Cape Light Compact

The Cape Light Compact

Tel: (508) 375-6648 • Fax (508) 362-4136

POST OFFICE BOX 427 • BARNSTABLE SUPERIOR COURT HOUSE • BARNSTABLE, MASSACHUSETTS 02630

July 14, 2006

Mary Cottrell, Secretary
Department of Telecommunications and Energy
One South Station
Boston, MA 02110

David L. O'Connor, Commissioner
Division of Energy Resources
100 Cambridge Street
Boston, MA 02114

Re: The Cape Light Compact 2005 Annual Report on Energy Efficiency Activities

Dear Secretary Cottrell and Commissioner O'Connor:

I am pleased to enclose for filing with the Division of Energy Resources (DOER) and the Department of Telecommunications and Energy (DTE) the Cape Light Compact's *2005 Annual Report on Energy Efficiency Activities*. These reports are also being submitted electronically by e-mail to Hearing Officer Renner of DTE and Larry Masland of the DOER.

Please note that per discussion with Hearing Officer Sheila Renner that the prior years Annual Reports of Energy Efficiency Activities from 2001 – 2004 will be submitted to DTE under separate cover.

If you have any questions or comments regarding this report, please feel free to contact me or the Compact Energy Efficiency Program Manager, Kevin Galligan.

Sincerely,

Bob Mahoney

Robert Mahoney
Chairman
Cape Light Compact Governing Board

Enclosure

Cape Light Compact

Annual Report on Energy Efficiency Activities in 2005

Submitted to the
Massachusetts Department of Telecommunications and Energy
and the Massachusetts Division of Energy Resources

July 14, 2006

This page intentionally blank.

Table of Contents

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 2005.

In 2005, the Compact implemented the following set of efficiency programs:

- The Residential ENERGY STAR® 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.

- The Residential MassSAVE 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, including financial support to switch electric space heating systems to more efficient systems that use alternative fuels. This program represents the integration of the Home Energy Services, Residential Conservation Services and the Residential High Use Programs that were offered previously.

- The Residential ENERGY STAR Products and Services Program, which seeks to increase the availability and use of ENERGY STAR qualified lighting and appliances, including: clothes washers, room air conditioners, dehumidifiers and refrigerators. This program is used to implement the Northeast Energy Efficiency Partnership ("NEEP") initiatives and other regional market transformation efforts.

- Residential High Efficiency Central Air Conditioning Program ("MA COOL SMART" with ENERGY STAR), was introduced in the Spring of 2004, promotes the purchase and installation of ENERGY STAR 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.

- The Low-Income Single Family Program, which provides low-income customers in single-family dwellings with assistance in purchasing and installing efficient lighting, appliances, and weatherization measures.

- 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.

- The Low-Income New Construction Program, which provides low-income housing development agencies, weatherization assistance program ("WAP") providers, and residential construction trade allies with incentives to increase the home energy rating of new low-income housing.
- 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.
- 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.
- 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.
- The Government Agencies Program, which provides technical assistance and financial incentives to all government facilities, including municipal, state and federal facilities. For the purposes of reporting the results of this program in this Annual Report, the results of efficiency activities with small government customers are included in the Small C&I Retrofit BCR Activity, the results of efficiency activities with large government customers are included in the Large C&I Retrofit BCR Activity, and the results of government new construction activities are included in the C&I New Construction BCR Activity.
- 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 market transformation initiatives. The results of this program are included in the C&I New Construction BCR Activity.

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-energy benefits (NEBs), and the dollar values of the total benefits and the total costs.

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

- The preliminary data refers to savings estimates that are based on the evaluation impact factors that were used in the 2005 Energy Efficiency Plan (EEP). Using this data allows for a direct comparison with the estimated savings from the 2005 EEP.

- The evaluated data refers to savings results that are based on evaluation impact factors from all of the program evaluations that have been prepared since the 2005 EEP was filed. Thus, the evaluated data presents our best estimate of the efficiency savings, based on all the evaluation information available at this time. Appendix 2 presents the impact factors that were used to prepare the evaluated results.

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 2005 evaluated 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 the monitoring and evaluation results and the program savings. Of particular interest in this Annual Report, Appendix 3 provides greater detail of program budgets (by category) and savings (by type).

C. Summary of Results

Table 1 provides a summary of the program expenses and savings. It also presents the percent change between the final evaluated results and (a) the preliminary evaluated results, and (b) the estimates of expenses and savings targets in the Compact's 2005 EEP. The values in the "Amount" column are the 2005 results, based on all evaluations available at this time.

TABLE 1 SAVINGS AND EXPENSES FOR 2005				
Measurement	Amount	Units	Percent Change Comparison	
			Preliminary	Filed Target
Prorgram Implementation Expenses	$4,197,512	$ - Millions	0.0%	-6.0%
Total Expenses	$5,144,998	$ - Millions	0.0%	NA
Annual Energy Savings	12	GWh	-7.8%	24.8%
Annual Summer Demand Savings	1.87	MW	-2.5%	-27.4%
Annual Winter Demand Savings	2.77	MW	-7.7%	-18.4%
Lifetime Energy Savings	119	GWh	-22.8%	1.6%
Lifetime Demand Savings	19.82	MW-Years	-21.8%	-33.0%
Total Resource Cost Test	2.36	Benefit / Cost	-19.3%	-9.7%
Performance Incentive - After Taxes	0	$ - Millions	NA	NA

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

The Compact's 2005 program implementation expenses were roughly 6% lower than the 2005 budgets in the EEP. This was simply the result of cautiously managing year-end activities to ensure that the 2005 budgets were not overspent.

The 2005 program results include the use of supplemental funding of approximately $136,000 made available to support energy efficiency activities from Barnstable County appropriations and the Compact's competitive power supplier, ConEdison *Solutions*.

The annual energy savings achieved in 2005 were roughly 25% higher than those estimated in the 2005 EEP. This difference is primarily due to relatively high savings in the Residential Lighting, Residential MassSAVE, and the C&I Large Retrofit Programs.

The demand savings achieved in 2005 were significantly lower than those estimated in the 2005 EEP. This difference is primarily because the 2005 actual results are based on (a) much better data regarding demand savings, and (b) better coincidence factors used to estimate summer and winter demand from total maximum demand.

The benefit-cost ratio of the 2005 programs in total was 2.36. This indicates that the Compact's programs in total continue to be highly cost-effective, where every $1.00 spent reduces the net cost of electricity by $2.36. This ratio was slightly lower than what was estimated in the 2005 EEP (2.61). We expect that this difference is primarily due to the reduced demand savings and the reduced savings as a result of the most recent evaluation impact factors.

All of the evaluated savings results are lower than the preliminary savings results. This is primarily because most of the evaluation impact factors used in creating the evaluated results (i.e., free-ridership and realization rates) reduced the energy savings estimates. The difference between evaluated and preliminary lifetime energy and demand savings is also partly due to using improved measure life assumptions for the evaluated results.

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 2005 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.

TABLE 2
SUMMARY OF RESIDENTIAL BCR ACTIVITIES

Benefit-Cost Ratio	Lifetime MWH		Lifetime kW		Lifetime $ NEB		TRC Values	
Activity	Preliminary	Evaluated	Preliminary	Evaluated	Preliminary	Evaluated	$-Benefits	$-Costs
A02a Residential Lost Opportunity	3,493	3,791	1,150	1,168	$15,199	$15,199	$429,299	$411,100
A02b Residential HVAC	2,761	2,761	1,629	1,629	$0	$0	$487,874	$166,522
A03a Residential Retrofit 1-4	35,672	31,433	3,087	2,755	$57,354	$47,483	$2,017,535	$1,301,613
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	24,668	20,949	1,478	1,256	$169,193	$142,555	$1,260,335	$247,040
A04b Residential Appliances	8,443	8,443	4,149	4,150	$1,895,148	$1,895,213	$3,133,225	$426,477
Residential Total	75,036	67,377	11,494	10,956	$2,136,893	$2,100,450	$7,328,268	$2,552,751

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

FIGURE 1 – RESIDENTIAL LIFETIME MWH

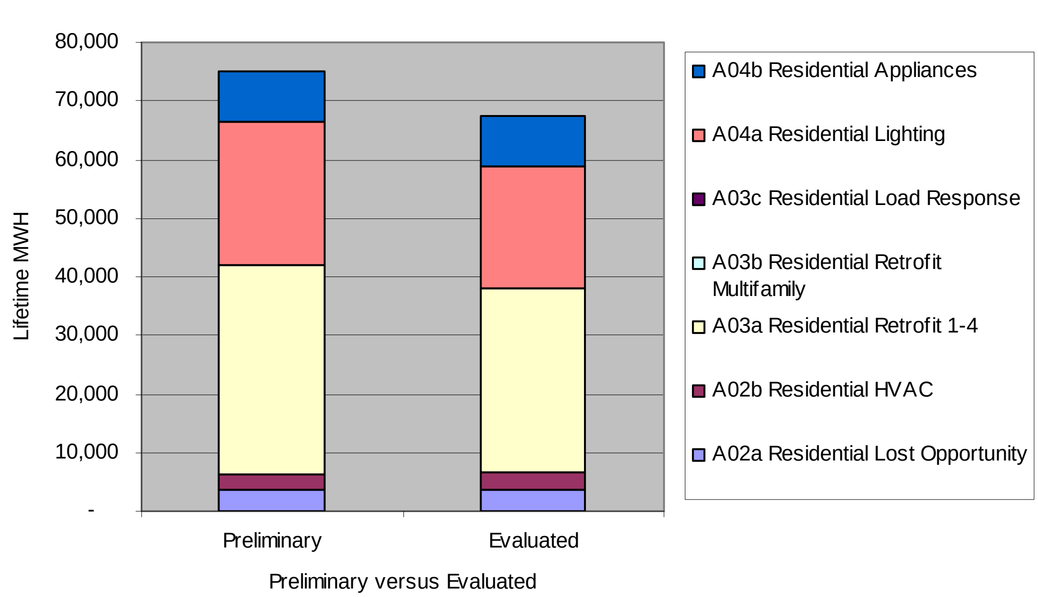


FIGURE 2 - RESIDENTIAL LIFETIME kW

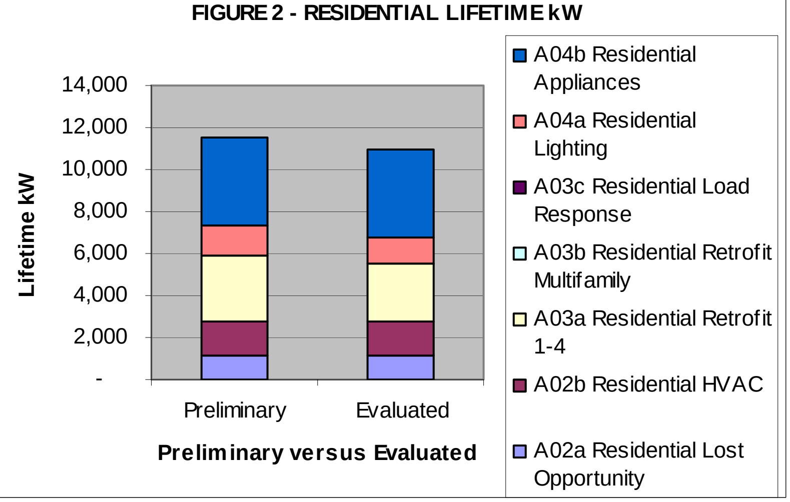


FIGURE 3 - RESIDENTIAL LIFETIME $ NEB

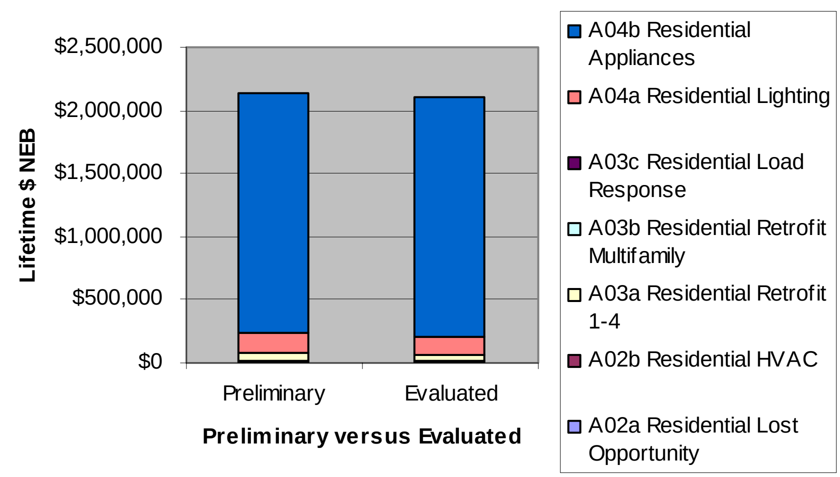
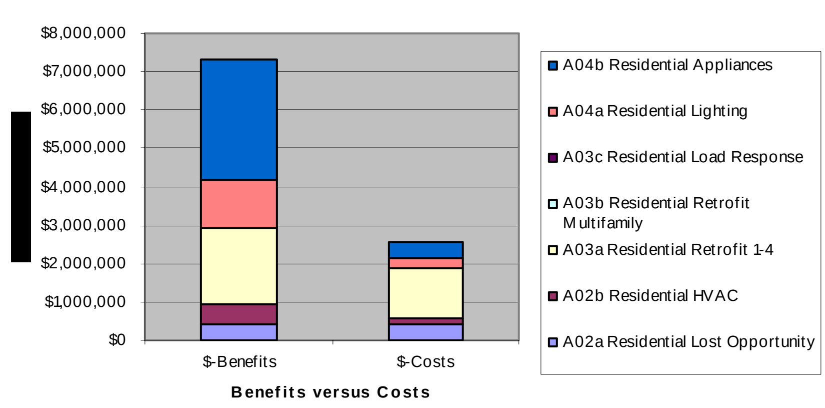


FIGURE 4 - RESIDENTIAL TRC VALUES



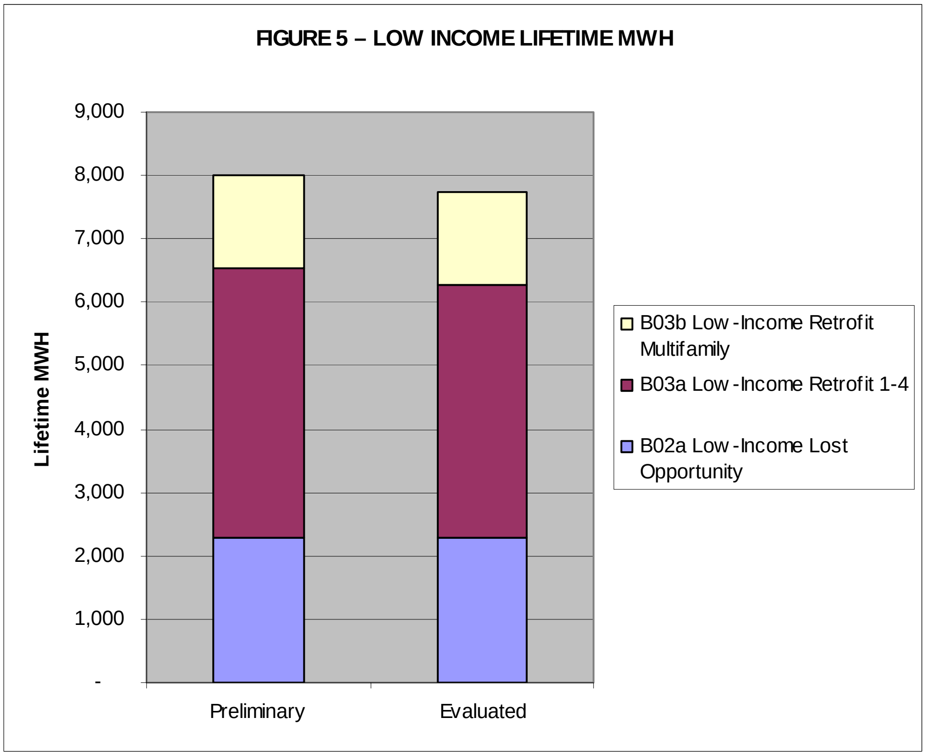
2. Low-Income Programs

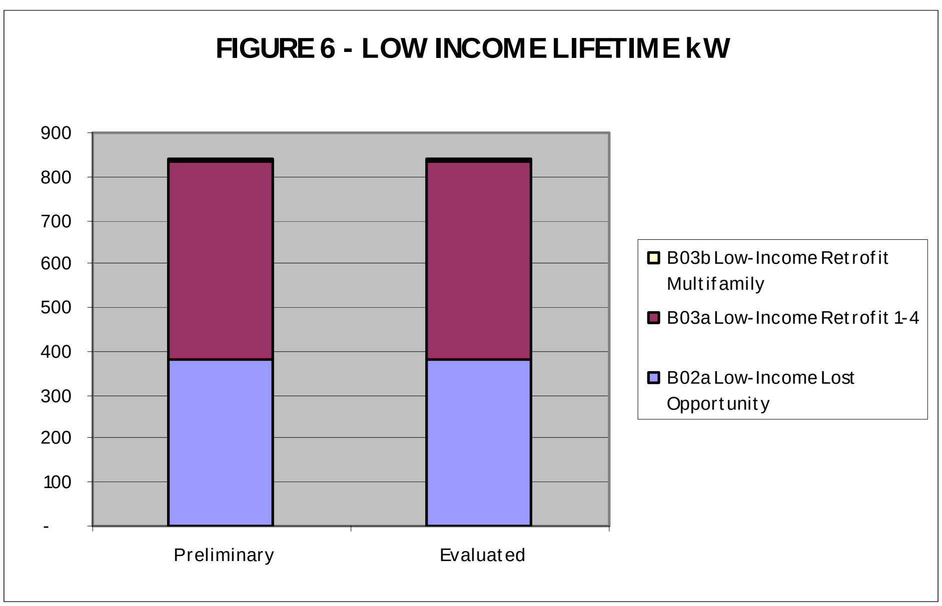
Table 3 presents the lifetime energy savings, lifetime capacity savings, and lifetime non-electric benefits for each of the low-income programs. It also presents the total cumulative benefits and costs, in 2005 present value dollars. These total benefits and costs are used to determine whether each program is cost-effective, based on the total resource cost test.

