as well as on current CFL use and saturation. However, it did not find a net positive program effect on CFLs purchased in the past three months. In general, years using CFLs was a little more important predictor of purchases than was strength of program. A purchase model without CFL saturation as a predictor yielded a 19% NTG ratio, while a similar model with saturation yielded a 63% NTG ratio. Given the uncertainties involved, the report recommends an average of the two, a 41% NTG ratio.

Results from this study drove declines in the reported net savings and benefits for the Residential ENERGY STAR<sup>®</sup> Lighting Program. The Cape Light Compact calculated its preliminary net savings and benefits for CFL screw-in bulbs using a 117% in-service rate comprised of an 84% installation rate multiplied by a 139% net-to-gross ratio. The Cape Light Compact calculated its reported net savings and benefits for CFL screw-in bulbs using a 40% in-service rate comprised of a 97% installation rate multiplied by a 41% net-to-gross ratio. This study informed the net-to-gross ratio change. The installation rate change was informed by the 2008 Residential Lighting Markdown Impact Evaluation<sup>28</sup> that was completed in January 2009.<sup>29</sup> Reported gross annual kWh and kW savings assumptions also changed as follows as a result of the 2008 Residential Lighting Markdown Impact Evaluation. Gross annual kWh changed from a preliminary value of 57 to a reported value of 47. Gross annual kW changed from a preliminary value of 0.049 to a reported value of 0.046.

The decline in the net-to-gross ratio indicates that the market is transformed for CFL bulbs for some groups of consumers. As a result, the program design is changing the mix of products offered to different consumers and the market channels used to target different groups of consumers.

### ***The Market for CFL's in Massachusetts, NMR Group, Inc., January 28, 2010.***

This report presents the findings of research conducted to understand the current market conditions and possible new program approaches for common and specialty CFLs in Massachusetts. The report presented findings within the following categories:

- Awareness and satisfaction
- CFL use
- Socket saturation
- CFL purchases

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<sup>28</sup> *Residential Lighting Markdown Impact Evaluation* by Nexus Market Research, RLW Analytics, Inc, and GDS Associates, January 20, 2009.

<sup>29</sup> As this study was not finalized until January 2009, the update does not appear in the 2009 EEP. Also, as the study is from the 2008 program year and was used to update the 2008 Annual Report, it is not listed with the studies from the 2009 program year.

- LEDs and other energy-saving technologies
- Upcoming federal lighting standards
- New technologies and policies

The recommendations that came out of this study will be taken into consideration in the statewide working group to enhance implementation, marketing, and program offerings moving forward. Results from this study did not drive changes to the reported savings and benefits for the Residential ENERGY STAR<sup>®</sup> Lighting Program.

### **Residential ENERGY STAR<sup>®</sup> Appliances Program**

No new evaluation activities were conducted on the results of this program in 2009.

### **Non Program-Related Pilots**

#### ***Energy Pay and Save Pilot Program Survey & Analysis, Black & Veatch, March 2010.***

The purpose of the study is to determine the extent to which on-bill financing motivates customers to install energy efficiency measures. The pilot ran from April 2009 through December 2009, and was offered to residential customers and small commercial and industrial customers. Statewide participation was low among residential customers, averaging 4% across the five participating Program Administrators (PAs), but was much higher among small business customers, averaging 22% across the five PAs.

For Cape Light Compact, a total of 32 customers participated in the program: 10 residential and 22 small business. Cape Light's residential participants installed heating systems, basement and attic insulation and air sealing measures. The average loan amount was \$402 (below the cap of \$500), the average term of the loan was 16 months, and the average monthly savings were \$21. Average measure costs ranged from \$95 to \$1,800.

For Cape Light's small business participants, lighting equipment was the predominant measure installed. The average rebate for those lighting measures was \$180, offsetting over 70% of the average measure cost of \$257. For all small business participants, the average loan amount was \$436 (well below the cap of \$1,000), the average term of the loan was 10 months, and the average monthly savings were \$81. The average project cost was \$2,179.