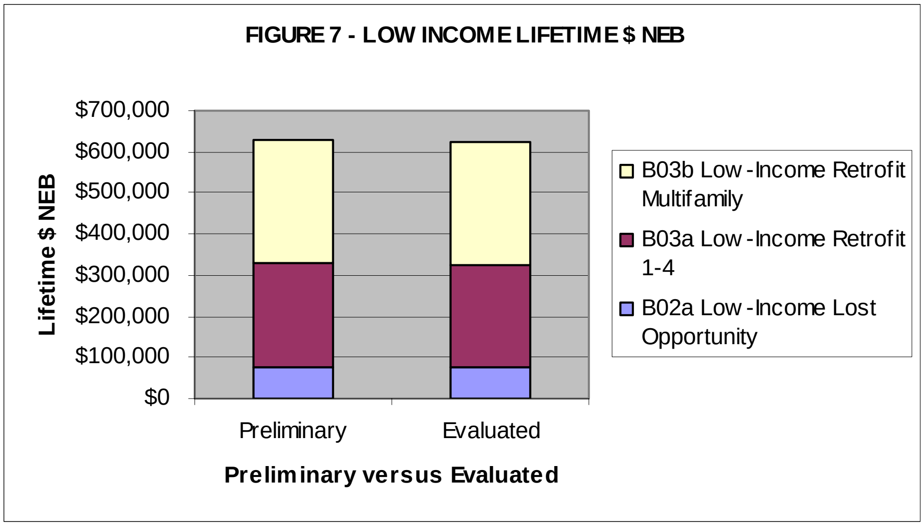
TABLE 3
SUMMARY OF LOW INCOME BCR ACTIVITIES

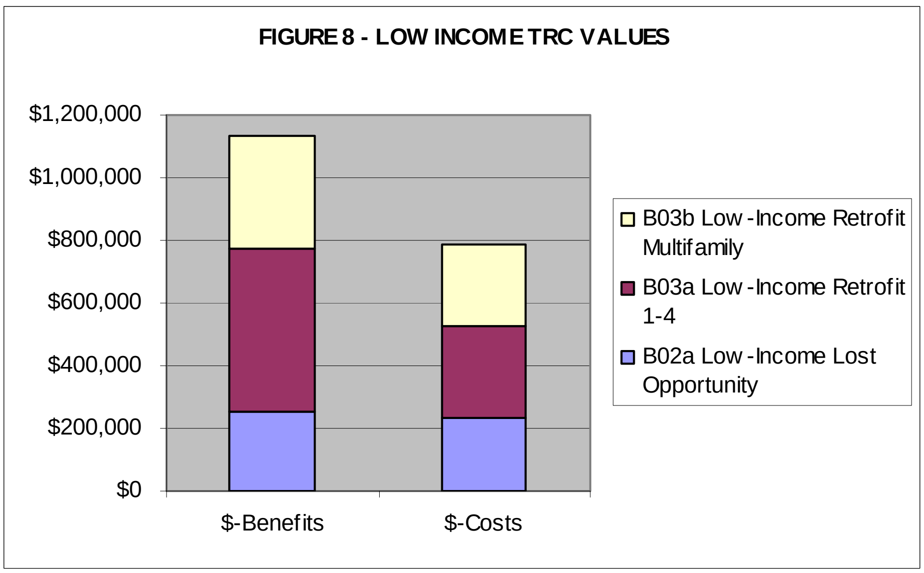
Benefit-Cost Ratio	Lifetime MWH		Lifetime kW		Lifetime $ NEB		TRC Values	
Activity	Preliminary	Evaluated	Preliminary	Evaluated	Preliminary	Evaluated	$-Benefits	$-Costs
B02a Low-Income Lost Opportunity	2,295	2,295	379	379	$74,704	$74,704	$251,655	$235,446
B03a Low-Income Retrofit 1-4	4,242	3,990	453	453	$257,037	$248,265	$518,599	$291,947
B03b Low-Income Retrofit Multifamily	1,452	1,452	7	7	$298,530	$298,530	$366,213	$260,251
Low-Income Total	7,989	7,737	839	839	$630,271	$621,499	$1,136,467	$787,643

Figures 5 through 8 present the same information as Table 3. They indicate that all of the programs are cost-effective. Most of the low-income energy, capacity and NEB savings are obtained from the lost opportunity and retrofit 1-4 programs. This is probably because the low-income retrofit multifamily program served a relatively small number of customers in 2005. Also, the multifamily retrofit program achieves fossil fuel savings, which are not presented in Figures 5, 6 and 7.









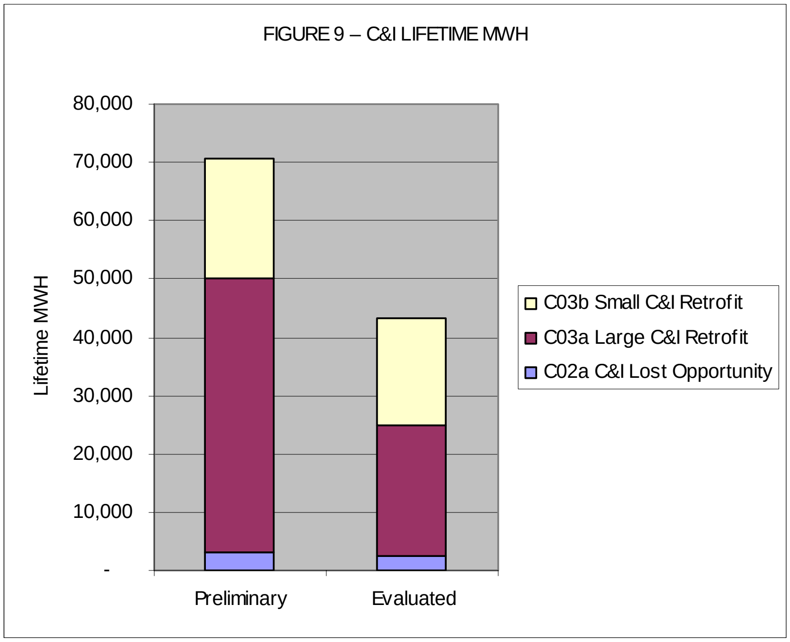
3. Commercial & Industrial Programs

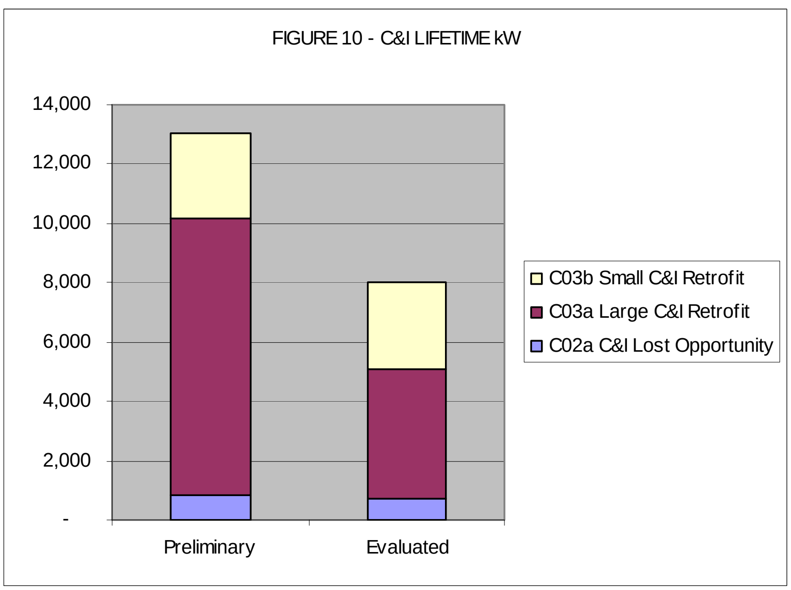
Table 4 presents the lifetime energy savings, lifetime capacity savings, and lifetime non-electric benefits for each of the Commercial & Industrial programs. It also presents the total cumulative benefits and costs, in 2005 present value dollars. These total benefits and costs are used to determine whether each program is cost-effective, based on the total resource cost (TRC) test.

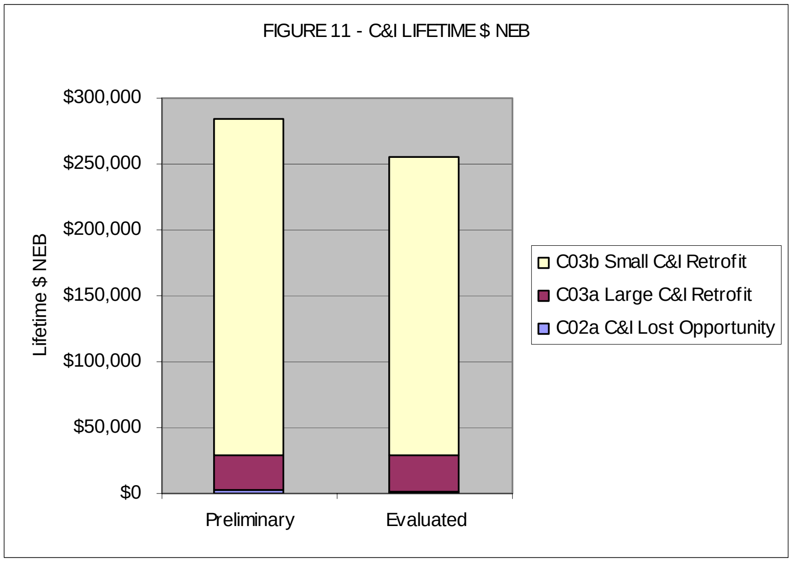
TABLE 4
SUMMARY OF C&I BCR ACTIVITIES

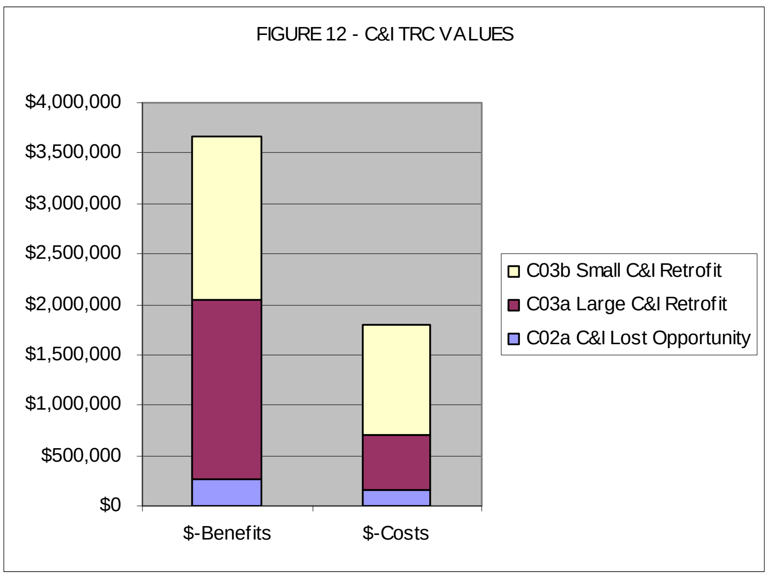
Benefit-Cost Ratio	Lifetime MWH		Lifetime kW		Lifetime $ NEB		TRC Values	
Activity	Preliminary	Evaluated	Preliminary	Evaluated	Preliminary	Evaluated	$-Benefits	$-Costs
C02a C&I Lost Opportunity	3,246	2,618	839	688	$2,061	$1,616	$258,382	$154,035
C03a Large C&I Retrofit	47,006	22,297	9,309	4,416	$26,641	$27,129	$1,788,464	$554,703
C03b Small C&I Retrofit	20,275	18,499	2,866	2,924	$255,322	$226,767	$1,619,633	$1,095,866
Total	70,527	43,414	13,014	8,028	$284,025	$255,512	$3,666,479	$1,804,604

Figures 9 through 12 present the same information as Table 4. They indicate that most of the Compact's C&I savings are obtained from the two Retrofit programs. As indicated in Figures 9 and 10, the evaluated savings for the C&I Large Retrofit Program are significantly lower than the preliminary savings. This is partly due to the change in measure life assumption (from 14 years to 5 years) for the Building Operator Certification (BOC) Program, which makes up a large portion of the energy savings from the Large C&I Program.









II. Overview of Evaluation Methodology[1]

Preliminary Versus Evaluated Results

As noted above, the savings data in this report are presented in terms of both "preliminary" and "evaluated" data.

---

[1] Some of the text below was taken from the 2003 Annual Reports on Energy Efficiency Activities of NSTAR, Massachusetts Electric Company, and Western Massachusetts Electric Company, because similar evaluation practices are used across all Massachusetts Program Administrators.

- The preliminary data refers to savings estimates that are based on the evaluation impact factors that were used in the 2005 Energy Efficiency Plan (EEP).[2] Using this data allows for a direct comparison with the estimated savings from the 2005 EEP.
- The evaluated data refers to savings results that are based on evaluation impact factors from all of the program evaluations that have been prepared since the 2005 EEP was filed. Thus, the evaluated data presents our best estimate of the efficiency savings, based on all the evaluation information available at this time. Appendix 2 presents the impact factors that were used to prepare the evaluated results.

Evaluation Studies Used in Preparing 2005 Evaluated Results

Since its inception in July 2001, the Compact has participated in many state-wide 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.

The evaluation studies that were used to prepare the estimates of 2005 energy efficiency savings are listed below. The executive summaries of these reports are included in Appendix 6.

- *Measure Life Study*, by energy & resource solutions, prepared for the Massachusetts Joint Utilities, October 10, 2005.
- *Impact and Process Evaluation Building Operator Certification (BOC) Program*, by RLW Analytics, prepared for Northeast Energy Efficiency Partnerships, June 2005.
- *Free-ridership and Spillover Study*, by PA Consulting, prepared for the Cape Light Compact in conjunction with National Grid and United Illuminating, June 2006.
- *Phase 1: Commercial Rooftop HVAC Unit Retrofit Programs*, by New Buildings Institute, Inc., prepared for Northeast Energy Efficiency Partnerships, March 2006.
- *Market Research Report on NEEP Commercial Lighting Initiative*, by energy & resource solutions, prepared for Northeast Energy Efficiency Partnership, June 2006.
- *Massachusetts ENERGY STAR Homes: 2005 Baseline Study, Final Report*, by Nexus Market Research, Inc. and Dorothy Conant, prepared for the Joint Management Committee, May 2006.
- *Analysis of Remaining Opportunities for the Massachusetts ENERGY STAR Appliances Program*, by NMR, RLW Analytics, Inc., Dorothy Conant and Shel Feldman Management Consulting, prepared for Cape Light Compact, National

---

2 The primary evaluation impact factors that are relevant here are free-ridership rates, spillover rates, realization rates, persistence rates, and measure lives.

Grid USA, NSTAR Electric Company, Unitil, and Western Massachusetts Electric Company, October 2005.

- *Evaluation of the MassSAVE Program: Market Survey Results,* by RLW Analytics, submitted to Bay State Gas, Berkshire Gas, Cape Light Compact, KeySpan Energy Delivery, National Grid, New England Gas Company, NSTAR Electric and Gas Corporation, Unitil, and Northeast Utilities/Western Massachusetts Electric, December 2005.
- *Kingman Yacht Center*, *Energy Audit Report*, by RLW Analytics, prepared for the Cape Light Compact, January 2006.
- *Evaluation of the Cape Light Compact Residential New Construction Green Building 2003 Demonstration Project*, by Vermont Energy Investment Corporation, prepared for the Cape Light Compact, March 2006.

In addition, some program evaluation studies are currently in development. Final reports for the following studies are expected in summer 2006.

- *Market Progress and Evaluation Report (MPER) for the 2005 Massachusetts ENERGY STAR Residential Lighting Program,* by Nexus Market Research, prepared for Cape Light Compact, National Grid USA, NSTAR Electric Company, Unitil, and Western Massachusetts Electric Company, Summer 2006.
- *Commercial HVAC Equipment Market Characterization*, by KEMA Consulting, prepared for the Northeast Energy Efficiency Partnerships, Summer 2006.

Types of Evaluations

The evaluation of 2005 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.

<u>Survey-Based Impact Parameter Studies</u>. 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.

In 2005 the Cape Light Compact joined National Grid in sponsoring a study to update free-ridership and spillover impact factors for Commercial and Industrial programs, based on standardized methods and survey instruments that were developed in 2004. The results of the 2005 study are included in Appendix 6.

In July of 2005, a survey-based evaluation of the Building Operator Certification Program was also completed and is summarized in Appendix 6. Results of this study were used to report savings from 2005 participants in the BOC 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.

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.

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.

Appendix 6 includes summaries of several studies that characterize current market conditions or report on market progress and aid in informing implementation of market-oriented energy efficiency programs implemented by the Compact, such as the residential new construction program, residential products program, and commercial and industrial products and services 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 cost-effectiveness results presented in this report – both preliminary and evaluated – are all based on the avoided cost estimates that were used in preparing the 2005 EEP. This approach allows for a more direct comparison of the economic results between the 2005 EEP and the 2005 Annual Report. The avoided cost estimates used for both of these studies are taken from the following report: ICF Consulting, *Avoided Energy Supply Costs in New England*, prepared for the Avoided Energy Supply Component (AESC) Study Group, August 21, 2003.

That study was prepared for a group of sponsors and project advisors from the six New England states from Maine to Connecticut, including the Compact. The study was intended to support energy efficiency program planning and development, including regulatory filings. The study employed a detailed and integrated fundamentals modeling approach combined with market data to estimate supply costs considered to be avoidable. It projected spot market fuel market prices, wholesale energy and capacity prices, transmission and distribution avoided costs. The impacts of locational pricing were considered in the analysis, in light of the fact that locational pricing markets were under development. Avoided costs were calculated for all sub-regions in New England for

2005 – 2040. In addition to the avoided electric supply costs, projections for gas, propane fuel oil, distillate fuel oil, kerosene heating fuel, and wood were also considered.

In 2005, an update of projected avoided energy supply costs was completed for the same parties, by the same consultant. These avoided costs were used in preparing the 2006 EEP, and will be used in presenting the 2006 Annual Report.

Other Compact-Specific Research and Evaluation. The Compact completed site-specific analyses of two special projects: the Residential New Construction Green Building 2003 Demonstration Project, and a custom project to identify efficiency opportunities for the Kingman Marina. While results of these studies are not used to develop savings estimates for this report, they help inform the design and delivery of the Compact's programs. These studies are briefly summarized below; additional details are provided in Appendix 6.

Evaluation of the Green Building Project included follow-up interviews with the homeowners and builders and suppliers, visits to each of the four houses in the project, development of a Cape Cod-specific reference home based on Massachusetts new construction baseline data, and an assessment to determine if the houses in the Project were performing as originally modeled.

Key findings included:

- Participants were very satisfied with their homes;
- While useful, the Vermont Build Green checklist needs to be supplemented with additional informational resources;
- Non-energy benefits, such as indoor environmental quality, durability, other factors, were more important than energy savings in motivating customers to build to a green standard.
- The energy benefits of the homes were cost-effective (i.e. incremental costs were more than offset by the associated savings).
- More generally, builders feel there is pent up demand for green building in the residential sector; lack of consumer awareness is the primary barrier to increased adoption of green building practices.
- The four homes saved from 930 to 1,400 kWh and 110 to 300 therms annually. Under the TRC test, the savings measures (excluding solar water heating) are cost effective relative to the Massachusetts baseline home; however, inclusion of program administration costs resulted in an overall program benefit-cost ratio of 0.93.

In 2005, the Compact contracted for an assessment of efficiency and energy management opportunities for the Kingman Yacht Center, a full service marina, restaurant and retail facility. The study included an analysis of two years of monthly billing history as well as construction of average dock load profiles based on monitoring of dock power consumption and recording of fifteen-minute interval data.

Key findings included:

- Kingman Yacht Center does not have enough discretionary kW to participate in regional load response programs. (The Center's peak load is 199kW, of which 89kW is dock load; 100 kW is the minimum required for the ISO-NE program).
- The Yacht Center could benefit from participation in a regional load response program, if opportunities for customers to aggregate loads become available. Meanwhile, customer education is recommended to help manage peak dock load.
- As a secondary priority, further investigation of usage in winter months and consumption by non-dock facilities is recommended to identify energy efficiency opportunities.

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.

Free-ridership and spillover rates for Commercial and Industrial Programs were determined as part of the study conducted jointly by National Grid, the Compact, and United Illuminating, and summarized in Appendix 6. For the purposes of the study, participants in the Compact's Small C&I, Medium and Large C&I, and Government programs were combined, and impacts were developed by measure category and by new construction, retrofit, and product and service, where possible. The impacts were assessed through a survey of a sample of program participants and some design professionals and vendors. The number of survey completions for some measure categories was very low because some of the Compact's programs, such as New Construction, had relatively few participants in 2005 and even fewer participants installed certain measures. Thus, although a high percentage of the 2005 program customers were sampled, as noted by the evaluators who conducted the analysis, "some caution should be used when interpreting results". For the Compact's C&I New Construction program, the Compact staff and advisors elected to use free-ridership and spillover results from National Grid in reporting 2005 results, due to concerns about the small sample sizes from the Compact. For the Compact's Government New Construction and Retrofit programs, the Compact elected to assume there is no free-ridership or participant spillover in 2005. This is because the government programs were designed and delivered in order to provide energy efficiency to customers who could not provide the same level of efficiency within their existing budgets[3].

[3] The Compact will evaluate government program impacts in a 2006 evaluation study.

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 these 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 and Compact surveys.

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, "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. Measure lives for Commercial and Industrial Programs were updated based on results of a 2005 literature review and study jointly sponsored by Massachusetts' energy efficiency program administrators. It is also summarized in Appendix 6. As defined by the 2005 Measure Life Study, 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 HVAC, Lighting and Appliances Programs are particularly cost-effective. The Residential Lost Opportunity Program is less cost-effective than the others, in part because the baseline homes are increasingly efficient. Nonetheless, this program is still important because of the long-term lost opportunities that it addresses.

TABLE 5											
IMPACT BY RESIDENTIAL BCR ACTIVITIES											
Benefit-Cost Ratio	Customers	Annual				Lifetime			Cost		Benefit-Cost
Activity		kWh	kWh per Customer	kW	$- NEB	MWH	kW	$- NEB	Activity	per Customer	TRC
A02a Residential Lost Opportunity	230	329,480	1,433	66.78	$760	3,493	1,168	$15,199	$411,100	$1,787	1.04
A02b Residential HVAC	269	138,040	513	81.43	$0	2,761	1,629	$0	$166,522	$619	2.93
A03a Residential Retrofit 1-4	1,996	2,512,200	1,259	240.85	$4,076	35,672	2,755	$47,483	$1,301,613	$652	1.55
A04a Residential Lighting	1,392	3,251,710	2,336	194.88	$23,295	24,668	1,256	$142,555	$247,040	$177	5.10
A04b Residential Appliances	3,888	567,750	146	305.61	$135,379	8,443	4,150	$1,895,213	$426,477	$110	7.35
Total	7,775	6,799,180	874	889.55	$163,511	75,036	10,956	$2,100,450	$2,552,751	$328	2.87

2. By End Uses

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 savings from the residential programs.

TABLE 6						
IMPACT BY RESIDENTIAL END USES						
End Use	Lifetime MWH		Lifetime kW		$ Lifetime NEB	
	Preliminary	Evaluated	Preliminary	Evaluated	Preliminary	Evaluated
Lighting	36,367	32,403	2,180	1,972	$196,985	$168,096
HVAC	31,596	27,497	5,685	5,294	($7,790)	($7,790)
Refrigeration	1,740	2,149	238	300	$0	$0
Hot Water	5,332	5,329	3,391	3,391	$1,947,698	$1,940,144
Motors	NA	NA	NA	NA	NA	NA
End User Behavior	NA	NA	NA	NA	NA	NA

The negative NEB values are due to the assumption that efficient boilers should be tuned-up each year to achieve the full level of efficiency savings.

Figures 13 through 15 present the same information as Table 6. They indicate that much of the residential energy savings are obtained from the lighting measures, with most of the remaining coming from HVAC.

The residential demand savings come primarily from HVAC and hot water. Lighting savings make up a relatively small portion of the demand savings, because only a small portion of the lighting measures are assumed to be operational during the peak demand period. Many of the residential non-electric benefits are from hot water savings, as a result of the saved water from ENERGY STAR clotheswashers and dishwashers.

FIGURE 13 – RESIDENTIAL LIFETIME MWH - END USE

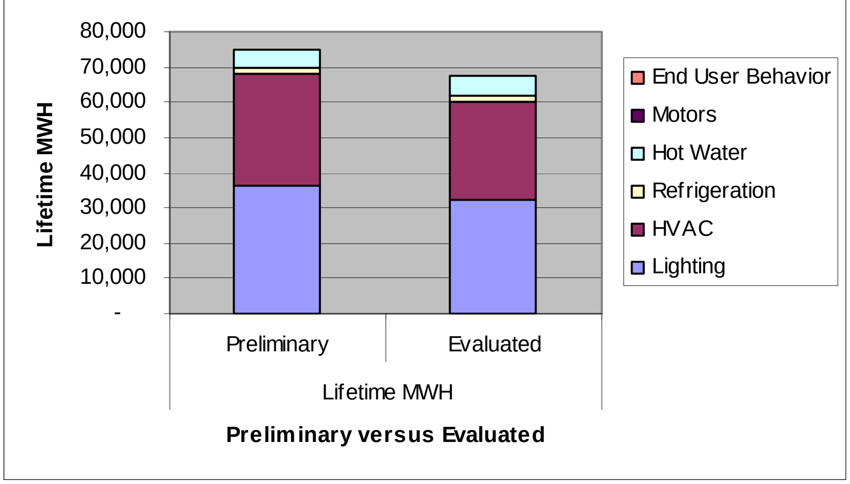


FIGURE 14 - RESIDENTIAL LIFETIME kW - END USE

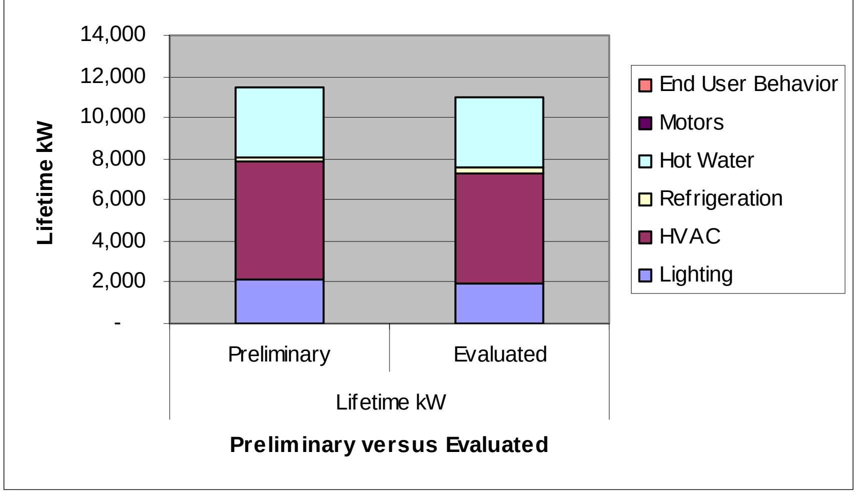
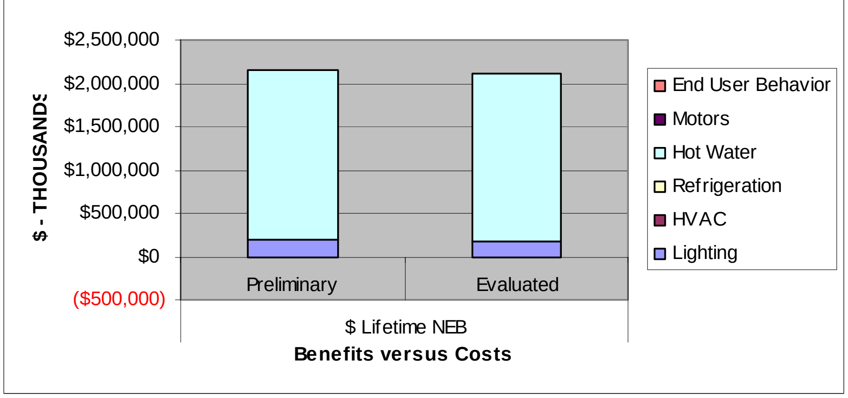


FIGURE 15 - RESIDENTIAL LIFETIME NEB - END USE



3. Program Evaluation

The Residential ENERGY STAR® New Construction Program

Savings attributed to ENERGY STAR New Construction Program come from two main areas: (a) heating, cooling, and water heating in the home; and (b) appliances and lighting installed in the home. Savings for appliances and lighting in certified homes were based on previous studies provided by Massachusetts program administrators.

Heating, Cooling, Water Heating Savings: As part of the ENERGY STAR certification process, projected energy use is calculated for each ENERGY STAR home and a matching baseline home, the User Defined Reference Home (UDRH), using REM/rate software, a detailed residential simulation tool which is also the tool used to calculate both electric and fossil fuel energy savings due to heating, cooling, and water heating for all homes, both single and multifamily, certified in 2005.

In May 2006, the Joint Management Committee (JMC) completed a study to characterize baseline new construction in Massachusetts. The reference home was revised based on many of the findings of this study, "Massachusetts ENERGY STAR HOMES: 2005 BASELINE STUDY, Final Report." However, the savings presented in this Annual Report do not reflect these results, as per the DOER definition of preliminary and evaluated results.

The baseline study is one of several evaluation activities of the JMC relating to the Multi-Year Program Evaluation and Market Progress Reporting Plan (MPER) beginning in 2005. A homeowner survey was also conducted to obtain additional information such as awareness and interest in energy efficiency from the owners of the 150 homes inspected in the 2005 Baseline Study.

MassSAVE

In December 2005, "Evaluation of the MassSAVE Program: Market Survey Results" was released (Appendix 6). This is part of a larger multi-year evaluation plan. The market survey was conducted from a random sample of Massachusetts residents. It measured: residents' name recognition, understanding, and valuing of the program; payback requirements for efficiency measures; and other characteristics of customers likely to be targeted by the program. Results of this survey inform a table of market and program indicators.

Key findings included:

- Continued need to emphasize the MassSAVE name;
- Need to explore targeting landlords;
- Need to overcome high first-cost barriers for some measures in various ways, including educating customers on the payback concept, and providing rebate/interest-free loan combinations.

The Residential ENERGY STAR Products and Services Program

2005 marked the beginning of a new Multi-Year Program Evaluation and Market Progress Reporting Plan (MPER) effort for lighting and appliances.

An “Analysis of Remaining Opportunities for the Massachusetts ENERGY STAR Appliances Program” was completed in October 2005 (Appendix 6). The analysis is based on interviews with program administrators and ENERGY STAR partners as well as review of program materials. The purpose of this analysis is to help inform decisions about future program design as well as evaluation activities, given that significant progress toward market transformation has been made in recent years. Key findings included:

- Need to maintain sales and marketing support mechanisms for an appliance program even with reduced program spending, in order to maintain visibility of ENERGY STAR and to push manufacturers toward higher appliance efficiencies.

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.

While the Single Family and Multi-Family Retrofit Programs are clearly cost-effective, the Lost Opportunity Program is less so. We believe that the benefit-cost ratio for the Lost Opportunity Program is especially low this year as a result of relatively low activity in 2005.

TABLE 7

IMPACT BY LOW INCOME BCR ACTIVITIES

Benefit-Cost Ratio		Annual				Lifetime			Cost		Benefit-Cost
Activity	Customers	kWh	kWh per Customer	kW	$- NEB	MWH	kW	$- NEB	Activity	per Customer	TRC
B02a Low-Income Lost Opportunity	12	185,220	15,435	31.13	$5,841	2,295	379	$74,704	$235,446	$19,620	1.07
B03a Low-Income Retrofit 1-4	375	271,540	724	29.69	$16,327	4,242	453	$248,265	$291,947	$779	1.78
B03b Low-Income Retrofit Multifamily	3	139,410	46,470	0.35	$29,697	1,452	7	$298,530	$260,251	$86,750	1.41
TOTAL	390	596,170	1,529	61.17	$51,864	7,989	839	$621,499	$787,643	$2,020	1.44

2. By End Uses

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.

TABLE 8

IMPACT BY LOW INCOME END USES

End Use	Lifetime MWH		Lifetime kW		$ Lifetime NEB	
	Preliminary	Evaluated	Preliminary	Evaluated	Preliminary	Evaluated
Lighting	847	731	51	51	$22,893	$19,731
HVAC	2,454	2,454	24	24	$461,255	$461,255
Refrigeration	2,409	2,339	330	330	$89,420	$86,778
Hot Water	211	144	73	73	$9,969	$7,001
Motors	NA	NA	NA	NA	NA	NA
End User Behavior	NA	NA	NA	NA	NA	NA

Figures 16 through 18 present the same information as Table 8. They indicate that most of the energy and demand savings are from the refrigeration 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.