The results of this evaluation suggest a very limited need for an on-bill financing option for residential customers. The results of this pilot study are being reviewed and used in conjunction with the statewide on-bill financing working group. Any findings will be used to inform financing options in future program years. Results from this study did not drive changes to the reported savings and benefits for the Residential Mass Save<sup>®</sup> Program.

#### ***Cape Light Compact Residential Smart Energy Monitoring Pilot, PA Consulting, March 31, 2010.***

Cape Light Compact designed and implemented a Residential Smart Home Energy Monitoring Pilot program in 2009 to evaluate potential energy savings from in-home



energy monitoring systems, gain insight to behavioral aspects of energy use, and inform future residential Smart Grid projects. The response to the pilot announcement was outstanding, with more than 300 residents requesting the available spots in the program.

To implement the pilot, the Cape Light identified 91 participants on Cape Cod and Martha's Vineyard and installed an in-home energy monitoring system in each participants home for a period of one year. The monitoring system is unique as compared to other behavioral programs in that it enables the participant to view their electricity consumption in real time, displaying energy usage down to the minute. Participants received information and training regarding the system and had access to an online dashboard. The online dashboard offered participants feedback on their energy consumption by providing:

- real time current energy use and demand;
- savings metrics in kWh, dollars, and CO<sub>2</sub> emissions; and,
- opportunities to learn about and sign up for energy saving activities (e.g., unplugging chargers when not in use).

Participants were also part of a community network and could view electricity use of other similar households in the pilot and communicate with other pilot members each other through a social networking system.

Results of the evaluation indicate:

- Strong customer interest in the pilot (with minimal marketing expense, the pilot attracted more than triple the number of desired participants);
- High levels of customer satisfaction with the pilot;
- Significant energy savings.

Seventy-five percent of program participants reduced energy consumption during the program. Program participants reduced their daily energy use by an average of 9.3 percent or 2.9 kWh per day, the second highest decrease when compared to results from similar smart monitoring programs tested throughout North America. One-third reduced average energy consumption by 4 or more kWh per day. Additional results are available in a report that is available at <http://www.capelightcompact.org/reports.html>. Click on the report titled, Residential Smart Home Energy Monitoring Pilot Final Evaluation Report, dated March 31, 2010.

As a result of the findings in the report, Cape Light Compact will expand the pilot by offering Phase 2 which will include residential and commercial participants. An RFP for Phase 2 will be available in August 2010. Evaluation of the pilot will continue through the end of calendar year 2010, at which point further information regarding the persistence of the identified energy savings will be further measured and evaluated. If savings and persistence remain, the Cape Light Compact would recommend making this pilot a program. This Annual Report does not include the savings estimates from this evaluation. The savings estimates will be applied if the pilot becomes a program.

## B. Low-Income

### 1. By BCR Activity

Table 7 presents a summary of the number of customers served, the annual savings, the lifetime savings, and the costs incurred for the Low-Income programs. It also presents the benefit-cost ratio, based on the total resource cost test. The costs and benefits used to derive this ratio are the same as those presented in Table 3.

The Low-Income Retrofit 1-4 Program contributes greater annual and lifetime energy and capacity savings and non-electric benefits due to the fact that there are a greater number of participants in this program. All of the programs are cost-effective.

Benefit-Cost Ratio  Activity	Participant	Annual				Lifetime			Cost		Benefit-Cost
		kWh	kWh per Cust	kW	-\$NEB	MWH	kW	-\$NEB	Activity	per Cust	TRC
B02a Low-Income Lost Opportunity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B03a Low-Income Retrofit 1-4	624	396,453	635	102.58	\$152,366	4,259	1,642	\$2,556,586	\$824,610	\$1,321	4.19
B03b Low-Income Retrofit Multifamily	78	15,235	195	1.32	\$46,346	193	11	\$889,419	\$169,814	\$2,177	5.36
<b>TOTAL</b>	<b>702</b>	<b>411,687</b>	<b>586</b>	<b>103.89</b>	<b>\$198,712</b>	<b>4,451</b>	<b>1,654</b>	<b>\$3,446,006</b>	<b>\$994,424</b>	<b>\$1,417</b>	<b>4.39</b>

### 2. By End Use

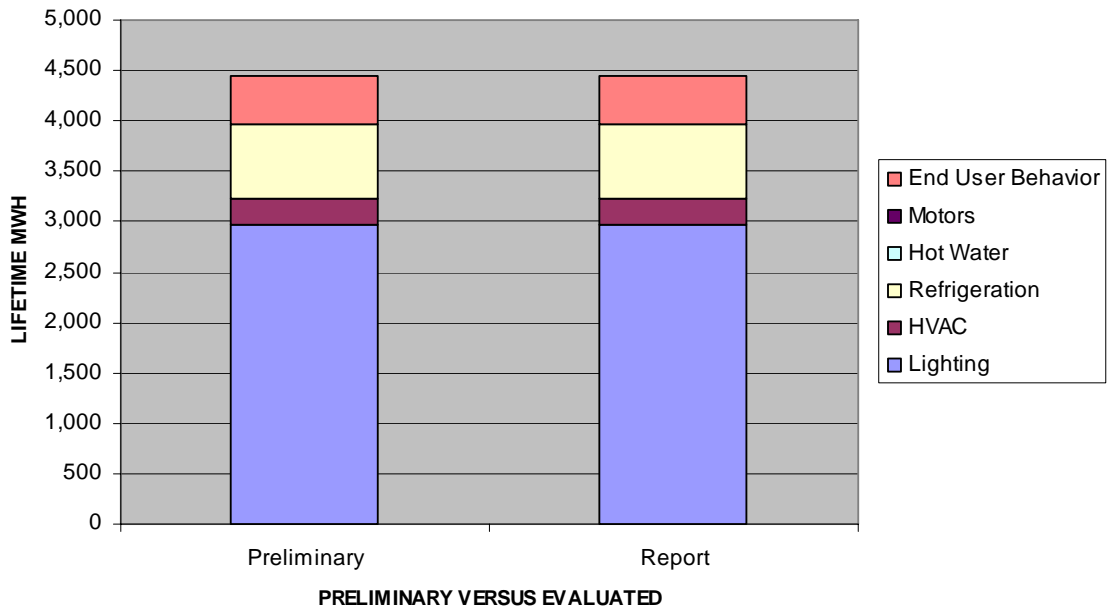
Table 8 presents a summary of the lifetime energy savings, capacity savings, and non-electric benefits, by the different end-uses addressed in the Low-Income programs. Most of the energy savings for Low-Income are from the Lighting and End User Behavior end uses. Most of the capacity savings for Low-Income are from the Lighting and HVAC end uses. Most of the Low-Income non-electric benefits come from the HVAC measures. This is because the home energy audits result in benefits associated with (a) improved property values, (b) reduced fire, illness and moving costs, and (c) fossil-fuel savings. All of the Low-Income programs also have non-electric benefits as a result of reduced usage of the low-income discount rate. The Low-Income programs also have non-electric benefits that are experienced by non-low-income residential customers, such as lighting O&M savings and reduced water usage.

There is no difference between the reported and preliminary results for Low-Income programs since there were no updates from evaluation studies this year.