FIGURE 16 – LOW INCOME LIFETIME MWH - END USE

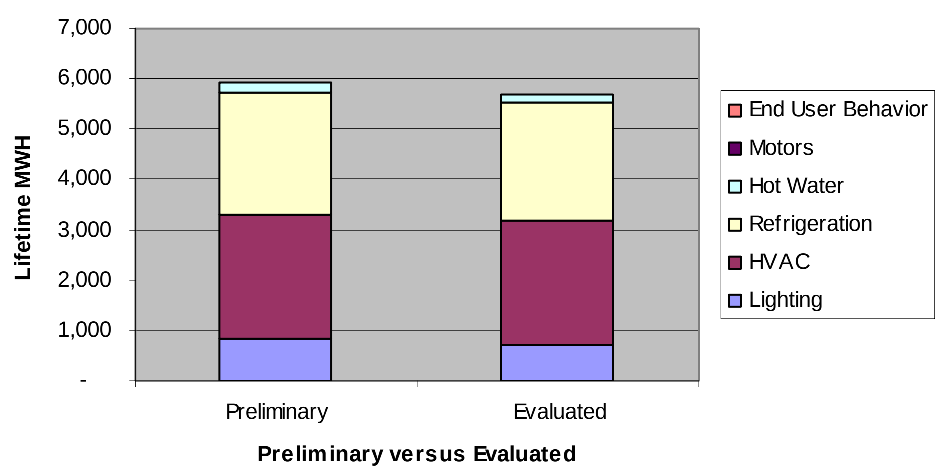
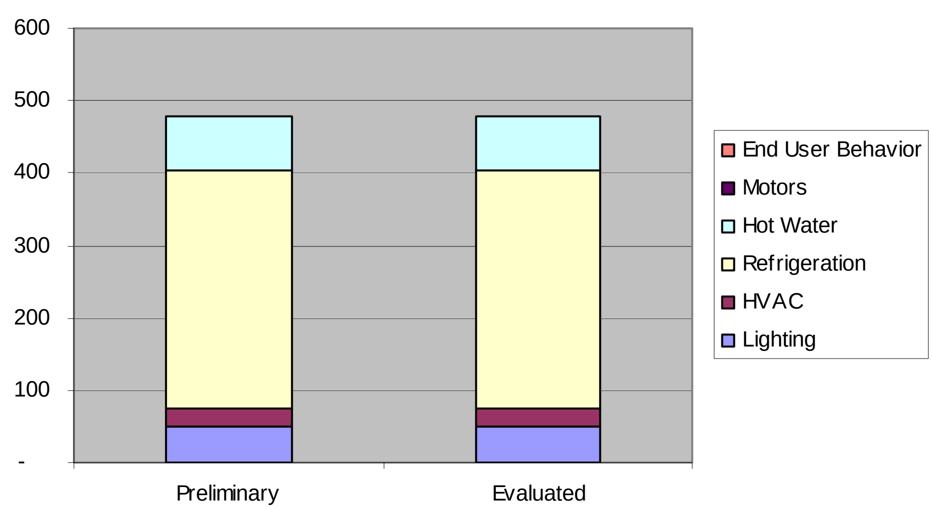
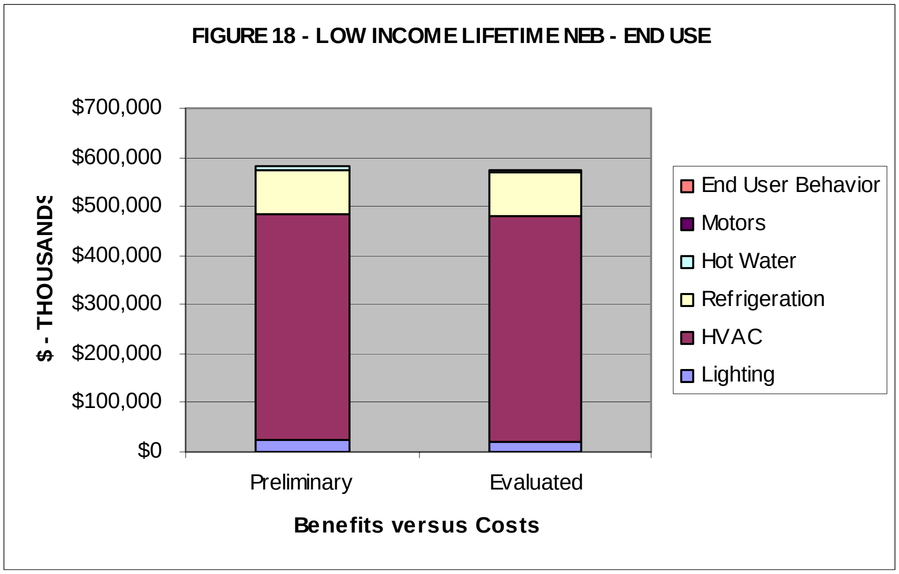


FIGURE 17 - LOW INCOME LIFETIME kW - END USE





3. Program Evaluation

The Compact conducted no new evaluation activities since the 2004 process evaluation of the low income 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.

TABLE 9
IMPACT BY C&I BCR ACTIVITIES

Benefit-Cost Ratio	Customers	Annual				Lifetime			Cost		Benefit-Cost
Activity		kWh	kWh per Customer	kW	$- NEB	MWH	kW	$- NEB	Activity	per Customer	TRC
C02a C&I Lost Opportunity	10	165,520	16,552	43.35	$108	3,246	688	$1,616	$154,035	$15,403	1.68
C03a Large C&I Retrofit	61	3,309,770	54,259	655.49	$2,087	47,006	4,416	$27,129	$554,703	$9,093	3.22
C03b Small C&I Retrofit	140	1,396,590	9,976	221.17	$17,444	20,275	2,924	$226,767	$1,095,866	$7,828	1.48
TOTAL	211	4,871,880	23,089	920.01	$19,638	70,527	8,028	$255,512	$1,804,604	$8,553	2.03

2. By End Uses

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.

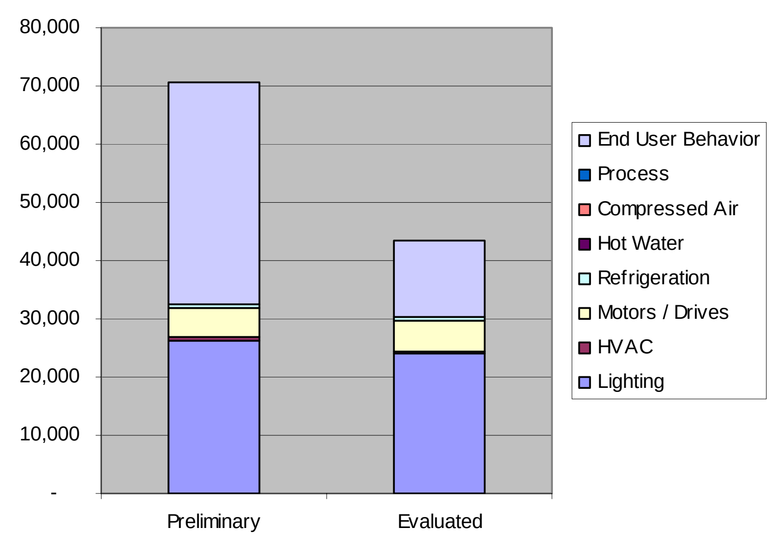
TABLE 10						
IMPACT BY C&I END USES						
End Use	Lifetime MWH		Lifetime kW		$ Lifetime NEB	
	Preliminary	Evaluated	Preliminary	Evaluated	Preliminary	Evaluated
Lighting	26,262	24,215	4,461	4,442	$284,025	$255,512
HVAC	594	301	109	53	$0	$0
Motors / Drives	4,919	5,037	804	821	$0	$0
Refrigeration	863	865	137	138	$0	$0
Hot Water	-	-	-	-	$0	$0
Compressed Air	NA	NA	NA	NA	NA	NA
Process	NA	NA	NA	NA	NA	NA
End User Behavior	37,888	12,996	7,503	2,574	$0	$0

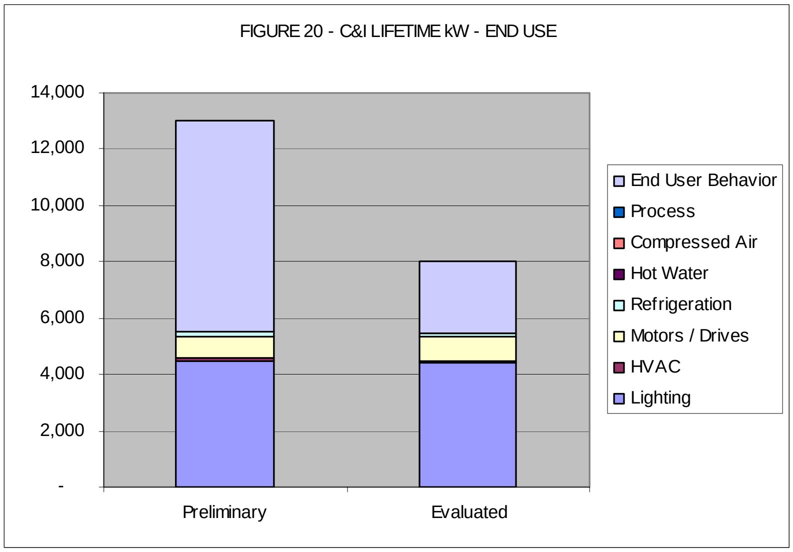
Figures 19 through 21 present the same information as Table 10. They indicate that the energy and capacity savings are obtained primarily from lighting measures and, to a lesser extent, from end user behavior measures.

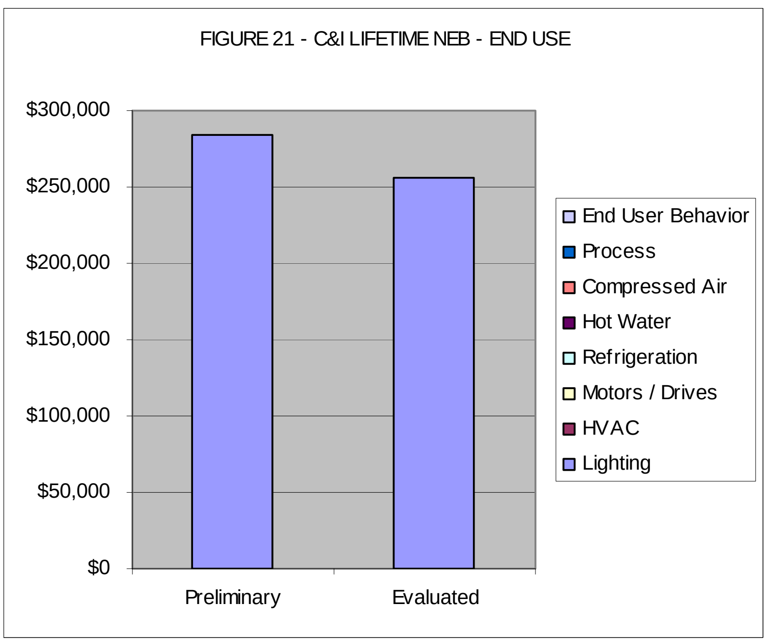
The savings in the end user behavior measure category are from the BOC Program. The large reduction in lifetime MWh savings for the BOC Program between preliminary and evaluated estimates is a result using a much shorter measure life provided by the 2005 BOC evaluation study.

The non-energy benefits in the C&I sector are from reduced O&M costs as a result of efficient light bulbs with longer operating lives.

FIGURE 19 – C&I LIFETIME MWH - END USE







3. Program Evaluation

Building Operator Certification Program

End User Behavior is addressed under the Building Operator Certification Program. Savings attributed to this program come from a combination of practices and measures implemented by facility managers as a result of training under this program. Impact estimates for this program were updated in 2005 (Appendix 6). The Compact reports energy impacts without rebated measures for the participants who have NOT participated in any other C&I program in the same year, and it reports energy impacts with rebated measures for the participants who have participated in an audit and/or installed measures during this program year.

Lighting (Commercial Lighting Initiative)

The Commercial Lighting Initiative, facilitated by NEEP, has as its goal the transformation of the market for high performance lighting. While the Compact and other Massachusetts program administrators promote Super T8 technology, the availability of new lighting fixtures equipped with this technology has lagged behind the availability of individual lamps and ballasts.

Late in 2005, a market research study was launched to determine the current status of market availability of Super T8 fixtures and to explore barriers to their availability. The goal of this research was to inform future program activities. Results of the study are based on telephone interviews with a random sample of 50 lighting distributors and manufacturers' representatives. Key findings include:

- Need to encourage manufacturers to stock Super T8s and to install them as part of their standard product runs;
- Need to increase awareness of Super T8s among distributors who are not active participants in efficiency programs;
- Need to focus on manufacturers' reps as key agents likely to "up-sell", since they typically provide design assistance, and they can benefit from increased profit margins on premium products (e.g. through circuit riding);
- Need to transition to exclusive promotion of Super T8 and away from incentives supporting standard T8s.

HVAC (Cool Choice)

The Cool Choice program, facilitated by NEEP, has as its goal the transformation of the market for high efficiency unitary HVAC equipment by promoting consistent standards and rebates among Massachusetts utilities and in the region.

Late in 2005, two market research studies were launched to inform the design and possible future direction of Cool Choice and sponsors' program activities.

A study to characterize regional and national experience with commercial rooftop HVAC unit retrofit programs was completed in March 2006. Findings are based on expert interviews, literature research and critical review of program materials. The design and performance of programs in the Northeast, California and Northwest were examined. The key findings were:

- Pilot efforts have shown possible energy savings of 1,800 kWh/unit treated; this is principally an energy resource, not a substantial demand resource;
- Benefits are based on a variety of measures including charge, airflow, controls and economizers;

- Need for additional impact evaluation results (most programs are in early stages);
- Northeast may benefit from early replacement program to achieve maximum demand savings potential from rooftop units.

Appendices

Appendix 1. Glossary of Terms and Abbreviations

Annual kWh Reduction	Expected net annual energy savings after all impact factors have been taken into consideration.
AMP	Appliance Management Program
BBRS	Board of Building Regulations and Standards
CAP	Community Action Program
CEE	Consortium for Energy Efficiency
CFL	Compact Fluorescent Lamps
Coincident Peak Demand	Demand for electricity at the time of the Company's peak demand.
Delta Watts	The difference in the wattage between pre-existing or baseline lighting equipment and energy efficient lighting equipment.
Demand	The amount of electric energy used by a customer or a piece of equipment at a specific time, expressed in kilowatts.
Demand Adjustment Factor	This factor is a combination of one or more evaluation impact parameters applied to gross demand savings in the calculation of net demand savings.
Diversity	That characteristic of a variety of electric loads whereby individual maximum demands usually occur at different times.
Diversity Factor	Percent of savings available at the time of the Company's peak demand.
DOE	Department of Energy
DOER	Massachusetts Division of Energy Resources
D&R	D&R International, the contractor to DOE and EPA that monitors sales of ENERGY STAR® appliances.
DSM	Demand Side Management
DTE	Massachusetts Department of Telecommunications and Energy
EFLH	Equivalent Full Load Hours
Energy Adjustment Factor	A factor made up of one or more evaluation impact parameters applied to gross kWh savings in the calculation of net kWh savings.
EPA	Environmental Protection Agency
EPACT	Energy Policy Act

ENERGY STAR®	Brand name for the voluntary energy efficiency labeling initiative sponsored by the U.S. Environmental Protection Agency and Department of Energy.
Free Riders	Customers who participate in an energy efficiency program but would have installed the same measure(s) on their own if the program had not been available.
Free-Ridership Rate	The percent of savings attributable to Free Riders.
Gross kW	Expected demand reduction based on a comparison of standard or replaced equipment, and equipment installed through an energy efficiency program.
Gross kWh	Expected kWh reduction based on a comparison of standard or replaced equipment, and equipment installed through an energy efficiency program.
GWh	Gigawatt-hour – a measure of electricity usage over time equal to 1,000 megawatt-hours or 1,000,000 kilowatt-hours.
Hours of Use	The estimated number of hours per year that a measure operates.
Hours of Use Realization Rate	Ratio of actual metered hours of use data to estimated hours of use data.
HP	Horsepower
HVAC	Heating Ventilation and Air Conditioning
Impact Factor	Generic term for persistence, realization rates, in-service rates, non-coincident connected demand factors, etc., developed during the evaluation of energy efficiency programs and used to calculate net savings.
JMC	The Joint Management Committee of utility and non-utility parties that manages the ENERGY STAR® Homes Program.
kWh	Kilowatt-hour – The basic unit of electric energy usage over time. One kWh is equal to one kW of power supplied to a circuit for a period of one hour.
kW	Kilowatt – A measure of electric demand – 1000 watts
kW – Years	See: Lifetime kW
Lifetime	The expected length of time, in years, that an installed measure will be in service and producing savings.
Lifetime kW	The expected demand savings over the lifetime of an installed measure, calculated by multiplying the annual peak kW reduction associated with a measure by the expected lifetime of that measure. It is expressed in units of kW-years.
Lifetime MWh	The expected energy savings over the lifetime of an installed measure, calculated by multiplying the annual MWh

	reduction associated with a measure by the expected lifetime of that measure.
LIHEAP	Low Income Heating Assistance Program
Maximum Annual kW Savings	Peak annual demand savings of a measure. At the program level, this equals the sum of the annual peak demand savings across all measures.
Measure	Specific technology or practice that produces energy and/or demand savings for which the company provides financial incentives.
MPER	Multi-Year Program Evaluation and Market Progress Reporting, or Market Progress and Evaluation Report, developed for various residential programs.
MW	Megawatt – a measure of electric demand equal to 1,000 kilowatts.
MWh	Megawatt-hour – a measure of energy use over time equal to 1,000 kilowatt-hours.
NATE	North American Technician Excellence Program
NEEP	Northeast Energy Efficiency Partnerships
O&M	Operation and Maintenance
Off-Peak energy kWh	The kWh reduction that occurs during the Company's off-peak hours for energy. (Monday-Friday 9 p.m. to 8 a.m. and all day of weekends and holidays)
On-Peak Energy kWh	The kWh reduction that occurs during the Company's on-peak hours for energy. (Monday-Friday 8 a.m. to 9 p.m., except holidays)
Persistence Rate	Percentage of first year energy or demand savings expected to persist over the life of the installed energy efficiency equipment; developed by conducting surveys of installed equipment several years after installation to determine presence and operational capability of the equipment.
RCS	Residential Conservation Services. Formerly Energy Conservation Services or ECS
Seasonal (Winter/Summer) kW	The net demand reduction during either the Winter or Summer seasons.
Spillover	Additional energy efficient equipment installed by customers that were influenced by the Company's sponsored program, but without direct financial or technical assistance from the program. Spillover is separated into Participant and Non-participant factors. Non-participating customers may be influenced by product availability, publicity, education, and other factors that are affected by the program.

Spillover Rate	Estimate of energy savings attributable to spillover effects expressed as a percent of savings installed by participants through an energy efficiency program.
VSD	Variable Speed Drive
WAP	Weatherization Assistance Program
Watt	The basic electrical unit of power.

Much of this glossary was taken from Massachusetts Electric and Nantucket Electric, 2003 Energy Efficiency Annual Report, submitted to the Massachusetts Department of Telecommunications and Energy, September 2004.

Appendix 2. 2005 Evaluation Impact Parameters

The table below presents the impact factors that were used to calculate the evaluated savings for the commercial and industrial programs in 2005.

As noted earlier, Commercial and Industrial free-ridership and spillover results were obtained from an evaluation jointly sponsored by the Compact and National Grid. The C&I Lost Opportunity program results shown below are from the National Grid sample, due to concerns about interpreting the results of the Compact. For the Compact's Government New Construction and Government Retrofit programs, no free-ridership or participant spillover is assumed, due to the design and delivery of the program in 2005.