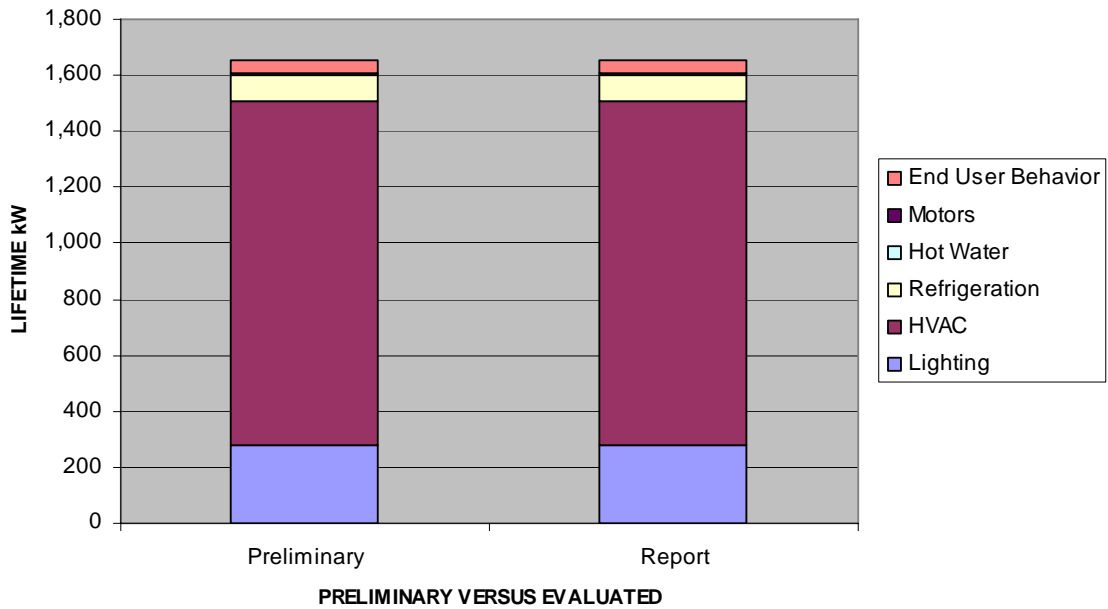
End Use	Lifetime MWH		Lifetime kW		Lifetime \$ NEB	
	Preliminary	Report	Preliminary	Report	Preliminary	Report
Lighting	2,978	2,978	276	276	\$86,026	\$86,026
HVAC	246	246	1,231	1,231	\$3,170,936	\$3,170,936
Refrigeration	739	739	96	96	\$50,706	\$50,706
Hot Water	8	8	5	5	\$100,919	\$100,919
Motors	0	0	0	0	\$0	\$0
End User Behavior	480	480	46	46	\$37,418	\$37,418
<b>Total</b>	<b>4,451</b>	<b>4,451</b>	<b>1,654</b>	<b>1,654</b>	<b>\$3,446,006</b>	<b>\$3,446,006</b>

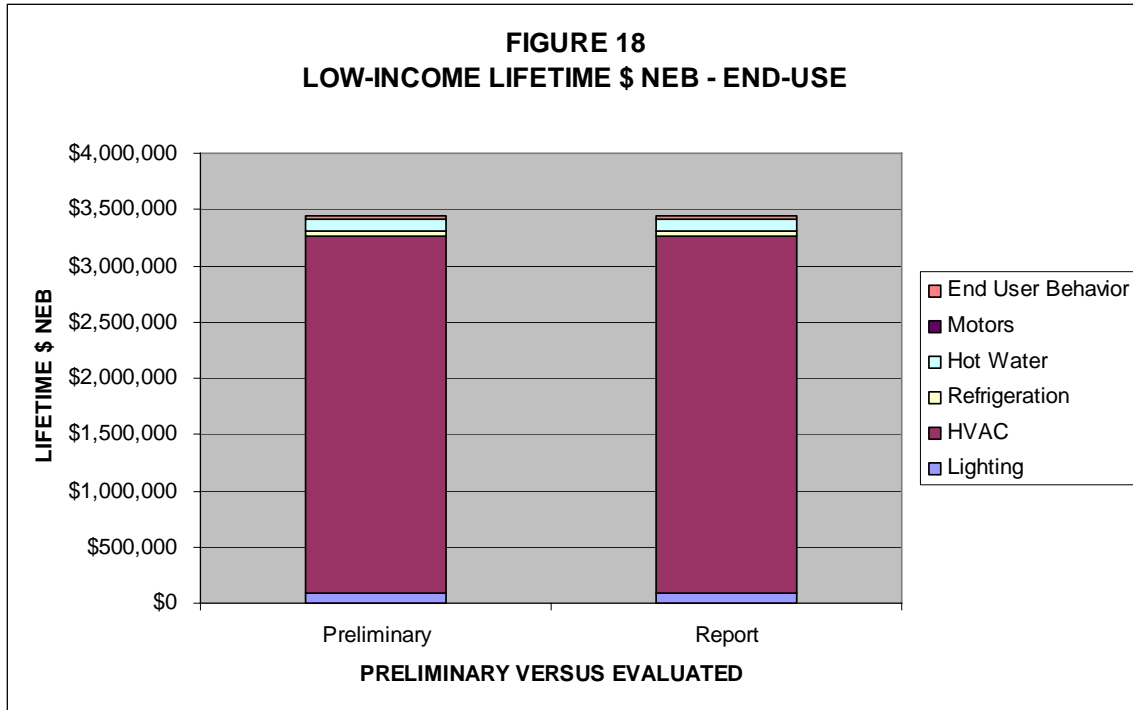
Figures 16 through 18 present the same information as Table 8.

**FIGURE 16  
LOW-INCOME LIFETIME MWH - END-USE**



**FIGURE 17  
LOW-INCOME LIFETIME KW - END-USE**





### 3. Program Evaluation

#### Low-Income Single Family Program

No new evaluation activities were conducted on the results of this program in 2009.

#### Low-Income Multi-Family Program

*2009 Massachusetts Multi-Family Program Assessment, Nexus Market Research, Inc., August 19, 2009.*<sup>30</sup>

On March 24, 2009 the Energy Efficiency Advisory Council (EEAC) issued a “Priorities Resolution” to support the development of statewide electric and natural gas efficiency investment plans.

In response to the Council’s resolution, a Multi-Family Program Design Workshop was held in April 2009. The purpose of the workshop was to obtain key stakeholder feedback on the design elements of a successful Multi-Family program. The workshop was attended by customers, the EEAC members and their consultants, vendors providing service for MA Multi-Family programs, and PA staff. Customers that attended the workshop were primarily from the low-income/affordable housing sector.

<sup>30</sup> The Cape Light Compact is listing this study under the Low-Income Multi-Family Program, as it does not report Multi-Family program results under Residential and C&I. However, the results of this study include and therefore apply to all program participants, including Residential and C&I Multi-Family program participants.

As required by law, the program administrators filed drafts of the 2010-2012 statewide gas and electric energy efficiency plans on April 30, 2009. Due to time constraints, the program administrators did not have the opportunity to fully assess the results of the workshop, identify and fill additional data needs, or develop a comprehensive Multi-Family program design. As a result, the program administrators and EEAC agreed that additional time and effort was required, including gathering input from market rate actors given the composition of customers attending the workshop.

Accordingly, the purpose of this assessment was to obtain further data to inform the program design effort including:

- Confirm or disconfirm, as well as augment, the findings and recommendations from the workshop;
- Understand the progress made to date on overcoming technical barriers;
- Identify successful strategies for delivering a program that is fuel and rate class blind, takes a “whole building” approach to identifying energy efficiency opportunities, and encourages customers to achieve “deeper savings” within Multi-Family properties.

The following tasks were completed in support of this assessment:

- Four focus groups with multi-family building owners, managers and landlords;
- Eight interviews with program administrators in other states;
- A review of available literature and a review of the April 2009 workshop results.

Findings included the fact the same barriers identified in 1995 and 2001 hold true in 2009, suggesting continuing challenges in penetrating this market.

Key strengths of the existing program include, technical assistance offered, customer service, labeling and brand recognition, the whole building approach and quality assurance.

Key weaknesses include, the inability to operate blind to fuel type, poor uptake of tenant training services, insufficient market research, lack of funding for additional training services and not keeping up with client expectations. The principal barriers continue to be the split incentive issue, uncertainty of equipment performance, financial constraints and lack of program awareness.

The findings that came out of this study will be taken into consideration in the statewide working group to inform successful implementation of the program moving forward. Results from this study did not drive changes to the reported savings and benefits for the Low-Income Multi-Family Program.

## C. Commercial & Industrial

### 1. By BCR Activity

Table 9 presents a summary of the number of customers served, the annual savings, the lifetime savings, and the costs incurred for the commercial & industrial programs. It also presents the benefit-cost ratio, based on the total resource cost test. The costs and benefits used to derive this ratio are the same as those presented in Table 4.