Impact parameters for the C&I Large and Small Retrofit Programs are identical, because in the evaluation study Compact pooled the customers in the retrofit program in order to increase sample sizes. The nonparticipant spillover estimate reported below is based on a sample of vendors that combined National Grid and Cape Light Compact survey data, again, to increase the sample size to obtain a more meaningful result.

Table A2.1 Commercial & Industrial Evaluation Impact Factors

BCR Activity	Program	End Use	Free-Ridership Rate	Spillover [Participant] Rate	Spillover [Non-Participant] Rate	kWh Realization Rate
C02a C&I Lost Opportunity	C02a C&I New Construction	CMoDr	21.1%	17.7%	2.9%	100%
C02a C&I Lost Opportunity	C02a C&I New Construction	ALght	30.7%	6.2%	2.9%	100%
C02a C&I Lost Opportunity	C02a C&I New Construction	BHVAC	33.2%	8.8%	2.9%	100%
C02a C&I Lost Opportunity	C02b C&I Govt New Construction	ALght	0.0%	0.0%	2.9%	100%
C03a Large C&I Retrofit	C03a C&I Large Retrofit	ALght	5.7%	3.2%	2.9%	100%
C03b Small C&I Retrofit	C03b C&I Small Retrofit	ALght	6%	3.2%	2.9%	86.4%
C03b Small C&I Retrofit	C03b C&I Small Retrofit	DRefr	4.2%	0%	2.9%	100%
C03b Small C&I Retrofit	C03b C&I Small Retrofit	BHVAC	43.3%	0%	2.9%	100%
C03a Large C&I Retrofit	C03c C&I Govt Large	ALght	0.0%	3.2%	2.9%	100%
C03a Large C&I Retrofit	C03c C&I Govt Large	DRefr	0.0%	0%	2.9%	100%
C03a Large C&I Retrofit	C03c C&I Govt Large	BHVAC	0.0%	0%	2.9%	100%
C03a Large C&I Retrofit	C03c C&I Govt Large	EHoWa	0.0%	0%	2.9%	100%
C03a Large C&I Retrofit	C03c C&I Govt Large	CMoDr	0.0%	0%	2.9%	100%
C03a Large C&I Retrofit	C03c C&I Govt Large	HEUBe	0.0%	0%	2.9%	100%
C03b Small C&I Retrofit	C03d C&I Govt Small	ALght	0.0%	3.2%	2.9%	86.4%
C03b Small C&I Retrofit	C03d C&I Govt Small	DRefr	0.0%	0%	2.9%	100%
C03b Small C&I Retrofit	C03d C&I Govt Small	CMoDr	0.0%	0%	2.9%	100%
C03b Small C&I Retrofit	C03d C&I Govt Small	BHVAC	0.0%	0%	2.9%	100%
C02a C&I Lost Opportunity	C04c Cool Choice	DRefr	35.9%	17.7%	2.9%	100%
C02a C&I Lost Opportunity	C04c Cool Choice	BHVAC	67.5%	2.0%	2.9%	100%
C02a C&I Lost Opportunity	C04e MotorUp	CMoDr	8.3%	0%	2.9%	100%
C03a Large C&I Retrofit	C03c C&I Govt Large	HEUBe	0%	0%	2.9%	100%

Note: Shaded cells indicate impact factors that are neither 100% nor 0%.

The table below presents the impact factors that were used to calculated the evaluated savings for residential programs offered by the Cape Light Compact in 2005. Impact factors shown below for most programs represent the common assumptions developed by Massachusetts program administrators, based on a review of best available information on measures in statewide programs. The Compact's Residential Low Income impact factors were not evaluated or updated in 2005.

Table A2.2 Residential Evaluation Impact Factors

BCR Activity	Measure	Free-Ridership Rate	Spillover [Participant] Rate	In-Service Rate	kWh Realization Rate
A02a Residential Lost Opportunity	CFL	6%	25%	100%	100%
A02a Residential Lost Opportunity	HERS	0%	0%	100%	100%
A02b Residential HVAC	HVAC	0%	0%	100%	100%
A03a Residential Retrofit 1-4	AIRSEAL	2%	0%	100%	95%
A03a Residential Retrofit 1-4	BOILRWATER	0%	0%	100%	100%
A03a Residential Retrofit 1-4	CFL	1%	0%	100%	90%
A03a Residential Retrofit 1-4	FIXTUREIN	0%	0%	100%	100%
A03a Residential Retrofit 1-4	FIXTUREOUT	0%	0%	100%	100%
A03a Residential Retrofit 1-4	FURNACE	0%	0%	100%	100%
A03a Residential Retrofit 1-4	HOTWATER	5%	0%	100%	90%
A03a Residential Retrofit 1-4	HVAC	0%	0%	100%	100%
A03a Residential Retrofit 1-4	INDIRECTDH	0%	0%	100%	100%
A03a Residential Retrofit 1-4	INSULATION	2%	0%	100%	95%
A03a Residential Retrofit 1-4	REFRIG (ES value)	10%	36%	100%	98%
A03a Residential Retrofit 1-4	SWITCH	0%	0%	100%	100%
A03a Residential Retrofit 1-4	TORCHIERE	0%	0%	100%	100%
A03a Residential Retrofit 1-4	T-STAT	2%	0%	100%	95%
A04a Residential Lighting	CFL	6%	25%	84%	100%
A04a Residential Lighting	FIXTUREIN	8%	4%	95%	100%
A04a Residential Lighting	FIXTUREOUT	12%	7%	87%	100%
A04a Residential Lighting	TORCHIERE	6%	3%	83%	100%
A04b Residential Appliances	CLOTHESWAS	0%	0%	100%	100%
A04b Residential Appliances	DEHUMIDIFI	0%	0%	100%	100%
A04b Residential Appliances	DISHWASHER	0%	0%	100%	100%
A04b Residential Appliances	ECMHEAT	0%	0%	100%	100%
A04b Residential Appliances	REFRIG	0%	0%	100%	100%
A04b Residential Appliances	ROOMAC	0%	0%	100%	100%
B02a Low-Income Lost Opportunity	AIRSEAL	0%	0%	100%	100%
B02a Low-Income Lost Opportunity	CLOTHESWAS	0%	0%	100%	100%
B02a Low-Income Lost Opportunity	DISHWASHER	0%	0%	100%	100%
B02a Low-Income Lost Opportunity	FIXTURE	0%	0%	100%	100%
B02a Low-Income Lost Opportunity	HEATSYSTEM	0%	0%	100%	100%
B02a Low-Income Lost Opportunity	HOTWATER	0%	0%	100%	100%
B02a Low-Income Lost Opportunity	INSULATION	0%	0%	100%	100%
B02a Low-Income Lost Opportunity	REFRIG	0%	0%	100%	100%
B03a Low-Income Retrofit 1-4	AIRSEAL	0%	0%	100%	100%
B03a Low-Income Retrofit 1-4	CFL	0%	0%	100%	83%
B03a Low-Income Retrofit 1-4	DEHUMIDIFI	0%	0%	100%	100%
B03a Low-Income Retrofit 1-4	HEATSYSTEM	0%	0%	100%	100%
B03a Low-Income Retrofit 1-4	HOTWATER	0%	0%	100%	67%
B03a Low-Income Retrofit 1-4	INSULATION	0%	0%	100%	100%
B03a Low-Income Retrofit 1-4	REFRIG	0%	0%	100%	97%
B03b Low-Income Retrofit Multifami	AIRSEAL	0%	0%	100%	100%
B03b Low-Income Retrofit Multifami	FIXTURE	0%	0%	100%	100%
B03b Low-Income Retrofit Multifami	HEATSYSTEM	0%	0%	100%	100%
B02a Low-Income Lost Opportunity	CILARGE	0%	0%	100%	100%

Note: Shaded cells indicate impact factors that are neither 100% nor 0%.

Appendix 3. Detailed Savings Calculations of BCR Activities

Table A3.1a TRC Benefits and Costs by Program (Reported)

BCR Activity	TRC Benefit/ Cost	TRC Net Benefits	Total Benefits ($000)	Total Costs ($000)	PA Costs ($000)
Residential					
A02a Residential Lost Opportunity	1.04	$18	$429	$411	$411
A02b Residential HVAC	2.93	$321	$488	$167	$167
A03a Residential Retrofit 1-4	1.55	$716	$2,018	$1,302	$937
A04a Residential Lighting	5.10	$1,013	$1,260	$247	$247
A04b Residential Appliances	7.35	$2,707	$3,133	$426	$426
Subtotal: Residential	**2.87**	**$4,776**	**$7,328**	**$2,553**	**$2,188**
Low-Income					
B02a Low-Income Lost Opportunity	1.07	$16	$252	$235	$222
B03a Low-Income Retrofit 1-4	1.78	$227	$519	$292	$285
B03b Low-Income Retrofit Multifamily	1.41	$106	$366	$260	$196
Subtotal: Low-Income	**1.44**	**$349**	**$1,136**	**$788**	**$703**
Com/Ind					
C02a C&I Lost Opportunity	1.68	$104	$258	$154	$125
C03a Large C&I Retrofit	3.22	$1,234	$1,788	$555	$365
C03b Small C&I Retrofit	1.48	$524	$1,620	$1,096	$932
Subtotal: C&I	**2.03**	**$1,862**	**$3,666**	**$1,805**	**$1,422**
Grand Total	**2.36**	**$6,986**	**$12,131**	**$5,145**	**$4,314**

Table A3.1b TRC Benefits and Costs by Program -- From the 2005 EEP (Planned)

	BCR	Net Benefits	Benefits	Costs
Low-Income Programs				
LI Single Family	2.04	1,193,202	2,341,858	1,148,655
LI Multi-Family	3.34	1,217,519	1,737,440	519,921
LI New Construction	2.26	629,128	1,129,081	499,953
Total Low-Income	2.40	3,039,850	5,208,380	2,168,530
Residential Programs				
New Construction	1.55	480,917	1,353,580	872,663
P&S - Lighting	5.86	4,955,979	5,974,973	1,018,994
P&S - Appliances	4.85	8,088,520	10,189,471	2,100,951
P&S - HVAC	3.37	1,714,287	2,436,435	722,148
MassSAVE	1.80	4,123,814	9,297,937	5,174,123
Total Non Low-Income	2.96	19,363,517	29,252,396	9,888,879
Total Residential	2.86	22,403,367	34,460,775	12,057,409
C&I Programs				
Large New Construction	2.83	401,700	621,447	219,747
Large Retrofit	1.86	344,043	742,892	398,849
Small Customers	2.22	2,470,493	4,500,866	2,030,373
Government - Large	1.90	1,220,114	2,581,253	1,361,139
Government - Small	2.18	2,406,007	4,447,715	2,041,709
Products and Services	****	****	****	****
Total Commercial & Industrial	2.13	6,842,356	12,894,173	6,051,817
Total Compact	**2.61**	**29,245,723**	**47,354,949**	**18,109,226**

Table A3.2a Costs by BCR Activity and Program (Reported)

Sector	BCR Activity	Program	Total TRC Costs ($000)	Total PA Costs ($000)	Program Implementation ($000)	Participant ($000)	Evaluation ($000)
A - Residential			**$2,553**	**$2,188**	**$2,098**	**$365**	**$90**
	A02a Residential Lost Opportunity		$411	$411	$385	$0	$26
		A02a Energy Star Homes	$411	$411	$385	$0	$26
	A02b Residential HVAC		$167	$167	$162	$0	$5
		A02b Residential HVAC	$167	$167	$162	$0	$5
	A03a Residential Retrofit 1-4		$1,302	$937	$911	$365	$26
		A03a Residential Conservation Service	$1,302	$937	$911	$365	$26
	A04a Residential Lighting		$247	$247	$233	$0	$14
		A04a Energy Star Lighting	$247	$247	$233	$0	$14
	A04b Residential Appliances		$426	$426	$408	$0	$19
		A04b Energy Star Appliance	$426	$426	$408	$0	$19
B - Low-Income			**$788**	**$703**	**$703**	**$84**	**$1**
	B03a Low-Income Retrofit 1-4		$292	$285	$284	$7	$0
		B03a Low-Income Single-Family Program	$292	$285	$284	$7	$0
	B03b Low-Income Retrofit Multifamily		$260	$196	$196	$64	$0
		B03b Low-Income Multi-Family Program	$260	$196	$196	$64	$0
	B02a Low-Income Lost Opportunity		$235	$222	$222	$13	$0
		B02a Low-Income Energy Star Homes	$128	$115	$114	$13	$0
		B03c Low-Income Special Projects Progra	$108	$108	$108	$0	$0
C - Commercial & Industrial			**$1,805**	**$1,422**	**$1,397**	**$383**	**$25**
	C02a C&I Lost Opportunity		$154	$125	$123	$29	$2
		C02a C&I New Construction	$52	$52	$52	$0	$1
		C02b C&I Govt New Construction	$21	$21	$20	$0	$0
		C04c Cool Choice	$71	$42	$41	$29	$1
		C04e MotorUp	$10	$10	$10	$0	$0
	C03b Small C&I Retrofit		$1,096	$932	$916	$164	$17
		C03b C&I Small Retrofit	$648	$485	$476	$164	$9
		C03d C&I Govt Small	$448	$448	$440	$0	$8
	C03a Large C&I Retrofit		$555	$365	$358	$190	$6
		C03a C&I Large Retrofit	$197	$118	$116	$79	$2
		C03c C&I Govt Large	$357	$246	$242	$111	$4
Grand Total			**$5,145**	**$4,314**	**$4,198**	**$831**	**$116**

Program Implementation costs include: PP&A, marketing and education, customer incentives, and sales, technical assistance and training.

Table A3.2b Costs by BCR Activity and Program – From the 2005 EEP (Planned)

Sector	BCR activity	Program	Total TRC Costs ($000)	Total PA Costs ($000)	Program Implementation ($000)	Participant ($000)	Evaluation ($000)
A - Residential	A02a Residential Lost Opportunity	A02a New Construction	326	243	218	83	25
	A02b Residential HVAC	A02b P&S HVAC	412	134	123	278	12
	A03a Residential Retrofit 1-4	A03a MassSAVE	3,068	851	815	2,217	36
	A04a Residential Lighting	A04a P&S - Lighting	300	300	273		27
	A04b Residential Appliances	A04b P&S - Appliances	383	383	354		30
A - Residential Total			4,489	1,912	1,783	2,578	129
B - Low Income	B02a Residential Lost Opportunity L I	B02a LI New Construction	150	150	148	0	2
		B02b LI Special Projects	117	117	115	0	2
	B03a Low Income Retrofit 1-4	B03a LI Single Family	243	243	240	0	3
	B03b Low-Income Retrofit Multifamily	B03b LI Multi-Family	124	124	122	0	2
B - Low Income Total			634	634	625	0	9
C - Commercial & Industrial	C02a C&I Lost Opportunity	C02a Large New Construction	120	44	43	77	1
	C03a Large C&I Retrofit	C03a Large Retrofit	79	44	43	35	1
		C03e Products and Services	49	49	35	0	15
	C03b Small C&I Retrofit	C03b Small Customers	887	503	476	383	28
		C03d Government Agencies	1,040	1,040	977	0	63
C - Commercial & Industrial Total			2,176	1,680	1,574	496	107
Grand Total			7,299	4,226	3,982	3,073	244

Table A3.3a Benefits by BCR Activity (Reported)

BCR Activity		Total Benefits	Capacity: Generation Summer	Capacity: Generation Winter	Capacity: Trans	Capacity: MDC	Energy: Winter Peak	Energy: Winter Off Peak	Energy: Summer Peak	Energy: Summer Off Peak	Non Electric: Resource	Non Electric: Non-Resource
		Data										
Sector	BCR Activity	Total Ben	SumCapVal	WinCapVal	TransVal	DistVal	WinPkVal	WinOffVal	SumPkVal	SumOffVal	ResVal	NonResVal
Residential		$7,328,268	$490,896	$255,555	$461,406	$1,142,246	$1,307,137	$640,664	$603,615	$326,298	$1,450,634	$649,816
	A02a Residential Lost Opportunity	$429,299	$55,743	$21,845	$49,480	$122,492	$77,112	$34,205	$36,433	$16,790	$15,199	$0
	A02b Residential HVAC	$487,874	$79,416	$49,108	$69,212	$171,340	$35,184	$26,154	$35,562	$21,899	$0	$0
	A03a Residential Retrofit 1-4	$2,017,535	$120,474	$71,027	$116,093	$287,397	$723,221	$272,389	$259,783	$119,665	$49,051	-$1,568
	A04a Residential Lighting	$1,260,335	$44,288	$49,291	$50,009	$123,801	$326,903	$237,584	$170,340	$115,566	$0	$142,555
	A04b Residential Appliances	$3,133,225	$190,976	$64,285	$176,612	$437,216	$144,717	$70,332	$101,497	$52,378	$1,386,384	$508,829
Low-Income		$1,136,467	$38,528	$15,573	$35,619	$88,178	$145,685	$67,882	$82,305	$41,198	$72,191	$549,308
	B03a Low-Income Retrofit 1-4	$518,599	$21,275	$9,237	$19,238	$47,624	$68,722	$34,152	$43,144	$26,943	$56,217	$192,048
	B03b Low-Income Retrofit Multifamily	$366,213	$338	$2,749	$294	$728	$48,400	$13,496	$1,012	$666	$0	$298,530
	B02a Low-Income Lost Opportunity	$251,655	$16,916	$3,588	$16,087	$39,826	$28,563	$20,234	$38,149	$13,588	$15,975	$58,729
Com/Ind		$3,666,479	$331,283	$70,752	$330,094	$817,173	$754,277	$387,346	$533,420	$186,621	$0	$255,512
	C02a C&I Lost Opportunity	$258,382	$32,649	$6,459	$29,313	$72,565	$31,278	$22,563	$46,278	$15,661	$0	$1,616
	C03a Large C&I Retrofit	$1,788,464	$165,104	$30,472	$176,443	$436,797	$427,543	$141,665	$298,944	$84,368	$0	$27,129
	C03b Small C&I Retrofit	$1,619,633	$133,531	$33,822	$124,339	$307,810	$295,456	$223,118	$188,198	$86,592	$0	$226,767
Grand Total		**$12,131,214**	**$860,708**	**$341,881**	**$827,119**	**$2,047,597**	**$2,207,100**	**$1,095,892**	**$1,219,340**	**$554,117**	**$1,522,825**	**$1,454,636**