The Small C&I Retrofit Program contributes the most annual and lifetime energy and capacity savings and non-electric benefits. All of the programs are cost-effective.

Benefit-Cost Ratio	Participant	Annual			Lifetime			Cost		Benefit-Cost	
		kWh	kWh per Customer	kW	\$-NEB	MWH	kW	\$-NEB	Activity	per Customer	TRC
C02a C&I Lost Opportunity	63	989,771	15,711	282.20	\$1,139	14,425	3,992	\$17,083	\$469,945	\$7,459	5.78
C03a Large C&I Retrofit	32	2,521,062	78,783	347.98	\$857	35,170	4,844	\$11,137	\$1,248,429	\$39,013	4.08
C03b Small C&I Retrofit	353	4,613,133	13,068	1,034.29	\$9,019	59,663	13,565	\$117,242	\$3,394,506	\$9,616	3.00
<b>TOTAL</b>	<b>448</b>	<b>8,123,966</b>	<b>18,134</b>	<b>1,664.46</b>	<b>\$11,014</b>	<b>109,258</b>	<b>22,402</b>	<b>\$145,462</b>	<b>\$5,112,881</b>	<b>\$11,413</b>	<b>3.52</b>

### 2. By End Use

Table 10 presents a summary of the lifetime energy savings, capacity savings, and non-electric benefits, by the different end-uses addressed in the commercial & industrial programs.

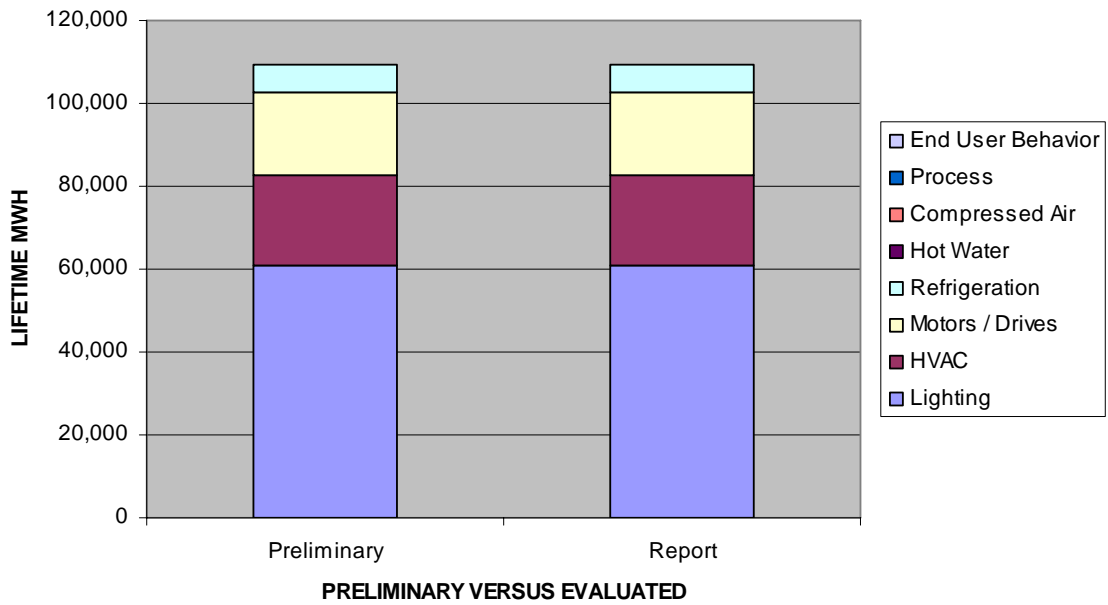
Most of the energy savings, capacity savings, and non-electric benefits are from lighting measures. The non-electric benefits in the C&I sector are primarily from reduced O&M costs as a result of efficient light bulbs with longer operating lives.

There is no difference between the reported and preliminary results for C&I programs since there were no updates from evaluation studies this year.