BCR Activity		Load Reduction				MWh Saved	
		Annual	Summer	Winter	Lifetime	Annual	Lifetime
Sector	BCR Activity	Ann kW	Sum kW	Win kW	Life kW	Ann MWh	Lifet MWh
Residential		5,201	890	1,970	10,956	6,799	67,686
	A02a Residential Lost Opportunity	332	67	125	1,168	329	3,791
	A02b Residential HVAC	189	81	189	1,629	138	2,761
	A03a Residential Retrofit 1-4	1,288	241	479	2,755	2,512	31,742
	A04a Residential Lighting	2,784	195	816	1,255	3,252	20,949
	A04b Residential Appliances	609	306	361	4,150	568	8,443
Low-Income		221	61	102	839	596	7,802
	B03a Low-Income Retrofit 1-4	130	30	55	453	272	4,037
	B03b Low-Income Retrofit Multifamily	48	0	23	7	139	1,407
	B02a Low-Income Lost Opportunity	44	31	24	379	185	2,358
Com/Ind		1,185	920	697	8,028	4,872	43,414
	C02a C&I Lost Opportunity	57	43	32	688	165	2,618
	C03a Large C&I Retrofit	771	655	455	4,416	3,310	22,297
	C03b Small C&I Retrofit	357	221	210	2,924	1,397	18,499
Grand Total		**6,608**	**1,871**	**2,769**	**19,823**	**12,267**	**118,901**

Table A3.3b Benefits by BCR Activity – From the 2005 EEP (Planned)

	Capacity				Energy				Energy & Capacity	Total Energy
	Generation				Winter		Summer			
	Summer	Winter	Trans	MDC	Peak	Off Peak	Peak	Off Peak		
Low-Income Programs										
LI Single Family	101,825	66,669	96,385	238,607	361,747	146,067	123,893	75,187	1,210,380	706,894
LI Multi-Family	85,693	36,535	81,067	200,688	124,645	79,700	101,282	60,798	770,409	366,425
LI New Construction	12,604	6,943	12,633	31,274	16,061	9,896	8,759	5,088	103,260	39,805
Total Low-Income	200,122	110,148	190,085	470,570	502,454	235,664	233,934	141,073	2,084,049	1,113,125
Residential Programs										
New Construction	88,352	49,074	82,493	204,218	82,349	42,633	42,902	21,023	613,044	188,907
P&S - Lighting	631,681	399,181	687,355	1,701,601	787,904	569,277	410,821	277,750	5,465,570	2,045,752
P&S - Appliances	957,436	50,874	906,967	2,245,268	293,456	345,883	480,529	265,582	5,545,995	1,385,450
P&S - HVAC	470,414	21,504	421,560	1,043,605	180,940	46,717	193,312	58,383	2,436,435	479,352
MassSAVE	529,081	330,926	487,503	1,206,852	1,097,202	537,374	504,516	268,213	4,961,666	2,407,304
Total Non Low-Income	2,676,964	851,559	2,585,879	6,401,544	2,441,850	1,541,883	1,632,080	890,951	19,022,709	6,506,764
Total Residential	2,877,086	961,706	2,775,964	6,872,114	2,944,303	1,777,547	1,866,014	1,032,025	21,106,759	7,619,889
C&I Programs										
Large New Construction	78,717	15,628	69,896	173,032	69,567	53,824	110,210	37,658	608,532	271,260
Large Retrofit	68,680	16,319	64,934	160,748	165,602	95,574	110,026	41,841	723,724	413,044
Small Customers	369,549	104,601	335,029	829,390	893,506	672,565	569,577	261,348	4,035,564	2,396,996
Government - Large	255,657	47,185	231,775	573,778	557,987	181,147	393,747	109,196	2,350,471	1,242,076
Government - Small	338,543	95,825	306,920	759,803	818,540	616,137	521,789	239,421	3,696,977	2,195,886
Products and Services	***	***	***	***	***	***	***	***	***	***
Total Commercial & Industrial	1,111,145	279,557	1,008,553	2,496,751	2,505,201	1,619,247	1,705,350	689,464	11,415,269	6,519,262
Total Compact	**3,988,231**	**1,241,264**	**3,784,517**	**9,368,866**	**5,449,505**	**3,396,794**	**3,571,363**	**1,721,489**	**32,522,027**	**14,139,150**

	Annual		Lifetime		Annual			Lifetime		
	Energy (MWH)	Capacity (kW)	Energy (MWH)	Capacity (kW)	Electricity MMBtu	Natural Gas MMBtu	Oil MMBtu	Electricity MMBtu	Natural Gas MMBtu	Oil MMBtu
Low-Income Programs										
LI Single Family	373	68	5,754	785	1,274	-306	505	19,634	-5,500	10,596
LI Multi-Family	233	57	2,985	662	794	95	77	10,185	2,378	1,924
LI New Construction	34	11	319	102	116	544	15	1,087	13,600	379
Total Low-Income	802	190	10,395	1,990	2,737	333	597	35,466	10,478	12,899
Residential Programs										
New Construction	140	54	1,513	681	479	1,239	35	5,163	30,964	864
P&S - Lighting	2,488	835	16,130	5,461	8,488	0	0	55,036	0	0
P&S - Appliances	893	689	11,342	7,334	3,048	1,703	801	38,701	23,840	11,217
P&S - HVAC	248	230	3,727	3,455	848	0	0	12,715	0	0
MassSAVE	1,451	302	19,535	4,013	4,952	5,972	6,370	66,653	112,701	120,380
Total Non Low-Income	5,221	2,110	52,247	20,944	17,815	8,914	7,206	178,268	167,505	132,461
Total Residential	6,023	2,300	62,642	22,933	20,552	9,247	7,803	213,734	177,983	145,360
C&I Programs										
Large New Construction	136	36	2,177	575	464	0	0	7,428	0	0
Large Retrofit	294	46	3,284	525	1,003	0	0	11,206	0	0
Small Customers	1,398	195	20,270	2,832	4,770	0	0	69,162	0	0
Government - Large	694	135	9,716	1,892	2,368	0	0	33,150	0	0
Government - Small	1,281	179	18,570	2,595	4,370	0	0	63,359	0	0
Products and Services	***	***	***	***						
Total Commercial & Industrial	3,803	591	54,017	8,419	12,975	0	0	184,305	0	0
Total Compact	9,826	2,891	116,659	31,352	33,527	9,247	7,803	398,039	177,983	145,360

Table A3.4 Outsourced and In-House Expenditures (Reported)

Sector	Outsourced	A001 Program Planning and Administration	A002 Marketing Advertising	A003 Customer Incentive	A004 Sales, Technical Assistance, Training	A005 Evaluation & Market Research	A006 Participant Cost	Total Compact	Percentage Outsourced	Percentage Competitively Bid	Total $ Competitively Bid
A - Residential	No	117,724	15,218	0	66,551	8,987	0	208,480	---	---	---
	Yes	117,724	35,509	1,146,503	598,956	80,884	364,695	1,979,576	---	---	---
A - Residential Total		235,448	50,727	1,146,503	665,507	89,871	364,695	2,188,056	90%	10%	1,979,576
B - Low Income	No	48,057	4,954	0	14,115	96	0	67,222	---	---	---
	Yes	48,057	11,560	448,766	127,031	861	84,146	636,275	---	---	---
B - Low Income Total		96,114	16,515	448,766	141,145	957	84,146	703,497	90%	10%	636,275
C - Commercial & Industrial	No	78,370	10,131	0	15,357	2,526	0	106,385	---	---	---
	Yes	78,370	23,639	1,052,702	138,217	22,735	382,556	1,315,663	---	---	---
C - Commercial & Industrial Total		156,741	33,770	1,052,702	153,574	25,261	382,556	1,422,048	93%	7%	1,315,663
Grand Total		488,303	101,012	2,647,971	960,226	116,089	831,397	4,313,601	91%	9%	3,931,514

Appendix 4. Post Program Savings Attributed to Selected 2005 Market Transformation Initiatives

The Compact has not developed estimates of post program savings associated with market transformation initiatives. It is our understanding that this issue has not been considered a high priority for DOER or other Program Administrators. To the extent that such savings exist, the actual savings and benefits of the 2005 activities will be greater than those reported here.

Appendix 5. Calculation of Shareholder Incentive

The Cape Light Compact does not require shareholder incentives to implement its energy efficiency programs. Therefore, this section is not relevant to the Compact.

Appendix 6. Summary of 2005 Energy Efficiency Evaluation Reports

The following studies were used in preparing the evaluated results presented in this Annual Report. The executive summaries of these reports are attached below. The full copies of these reports are available from the Compact upon request.

- *Measure Life Study*, by energy & resource solutions, prepared for the Massachusetts Joint Utilities, October 10, 2005.
- *Impact and Process Evaluation Building Operator Certification (BOC) Program*, by RLW Analytics, prepared for Northeast Energy Efficiency Partnerships, June 2005.
- *Free-ridership and Spillover Study*, by PA Consulting, prepared for the Cape Light Compact in conjunction with National Grid and United Illuminating, June 2006.
- *Phase 1: Commercial Rooftop HVAC Unit Retrofit Programs*, by New Buildings Institute, Inc., prepared for Northeast Energy Efficiency Partnerships, March 2006.
- *Market Research Report on NEEP Commercial Lighting Initiative*, by energy & resource solutions, prepared for Northeast Energy Efficiency Partnership, June 2006.
- *Massachusetts ENERGY STAR Homes: 2005 Baseline Study, Final Report*, by Nexus Market Research, Inc. and Dorothy Conant, prepared for the Joint Management Committee, May 2006.
- *Analysis of Remaining Opportunities for the Massachusetts ENERGY STAR Appliances Program*, by NMR, RLW Analytics, Inc., Dorothy Conant and Shel Feldman Management Consulting, prepared for Cape Light Compact, National Grid USA, NSTAR Electric Company, Unitil, and Western Massachusetts Electric Company, October 2005.
- *Evaluation of the MassSAVE Program: Market Survey Results*, by RLW Analytics, prepared for , December 2005.
- *Kingman Yacht Center*, *Energy Audit Report*, by RLW Analytics, prepared for the Cape Light Compact, January 2006.
- *Evaluation of the Cape Light Compact Residential New Construction Green Building 2003 Demonstration Project*, by Vermont Energy Investment Corporation, prepared for the Cape Light Compact, March 2006.

In addition, some program evaluation studies are currently in development. Final reports for the following studies are expected in summer 2006.

- *Market Progress and Evaluation Report (MPER) for the 2005 Massachusetts ENERGY STAR Residential Lighting Program,* by Nexus Market Research, prepared for Cape Light Compact, National Grid USA, NSTAR Electric Company, Unitil, and Western Massachusetts Electric Company, Summer 2006.

- *Commercial HVAC Equipment Market Characterization*, by KEMA Consulting, prepared for the Northeast Energy Efficiency Partnerships, Summer 2006.

Measure Life Study executive summary

1

1.1 INTRODUCTION

The Massachusetts electric utilities (Massachusetts Electric, NSTAR, Western Massachusetts Electric and Unitil) and the Cape Light Compact (collectively referred to as "the sponsors" or MA utilities) contracted Energy and Resource Solutions, Inc. (ERS) to conduct a Common Measure Life Study. The primary goals of the Common Measure Life Study were as follows:

- Define measure life and related terms, such as persistence
- Review the provided table of current measure lives
- Survey other utility energy efficiency programs
- Develop a table of technological measure lives
- Recommend common measure lives and persistence assumptions to be used by the sponsors.

Each of the sponsors offers a number of energy efficiency measures to their commercial and industrial (C&I) customers through the C&I New Construction, C&I Retrofit and Small Business Retrofit programs. Each program has prescriptive and custom measures. Many of the measures offered to customers are common among the sponsors. However, methodologies to estimate the expected lifetime savings of an individual measure sometimes vary for a specific measure. The measure lives sometimes differ as do use and/or magnitude of other factors such as persistence and realization.

The number of individual measures across all programs is large. Thus, the sponsors provided a simplified table that groups individual measure lives by end use within each program. The sponsors also provided a table of agreed upon measure lives with referenced sources.

Section 1 of this report, the Executive Summary, provides an introduction to the project and summary of completed tasks.

Section 2, Measure Life Definition, details the final definition for measure life, persistence and realization, and the supporting research.

Section 3, Measure Life Review, presents the current table of measure lives, discussion of New Construction versus Retrofit measures, Small versus Large measures, research results from the CALMAC database, a summary of results from surveying national utilities and a table of technical measure lives.

Section 4, Recommended Measure Lives, presents our final recommendations, conclusions and justifications for each recommendation.

1.2 MEASURE LIFE DEFINITION

As stated above, a primary goal of the Common Measure Life Study was to define uniform measure life and related terms, such as persistence and realization. The sponsors and ERS reached consensus on a measure life definition via telephone, email correspondence, conference calls and a draft report presentation and discussion. In proposing a definition, we first researched the pertinent uses of measure life with the utility representatives. Measure life is used for the three purposes listed below:

1) Measure screening tools
2) Program savings forecasting for Energy Efficiency Plans
3) Program reporting Massachusetts Annual Reporting Spreadsheet (MARS) database

In each case, we discussed the use of measure life, and its relation to Persistence and Realization with the sponsors. Originally, all parties agreed to define measure life as technical life, and to incorporate all persistence factors as Persistence. However, following a conference call, and in assembly of the draft report, we concluded that separate technical lives and measure persistence factors were very difficult to ascertain accurately, and refinement of these values in the future would be extremely difficult. Thus, we have slightly altered the definition of measure life to include *measure* persistence, while defining Persistence as solely *savings* persistence. The resulting definitions are as follows:

Measure Life: 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 (see definition below).

- Equipment life is the number of years installed equipment will operate until failure.
- Measure persistence takes into account business turnover, early retirement of the installed equipment, and any other reason the measure would be removed or discontinued.

In addition, this definition conforms in letter or in spirit with the definition of measure life used by most national utilities.

Persistence: 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. In cases where short-term savings have been measured (Realization), savings persistence would be relative to this.

Realization: The realization factor accounts for the short term measured savings of a project relative to the original estimation of savings projected during the screening process.

In researching these definitions, we analyzed the MARS database to understand how each of these factors is used. In addition, we reviewed how other organizations use measure life. Further details of this effort are presented in Section 2.

1.3 MEASURE LIFE REVIEW & RESEARCH

ERS reviewed the tables of agreed upon and disputed measure lives provided by the sponsoring utilities. As tasked in our proposal, we researched several sources to use in support of selecting individual measure lives. We first thoroughly researched the CALMAC database. The CALMAC database provides a public depository for all persistence, technical degradation factor and other related studies performed in the state of California. Next, we surveyed many electric utilities and state utility commissions throughout the nation, obtaining other utilities' tables of measure lives. We obtained measure life tables used in 8 states by at least 14 different utilities. Finally, we performed a literature search, referenced technical sources and consulted equipment manufacturers to establish a table of technical lives for each measure. In conjunction with these efforts, we specifically researched the affect of New Construction versus Retrofit status on measure lives, as well as the affect of Small versus Large businesses. Further details are provided in Section 3.

1.4 RECOMMENDED MEASURE LIVES

Using the established definition of measure life and the research results presented in Section 3, we developed recommendations for measure life for each measure for each program. In our decision making process, we evaluated the MA utilities measure lives, the mean national measure life, technical lives and input from the sponsors. Through this process we found that sometimes equipment life is the most important factor in determining measure life, while in other cases measure persistence factors such as the proper use of the equipment is much more important than the equipment lifetime. ERS judged each of the measure life cases individually to determine a common measure life and documented each decision in Section 4.

Several broad conclusions were reached concerning measure lives. ERS concluded that retrofit projects should have slightly shorter measure lives than new construction projects. This conclusion was reached based on a discussion of qualitative factors with the sponsors. ERS also concluded that small businesses should have the same measure lives as large businesses. Again, this conclusion was reached based on a discussion of qualitative factors with the sponsors. Finally, all measure lives were capped at 15 years to reflect uncertainty in measure persistence, with the exception of building shell measures. The 15-year cap was suggested by ERS in discussion with the sponsors, and received no objection.

Table 1-1 presents the final recommendations for prescriptive common measure lives. Table 1-2 presents the final recommendations for custom common measure lives. Further details are found in Section 4.