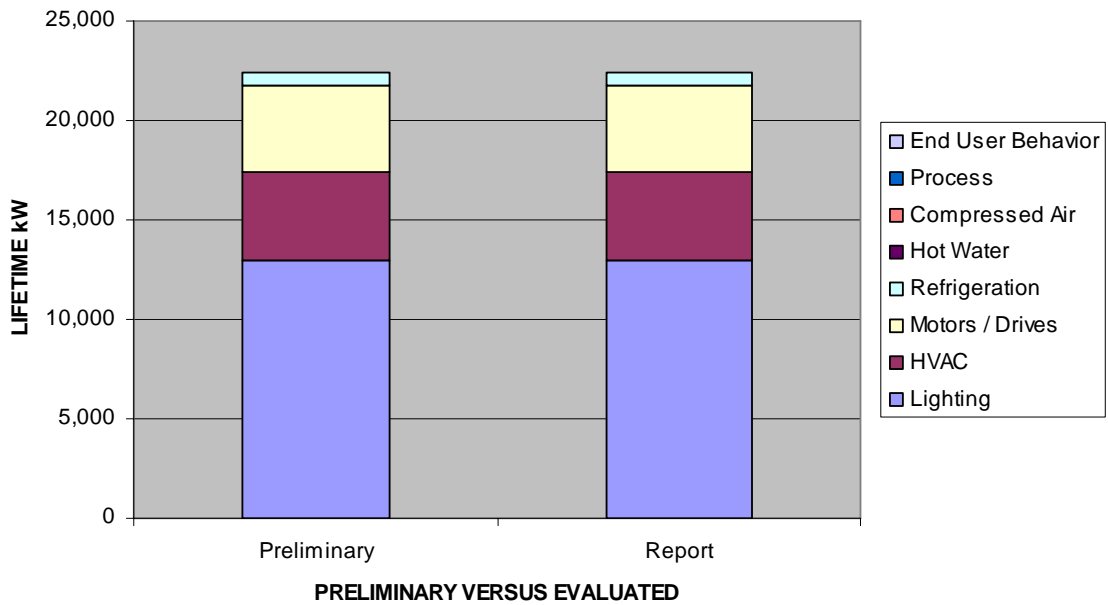
End Use	Lifetime MWH		Lifetime kW		Lifetime \$ NEB	
	Preliminary	Report	Preliminary	Report	Preliminary	Report
Lighting	60,673	60,673	12,940	12,940	\$145,462	\$145,462
HVAC	22,182	22,182	4,427	4,427	\$0	\$0
Motors / Drives	19,797	19,797	4,378	4,378	\$0	\$0
Refrigeration	6,607	6,607	657	657	\$0	\$0
Hot Water	0	0	0	0	\$0	\$0
Compressed Air	NA	NA	NA	NA	NA	NA
Process	0	0	0	0	\$0	\$0
End User Behavior	0	0	0	0	\$0	\$0
<b>Total</b>	<b>109,258</b>	<b>109,258</b>	<b>22,402</b>	<b>22,402</b>	<b>\$145,462</b>	<b>\$145,462</b>