Table 1-1

Prescriptive Common Measure Life Recommendations

Category	Measure	Common Measure Life (Years) Small Bus. Retrofit	Large C&I Retrofit	Large C&I New Const.
Lighting				
	Fluorescent	13	13	15
	Hardwired CFL	13	13	15
	LED Exit Signs	13	13	15
	Double Face Exit Signs	13	NA	NA
	HID	13	13	15
Lighting Controls				
	Occupancy Sensors	9	9	10
	Daylight Dimming	NA	9	10
HVAC				
	Packaged AC/HP	NA	NA	15
	Chillers	NA	NA	15
	Enthalpy Economizer	NA	NA	15
HVAC Controls				
	Programmable Thermostat	13	NA	NA
	EMS	NA	13	15
Motors				
	Motors	13	13	15
VFDs				
	on HVAC Fans	13	13	15
	on non-HVAC Fans	13	13	15
	on CT/Chilled Water Discharge Pump	13	13	NA
Refrigeration				
	Fan Control	12	NA	NA
	Door Heater Control	12	NA	NA
	Cooler Shut Off	12	NA	NA
	Vending	NA	10	NA
	Vending (non-refrig)	NA	10	NA
Compressed Air				
	15-75 HP Efficient Compressor	NA	13	15
	Dryer	NA	NA	15

Table 1-2

Custom Common Measure Life Recommendations

		Common Measure Life (Years)		
		Small Bus.	C&I	C&I
Category	**Measure**	**Retrofit**	**Retrofit**	**New Const.**
Lighting				
	Custom Lighting Measures	13	NA	NA
	Lighting Systems	13	NA	15
Lighting Controls				
	Lighting Controls	NA	10	10
	Occupancy Sensors	NA	NA	10
HVAC				
	HVAC Equipment of Systems	NA	13	15
HVAC Controls				
	EMS & HVAC Controls	NA	13	15
Motors				
	Motors	NA	13	15
VFDs				
	Drives on HVAC Systems	NA	13	15
	Drives on non-HVAC Systems	NA	13	15
Refrigeration				
	Industrial Refrigeration	NA	13	15
	Process Cooling	NA	13	15
	Refrigeration	NA	12	12
Compressed Air				
	Compressed Air	NA	13	15
Other				
	Custom Non-Lighting Measures	13	NA	NA
	O&M Projects	NA	5	NA
	Process Equipment or Systems	NA	7	7
	Building Shell	NA	NA	20
	Other	NA	NA	12
	Comprehensive Design Project	NA	NA	15
	Comprehensive Chiller Project	NA	NA	15

BOC • Building Operator Certification

2005 Impact and Process Evaluation

Northeast Energy Efficiency Partnerships

Building Operator Certification (BOC) is a nationally recognized training program designed to educate facilities personnel in the energy and resource efficient operation and maintenance of building systems. In 2005 NEEP served as project administer for an evaluation of the BOC program as delivered in 2002-2003. The evaluation was completed by RLW Analytics in July 2005 and was sponsored by: Efficiency Maine, Cape Light Compact, Unitil, National Grid, NSTAR, Northeast Utilities, United Illuminating, NYSERDA, Long Island Power Authority, and utilities in New Jersey represented by South Jersey Gas Company and consultants to the New Jersey Board of Public Utilities.[1]

Study Objectives:

- Estimate energy savings and identify non-energy benefits of BOC coursework.
- Assess persistence of savings from program-induced savings from 2000/2001 participants.
- Estimate costs associated with O&M activities by enrollees.
- Examine process-related issues, including barriers and marketing approaches.
- Assess perceived value of BOC course among participants.
- Update performance indicators.

Overall Energy Savings

Savings data is per enrollee per square foot (avg facility = 616,045 sq ft/enrollee)

	Electricity (kWH)	Oil (MMBTU)	Gas (MMBTU)	Water (Gallons)
With Rebates	**0.35**	**0.40**	**0.34**	**0.14**
Without Rebates	**0.18**	**0.40**	**0.31**	**0.14**

School Facility Energy Savings

Savings data is per enrollee per square foot (avg facility = 662,862 sq ft/enrollee)

	Electricity (kWH)	Oil (MMBTU)	Gas (MMBTU)	Water (Gallons)
With Rebates	**0.26**	**0.77**	**0.41**	**0**
Without Rebates	**0.15**	**0.77**	**0.35**	**0**

Non-School Facility Energy Savings

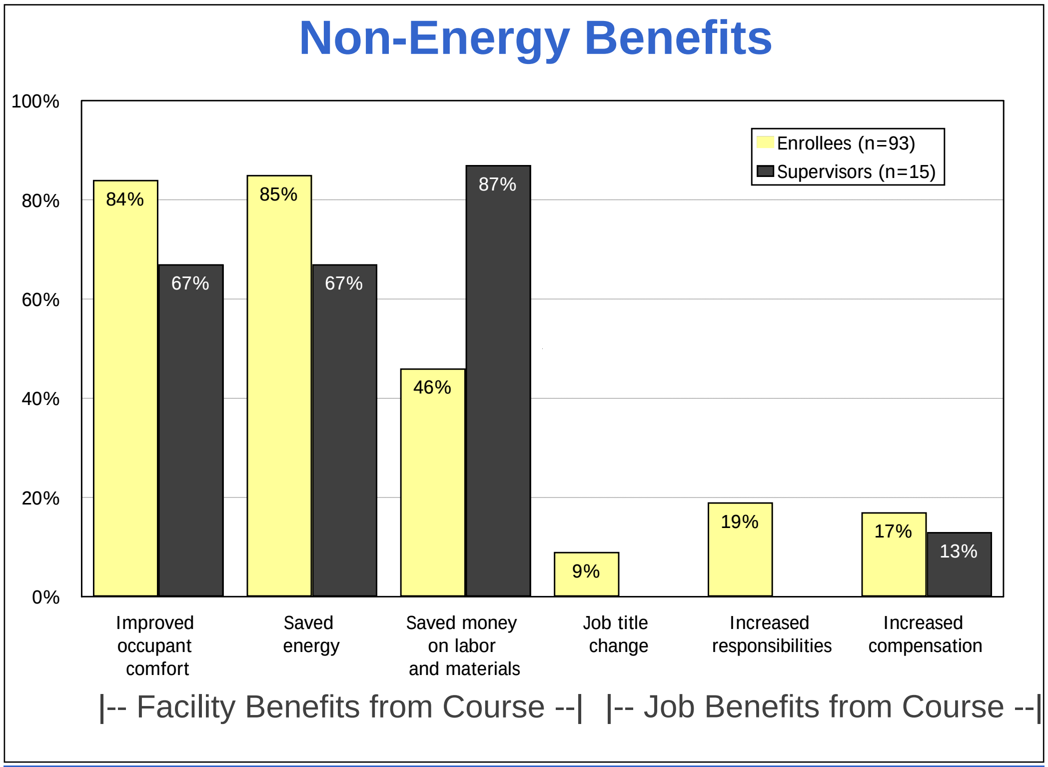
Savings data is per enrollee per square foot (avg facility = 854,360 sq ft/enrollee)

	Electricity (kWH)	Oil (MMBTU)	Gas (MMBTU)	Water (Gallons)
With Rebates	**0.40**	**0.14**	**0.29**	**0.24**
Without Rebates	**0.20**	**0.13**	**0.28**	**0.24**

Persistence of Savings: The evaluation indicates that all of the water savings, over 114% of the electricity savings, and almost 109% of the gas savings estimated in the 2002 evaluation of the BOC program are continuing today due to the program's influence. This shows that funding towards the BOC program is an investment towards continued energy savings.

---

[1] Efficiency Vermont, Keyspan Energy Delivery (MA), and PSNH were involved in the BOC Program during the time period evaluated but did not participate in the evaluation.



Survey of Program Value:

- 45% of non-participants think certification is important or very important.
- 80% of enrollees and forty percent of supervisors recommended the BOC to others.
- On a scale of 1 to 5 (1=not useful and 5=extremely useful), enrollees rated Level 1 courses 3.9 and Level 2 courses 4.3 (school enrollees) and 3.8 (non-school enrollees).
- 22% of non-participants reported willingness to pay $1,400. Most enrollees and supervisors felt the course was worth $1,400. Many enrollees did not pay full price due to sponsor subsidies.

Barriers to Participation:

- 47% of non-school and forty percent of school enrollees said time and staff availability were major considerations in decision to participate. Similarly, 51% of non-participants mentioned time and staff availability as a consideration.
- Cost was greatest barrier for 18% of non-participants, 60% of enrollee supervisors, and 47% of participants.
- Financial resources were greatest barrier to implementing O&M improvements by majority of enrollees and their supervisors (70% and 87%, respectively).

Cape Light Compact

2005 Commercial and Industrial Programs Free-ridership and Spillover Study

Executive Summary

June 14, 2006

Cape Light Compact

2005 Commercial and Industrial Programs Free-ridership and Spillover Study

Executive Summary

June 14, 2006

Prepared for: Kevin Galligan
Elizabeth Titus

Prepared by: Laura Schauer
Kimberly Bakalars
Bryan Ward
Pam Rathbun

PA Consulting Group
6410 Enterprise Lane
Suite 300
Madison
Wisconsin 53719
Tel: +1 608 443 2700
Fax: +1 608 661 5181
www.paconsulting.com

Version: 1.0

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This Executive Summary report summarizes the draft findings of the year 2005 Commercial and Industrial Free-ridership and Spillover Study for Cape Light Compact (CLC). The emphasis of this study was to assess program free-ridership, participant spillover and nonparticipant spillover for the following programs offered by CLC:

- New Construction
- Products and Services
- Retrofit

This study for CLC ran concurrent with the free-ridership and spillover studies conducted for National Grid and United Illuminating.

1.1 STUDY OBJECTIVES

The primary objective of the year 2005 Commercial and Industrial Free-ridership and Spillover Study was to assist CLC in quantifying the net impacts of their commercial/industrial energy efficiency programs by estimating the extent of:

- Program free-ridership
- Participant "like" spillover
- Nonparticipant "like" spillover

1.2 STUDY METHODOLOGY

The methodology used for this year's study follows the Standardized Methods developed in 2003 for a group of Massachusetts energy efficiency program administrators[1].

To accomplish the above objectives, telephone surveys were conducted with samples of 2005 program participants in each of the programs, with design professionals and equipment vendors involved in these 2005 installations. The program participant sample consisted of unique utility *accounts*, not unique customers names. The same customer name, or business entity, can be have multiple accounts in multiple locations, but program technical support and incentives are provided on behalf of an individual account. Thus for the purposes of this study, a customer or participant is defined as a unique account.

The majority of these telephone interviews were completed with program participants between March 30 and May 12, 2006. All sampled participating customers were mailed a letter on CLC letterhead in advance of the telephone call. This letter explained the purpose of the call, informed customers that someone would be calling them in the next couple of weeks to ask them some questions about their experience with the programs, and thanked them for their cooperation in advance. This advance letter and repeated call attempts resulted in an

[1] Rathbun, Pamela, Carol Sabo, and Bryan Zent, "Standardization Methods for Free-Ridership and Spillover Evaluation—Task 5 Final Report (Revised)." Prepared for National Grid, NSTAR Electric, Northeast Utilities, Unitil, and Cape Light Compact, June 16, 2003.

increased response rate, which increases the level of confidence in the survey results. The duration of interviews with program participants averaged nine minutes.

In addition to the customer surveys, surveys were conducted with

- Design professionals and vendors identified by customers as being the most knowledgeable about the decisions to install the equipment through CLC's programs. These surveys were used for estimating free-ridership for those installations where the design professional/equipment vendor was more influential in the decision than the customer.
- Design professionals and equipment vendors who had installed equipment through CLC's programs. These surveys were used for estimating the extent of nonparticipant 'like' spillover for these programs.

1.3 TOTAL PARTICIPANT FREE-RIDERSHIP ESTIMATES

A program's ***free-ridership rate*** is the percentage of program participants deemed to be free riders. A ***free rider*** refers to a customer who received an incentive through an energy efficiency program who would have installed the same or a smaller quantity of the same high efficiency measure on their own within one year if the program had not been offered. For free riders, the program is assumed to have had no influence or only a slight influence on their equipment purchase decision. Consequently, none or only some of the energy savings of equipment purchased by this group of customers should be credited to the energy efficiency program. Free riders account for costs but not benefits to the program, driving benefit-cost ratios down.

For programs that offer monetary incentives for multiple measure categories (e.g., motors, lighting, HVAC), it is important to estimate free-ridership by specific measure category. Category-specific estimates produce feedback on the program at the level at which it actually operates and allow for cost-effectiveness testing by measure category.

In addition, for commercial and industrial incentive programs, free-ridership has often been found to be highly variable among measure categories, making it essential to produce measure category-specific estimates. The ability to provide reliable estimates by measure category is dependent on the number of installations within that measure category—the fewer installations, the less reliable the estimation.

It is also important to measure the *extent* of free-ridership for each customer. Pure free riders (100%) would have installed exactly the same quantity and type of equipment within one year in the absence of the program. Partial free riders (1-99%) are those customers who would have installed some equipment within one year on their own, but a smaller quantity and/or a lesser efficiency. Thus, the program had some impact on their decision. Non-free riders (0%) are those who would not have installed any high efficiency qualifying equipment within one year in the absence of the program services. The total free-ridership estimates in this report include pure, partial, and non-free riders.

This year's approach to estimating free riders follows the approach outlined in the Standardized Methodology Report, which consisted of a sequential question technique to identify free riders. This sequential approach asks program participants about the actions they would have taken if the program had not been offered. This approach is considered an accurate method of estimating the actual level of free-ridership among program participants because it addresses the program's impact upon project timing, measure quantity, and efficiency levels while explicitly recognizing that the cost of energy-efficient equipment can be a barrier to installation in the absence of utility-sponsored energy efficiency programs. This method is also recommended because it walks survey respondents through their decision process with the objective of helping them recall the program's impact upon all aspects of project decision-making.

One issue with the method is how to handle responses of "Don't know." The "Don't know" responses to the initial free-ridership question are assigned a free-ridership value of 0%. For these cases, we then check their responses to the consistency questions and their response to open-ended question and adjust the free-ridership rate as appropriate. Note that program total free-ridership (pure and partial) rates illustrated in the following tables are not weighted, as we attempted to speak with a census of participants. When reviewing the measure category free-ridership rates it is important to consider the number of survey completions that the estimate is based upon.

New Construction Free-ridership Rates. Table 1 summarizes the total free-ridership results overall and by measure category for 2005 New Construction installations. The total free-ridership for the 2005 program year was 60.0%.

Table 1
CLC New Construction Program Total Participant Free-ridership Rates
All 2005 Installations

Measure Description	Total Participant Free-ridership Rate			
	# Accounts (Survey/Pop)	2005	2005 90% Error Margin	2004
HVAC	1/1	100.0%	—	---
Lighting	2/5	75.0%	±39.0%	---
Compressed Air	2/2	25.0%	±0.0%	---
Overall New Construction	**4/7**	**60.0%**	**±26.4%**	**---**

Overall survey and population participant counts do not equal the sum of measure category survey and population participant counts; the same participant may be represented in multiple measure categories.

No surveys were conducted with New Construction participants last year.

CLC Products and Services Participant Free-ridership Rates. Table 2 summarizes Products and Services free-ridership results for 2005 HVAC installations. Refrigeration installations could not be assessed; only one account was identified for refrigeration, and that account was not reachable for this study.

Table 2
CLC Products and Services Program Total Participant Free-ridership Rates
All 2005 Installations

Measure Description	Total Participant Free-ridership Rate			
	# Accounts (Survey/Pop)	2005	2005 90% Error Margin	2004
HVAC	10/19	67.5%	±16.8%	22.4%
Refrigeration	0/1	—	—	---
Overall Products & Services	**10/20**	**67.5%**	**±17.2%**	**19.5%**

Overall survey and population participant counts do not equal the sum of measure category survey and population participant counts; the same participant may be represented in multiple measure categories.

The HVAC rate was pulled from the 2004 C&I Products and Services category. Refrigeration was not part of the Products and Services sample in 2004.

CLC Retrofit Participant Free-ridership Rates. Table 3 summarizes the total free-ridership results overall and by measure category for 2005 Retrofit Program installations.

Table 3
CLC Retrofit Program Total Participant Free-ridership Rates
All 2005 Installations

Measure Description	Total Participant Free-ridership Rate			
	# Accounts (Survey/Pop)	2005	2005 90% Error Margin	2004
Custom	1/1	50.0%	±0.0%	---
VSD / Motors	3/3	8.3%	±0.0%	0.0%
HVAC	3/3	43.3%	±0.0%	8.1%
Refrigeration	6/11	4.2%	±9.1%	---
Lighting	77/103	5.7%	±2.2%	5.8%
Overall Retrofit	**86/116**	**7.5%**	**±2.4%**	**6.1%**

Overall survey and population participant counts do not equal the sum of measure category survey and population participant counts; the same participant may be represented in multiple measure categories.

Rates were pulled from the 2004 Small C&I Retrofit category. Refrigeration was not part of the Retrofit sample in 2004.

Overall Participant Free-ridership Rates. Table 4 shows the CLC programs included in the 2005 free-ridership study have a total 2005 free-ridership rate of 15.7%.

Table 4
Overall Cape Light Compact Participant Free-ridership Rates
All 2005 Installations

Program	Total Participant Free-ridership Rates		
	# Accounts Surveyed / Population	2005 Total Free-ridership	90% Error Margin
New Construction	4/7	60.0%	±26.4%
Products & Services	10/20	67.5%	±17.2%
Retrofit	86/116	7.5%	±2.4%
ALL	**100/142**	**15.7%**	**±3.3%**

1.4 PARTICIPANT "LIKE" SPILLOVER ESTIMATES

Spillover refers to additional energy-efficient equipment installed by a customer due to program influences but without any financial or technical assistance from the program. ***Participant "like" spillover*** refers to the situation where a customer installed equipment through the program in the past year and then installed additional equipment of the same type due to program influences. In contrast to free-ridership, spillover adds benefits to the program, increasing the program benefits and benefit-cost ratio.

Survey free-ridership questions were followed by questions designed to measure "like" spillover. These questions asked about recent purchases (since program participation in 2005) of any additional energy-efficient equipment of the same type as installed through the program that were made *without* any technical or financial assistance from the utility. A "like" spillover estimate was computed based on how much more of the same energy-efficient equipment the participant installed outside the program and did so because of their positive experience with the program.

One of the issues with attempting to quantify spillover savings is how to value the savings of measures installed outside the program since we are relying on customer self-reports of the quantity and efficiency of any measures installed. We used a conservative approach and reported only those measures installed outside the program that were of exactly the same type and efficiency as the ones installed through the program. Our conservative approach allowed customers to be more certain about whether the equipment they installed outside the program was the same type as the program equipment. This, in turn, made it possible for us to use the estimated program savings for that measure to calculate the customer's "like" spillover savings.