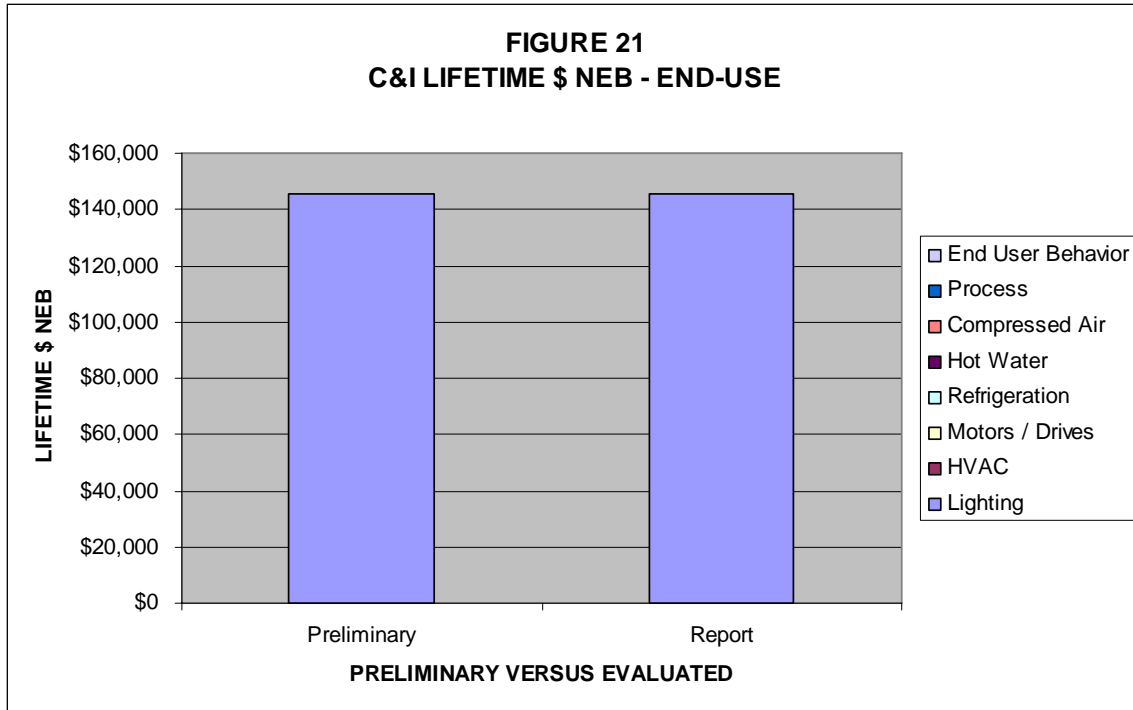
Figures 19 through 21 present the same information as Table 10.

**FIGURE 19  
C&I LIFETIME MWH - END-USE**



**FIGURE 20  
C&I LIFETIME KW - END USE**





### 3. Program Evaluation

#### Commercial and Industrial New Construction Program

No new evaluation activities were conducted on the results of this program in 2009.

#### Medium and Large Commercial and Industrial Retrofit Program

No new evaluation activities were conducted on the results of this program in 2009.

#### Small Commercial and Industrial Retrofit Program

*Market Assessment and Best Practices for Delivering Plug-Load Energy Efficiency in Business – Final Report, PA Consulting Group, June 14, 2010.*

The purpose of this study was to provide information on current plug-load programs, provide a preliminary estimate for potential energy savings, and recommend program strategies for the C&I sector, with an emphasis on small businesses.

The scope of this study was somewhat limited as there was no budget for primary data collection and analysis. While the results of the study include certain caveats, including recommendations for primary data collection, the results also point to a number of overarching recommendations, as well as numerous measure specific strategies for consideration. Overarching recommendations include the following:

- Integrate plug-load efficiency into existing programs;
- Consider programs that target upstream market actors;
- Explore the use of total work space control systems;
- Provide plug-load efficiency training and education.



Measure specific recommendations include the following:

- Distribute smart strips during energy audits and as part of a direct install program;
- Distribute educational materials on the benefits of computer and monitor power management;
- Encourage replacement of office task lights with energy efficient lights.

All recommendations from this study will be taken into consideration by the appropriate statewide PA working group. It is anticipated that some of the recommendations will be used to enhance C&I program offerings, and potentially residential program offerings as well.

**Government Agencies Program**

No new evaluation activities were conducted on the results of this program in 2009.

**Commercial and Industrial Products and Services Program**

No new evaluation activities were conducted on the results of this program in 2009.

## **IV. Appendices**

Appendix 1. Glossary of Terms and Abbreviations

Appendix 2. Impact Factors

Appendix 3. Detailed Benefits and Costs by BCR Activity

Appendix 4. Comparison of Planned and Reported Outsourced and In-House Expenditures

Appendix 5. Calculation of Shareholder Incentive

Appendix 6. Energy Efficiency Evaluations & Studies

Appendix 7. Performance Metrics Related Documents and Reports

Appendix 8. Detailed Savings Calculations of the 2009 Programs

Appendix 9. Progress Report/Update on Compliance Items

Appendix 10. Variance Analysis

Appendix 11. Cape Light Compact's Year End 2009 Town Program Activity Reports  
(Cape Light Compact-Specific Appendix)