When reviewing the measure category "like" spillover it is important to consider the number of survey completions that the estimate is based upon. The number of survey completions for some measure categories is low because very few customers in the sample installed the measure. Thus, although a high percentage of the 2005 program customers completed surveys, some caution should be used when interpreting the results.

New Construction Participant "Like" Spillover Rates. Table 5 presents the like spillover rate for year 2005 New Construction participants overall and by measure. The New Construction program has no spillover saving attributions for the purchase of like equipment outside of the program.

Table 5
CLC New Construction Program Participant "Like" Spillover Rates
All Year 2005 Installations

Measure Description	Total Participant "Like" Spillover Rate			
	# Accounts (Survey/Pop)	2005	2005 90% Error Margin	2004
HVAC	1/1	0.0%	—	---
Lighting	2/5	0.0%	—	---
Compressed Air	2/2	0.0%	—	---
Overall	**4/7**	**0.0%**	**—**	**---**

Overall survey and population participant counts do not equal the sum of measure category survey and population participant counts; the same participant may be represented in multiple measure categories.

No surveys were conducted with New Construction participants last year.

Products and Services Participant "Like" Spillover Rates. Table 6 presents the like spillover rate for year 2005 Products and Services installations overall and by measure.

Table 6
Products and Services Program Participant "Like" Spillover Rates
All Year 2005 Installations

Measure Description	Total Participant "Like" Spillover Rate			
	# Accounts (Survey/Pop)	2005	2005 90% Error Margin	2004
HVAC	10/19	2.0%	±5.0%	0.0%
Refrigeration	0/1	—	—	---
Overall	**10/20**	**2.0%**	**±5.2%**	**0.0%**

Overall survey and population participant counts do not equal the sum of measure category survey and population participant counts; the same participant may be represented in multiple measure categories.

The HVAC rate was pulled from the 2004 C&I Products and Services category. Refrigeration was not part of the Products and Services sample in 2004.

CLC Retrofit Participant "Like" Spillover Rates. Table 7 summarizes the like spillover rate for year 2005 Retrofit installations overall and by measure.

Table 7
CLC Retrofit Program Participant "Like" Spillover Rates
All Year 2005 Installations

Measure Description	Total Participant "Like" Spillover Rate			
	# Accounts (Survey/Pop)	2005	2005 90% Error Margin	2004
Custom	1/1	0.0%	—	---
VSD / Motors	3/3	0.0%	—	0.0%
HVAC	3/3	0.0%	—	0.4%
Refrigeration	6/11	0.0%	—	---
Lighting	77/103	3.2%	±1.7%	3.5%
Overall	**86/116**	**2.7%**	**±1.5%**	**2.7%**

Overall survey and population participant counts do not equal the sum of measure category survey and population participant counts; the same participant may be represented in multiple measure categories.

Rates were pulled from the 2004 Small C&I Retrofit category. Refrigeration was not part of the Retrofit sample in 2004.

Overall "Like" Spillover Rates. Table 8 shows the like spillover rate for all CLC programs.

Table 8
Overall Cape Light Compact Participant "Like" Spillover Rates by Account
All Year 2005 Installations

Program	Total Participant "Like" Spillover Rates		
	# Accounts Surveyed / Population	2005 Total "Like" Spillover	90% Error Margin
New Construction	4/7	0.0%	---
Products & Services	10/20	2.0%	±5.2%
Retrofit	86/116	2.7%	±1.5%
ALL	**100/142**	**2.5%**	**±1.4%**

1.5 NONPARTICIPANT SPILLOVER ESTIMATES

Nonparticipant spillover refers to energy efficient measures installed by program nonparticipants due to the program's influence. The program can have an influence on design professionals and vendors as well as an influence on product availability, product acceptance, customer expectations, and other market effects, all of which may induce nonparticipants to buy high efficiency products. The methodology for the 2005 study estimated nonparticipant like-measure spillover based on responses from design professionals and vendors participating in National Grid’s Energy Initiative and Design 2000*plus* programs and Cape Light Compact programs (it does not survey non-participating designers and vendors). United Illuminating design professional / vendors were not included due to insufficient data.

The data for the analysis could have been collected from nonparticipants directly or from the design professionals and vendors who recommended, sold and/or installed qualifying high efficiency equipment. We chose to survey the design professionals and vendors primarily because they could typically provide much more accurate information about the efficiency level of installed equipment than could the nonparticipants. Experience has shown that customers cannot provide enough data about the new equipment they have installed to allow for accurate estimates of the energy savings achieved from the equipment. While they usually can report what type of equipment was installed, they typically cannot provide sufficient information about the quantity, size, efficiency and/or operation of that equipment to allow us to determine whether the equipment is "program-eligible." On the other hand, design professionals and equipment vendors who have worked with the program are typically more knowledgeable about equipment and are familiar with what is and is not "program-eligible."

Another argument in favor of using design professionals and equipment vendors to estimate nonparticipant spillover was that we could use data in the program tracking system database to attach kWh savings estimates to nonparticipant spillover. In the program tracking system database, measure-specific program kWh savings are associated with each design professional and vendor who participated in the program in 2005.

To determine nonparticipant spillover, design professionals and equipment vendors were asked (by measure category they installed in the program) what percent of their sales met or exceeded the program standards for each program measure category and what percent of these sales did not receive an incentive through the programs. They were then asked about the program’s impact on their decision to recommend/install this efficient equipment outside the program. Using the survey responses and measure savings data from the program tracking system, the participating vendor nonparticipant like spillover savings could be estimated for each design professional/vendor and the results extrapolated to the total program savings.

This method of estimating nonparticipant spillover is a *conservative* estimate for two reasons. First, not all design professionals and equipment vendors who are familiar with the programs specified and/or installed equipment through the program in 2005. Thus, we miss any nonparticipant spillover that was associated with these other design professionals/vendors (although it is less likely these design professionals/vendors had nonparticipant spillover if they were not involved with the program in 2005).

Second, this method only allows us to extrapolate nonparticipant spillover for those same measure categories that a particular design professional/vendor was associated with for the 2005 programs. Thus, if a vendor installed program-eligible equipment in other measure categories in the year 2005 outside the program, but none through the program, we did not capture nonparticipant spillover savings with that particular type of equipment. In essence, we measured only "like" nonparticipant spillover; that is, spillover for measures like those installed through the program in 2005.

The nonparticipant spillover results are based on surveys with 161 design professionals and vendors out of a vendor population of 266. The analysis indicates that nonparticipant spillover from the programs amounted to 1,658,927 kWh in the 2005 program year, which is approximately 2.9% of the total savings produced in 2005 by the Cape Light Compact, Design 2000*plus* and Energy Initiative programs combined (Table 9). Nonparticipant spillover for National Grid's Small Business Services program was not estimated because of the small number of vendors involved in delivering the program.

None of the vendors associated with Cape Light Compact applications reported any like spillover.

Table 9
Combined National Grid and Cape Light Compact Nonparticipant Like Spillover Results for Program Year 2005

A	B	C	D	E	F	G	H	I
Survey Categories	**Vendor Population kWh Savings[2]**	**Number of Firms Surveyed with kWh Savings/ Number of Firms in Program with kWh Savings**	**Surveyed kWh Savings[3]**	**Surveyed Savings Coverage Rate (D/B)**	**Nonparticipant Spillover from Surveyed Firms (kWh)[4]**	**Estimated Spillover Percent (F/D)**	**90% Error Margin**	**Nonparticipant Spillover Extrapolated to Population (kWh) (B*2.9%)**
Motors	422,984	9/17	315,026	74.5%	644	0.2%	±1.7%	12,267
HVAC	12,965,586	37/64	8,536,556	65.8%	23,320	0.3%	±1.0%	376,002
VSD	5,530,615	12/21	4,563,367	82.5%	8,181	0.2%	±1.4%	160,388
Lighting	47,379,237	99/159	27,010,871	57.0%	273,303	1.0%	±1.1%	1,373,998
Transformers	46,165	2/3	10,811	23.4%	0	0%	±0.0%	1,339
Compressed Air	6,522,010	14/20	5,665,012	86.9%	575,756	10.2%	±7.5%	189,138
Refrigeration	2,809,999	9/11	2,150,586	76.5%	0	0%	±0.0%	81,490
Other[5]	9,904,501	24/35	8,382,091	84.6%	777,723	9.3%	±5.5%	287,231
Total	**85,581,098**	**161/266**	**56,634,320**	**66.2%**	**1,658,927**	**2.9%**	**±1.4%**	**2,481,852**
90% Confidence Interval					**Lower Bound**	**1.5%**		
					Upper Bound	**4.3%**		

---

[2] The vendor population kWhs represents the total savings for all measures for the Design 2000*plus* and Energy Initiative programs (including the CP program) for actual vendors. Spillover is measured for each vendor associated with the program. Because the same application (and associated kWh) can be the basis for more than one vendor, the vendor population kWh may be higher than the customer population kWh.

[3] The total surveyed kWhs represents the total savings for all surveyed design professionals and surveyed vendors in the program tracking system database whose names suggested they were actual vendors, not participants.

[4] Net of “like” spillover for the customers associated with the surveyed design professionals/vendors, as identified from the participating customer survey.

[5] Other is a residual category consisting of measures remaining from “Custom” after equipment was reassigned to existing categories such as “Motors,” “HVAC,” or “Lighting”.

New Buildings Institute, Inc.
P.O. Box 653
White Salmon, Washington 98672
Phone: (509) 493-4468
Fax: (509) 493-4078
E-mail: info@newbuildings.org
Website: www.newbuildings.org

Phase 1: Commercial Rooftop HVAC Unit Retrofit Programs

March 28, 2006

Prepared by:
Mark Cherniack, Howard Reichmuth and
David Hewitt, New Buildings Institute, Inc.

Prepared for:
Northeast Energy Efficiency Partnerships
Jon Linn, Program Manager
5 Militia Drive
Lexington, Massachusetts 02421
(781)860-9177

Table of Contents

1. Executive Summary

This report is sponsored by the Northeast Energy Efficiency Partnership (NEEP), to summarize regional and national experience with retrofit improvements to unitary HVAC equipment on commercial building stock. This report supports the collaborative effort among stakeholders in the NEEP service area to achieve better understanding of issues relating to establishing and maintaining energy efficient performance of rooftop package HVAC units. The report also assesses the elements that guide the design of utility programs aimed at accelerating the realization of energy and demand savings from operation of this technology.

The energy and demand savings available from rooftop HVAC systems are second only to lighting savings in the commercial buildings sector. Utility-sponsored rooftop unit service programs in the Northeast, California and Northwest have shown this resource to be a viable utility program target.

Pilot efforts have shown possible energy savings on the order of 1,800 kWh/unit treated in comprehensive rooftop unit service programs, but that overall demand savings of greater than 150W/unit are unlikely. A trial cost-effectiveness review showed that these savings have a levelized resource cost of 3.6 cents per kilowatt hour. This resource is principally an energy resource, not a substantial demand resource.

The programs include a variety of unit service measures aimed at refrigeration charge, air flow, thermostats/controls and economizers in an assortment of configurations. Most programs seek partnerships with the existing HVAC trade, emphasizing enhanced diagnostics, training, and quality control methods. The scale of both the program and the approach is driven by the new resource requirements of an individual utility and a region.

This resource is broad enough and cost effective enough to be the basis for utility demand-side program development. It is recommended that impact evaluation efforts be undertaken on a multi-utility basis to underpin the savings estimates for the principal portions of the resource in the Northeast.

Also included herein are discussions of:

- The several rooftop unit programs reviewed
- The rooftop unit equipment stock
- Estimated energy savings and cost-effectiveness
- Standard utility rooftop program service measures
- Key factors that guide the nature and scale of a rooftop program
- Marketing and training/certification and evaluation issues
- Potential for new technologies to impact the rooftop services market.

It is hoped that this report will support the design and implementation of a practical plan for the bringing energy and demand savings potential in the rooftop HVAC unit market to a level of certainty suitable for consideration as a resource for the region's power system and as a greenhouse gas mitigation strategy for the entire region.

The Massachusetts ENERGY STAR® Homes Program

2005 PROGRESS REPORT

Final Report

Submitted to:

The Massachusetts ENERGY STAR Homes Program

Joint Management Committee

Submitted by:

Dorothy Conant, Consultant

June 8, 2006

Table of Contents

List of Figures

1. Introduction

The annual Massachusetts ENERGY STAR® Homes Program 2005 Progress Report is a summary of 2005 program activity. Program performance information includes historical as well as current information to show the growth of the Program over time.

2. Metrics

There were two residential new construction metrics for 2005. As shown below, the Program expects to achieve the exemplary level for the first metric and achieved the exemplary level for the second metric.

2.1 New Construction #1: Utility Cost Indicator (UCI)

Analyze data and report on the UCI for ENERGY STAR Homes in Massachusetts in 2005 compared to the annual average of the previous three years and achieve 1% improvement in 2005 compared to previous three year average.

Threshold: Report UCI for 2005 and the average of three previous years and achieve a 1% improvement.

Design: Achieve 5% improvement in 2005 compared to previous three year average.

Exemplary: Achieve 10% improvement in 2005 compared to previous three year average.

Achieved the exemplary level based on preliminary estimates.

2.2 New Construction #2: Market Share of Agreements to build ENERGY STAR Homes in Massachusetts

Threshold: Achieve a 17% market share for signed ENERGY STAR Homes agreements as a percentage of statewide housing permits.

Design: Achieve an 18.5% market share for signed ENERGY STAR Homes agreements as a percentage of statewide housing permits.

Exemplary: Achieve a 20% market share for signed ENERGY STAR Homes agreements as a percentage of statewide housing permits.

Achieved the exemplary level by recruiting a 20% market share.

3. Over the Years

The figures on the following pages show the Program's achievements since 1999. They show the number of housing units recruited each year, the status of those units at the end of 2005, the average HERS ratings of homes completed in each year, the average cost per signed housing unit and per completed housing unit each year, and completed housing units each year as a percent of estimated total annual housing units completed in Massachusetts. As these figures will show, the number of housing units recruited increased sharply in 2004 and again in 2005. As of the end of 2005, over 18,300 housing units have been recruited, over 9,200 of these have been completed and ENERGY STAR-certified and over 7,100 remain as active projects.

3.1 Annual Signed Housing Units

As Figure 3.1 shows, the proportion of new housing units recruited to participate in the Massachusetts Program and committed to be built to ENERGY STAR standards has been 12% or more of total statewide annual housing permits issued since 2000, except for 2003. Following declines in 2002 and 2003, the number of housing units recruited rose sharply to 3,320 housing units in 2004 and to 4,761 housing units in 2005. The number of housing units recruited in 2005 is more than double the number recruited just two years earlier (2003).

Annual signed housing units as a percent of total permits issued in Massachusetts reached 20% in 2005. Single-family homes recruited through the Program represent just over 12% of single-family permits issued in the state, which is 50% higher than in 2003 and 2004. Multi-family housing units recruited through the Program as a percent of multi-family housing permits issued doubled from 14% in 2003 to 28% in 2004 and grew to 30% in 2005.

Figure 3.1: Annual Signed Housing Units
(Percent of MA Statewide Permits)

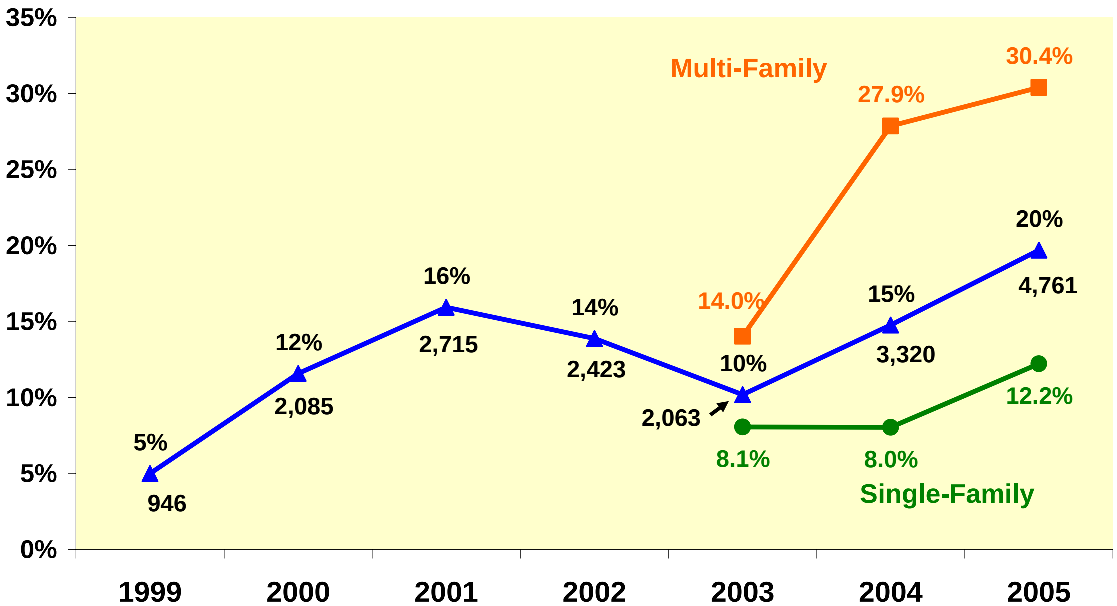


Figure 3.2, Figure 3.3 and Figure 3.4 on the following page show year-to-date total, single-family and multi-family permits issued for 2002, 2003, 2004, 2005 and the first three months of 2006.[1] Total permits issued in 2005 are 8% higher, single-family permits 4% lower and multi-family permits 30% higher than in 2004. Total permits issued through March 2006 are 16% higher, single-family permits 12% higher and multi-family permits 22% higher than in 2005.

---

[1] Total permits for each year are the final revised annual totals which are higher than the published December year-to-date totals.

Figure 3.2: Year-to-Date Total Permits Issued 2002 - 2006

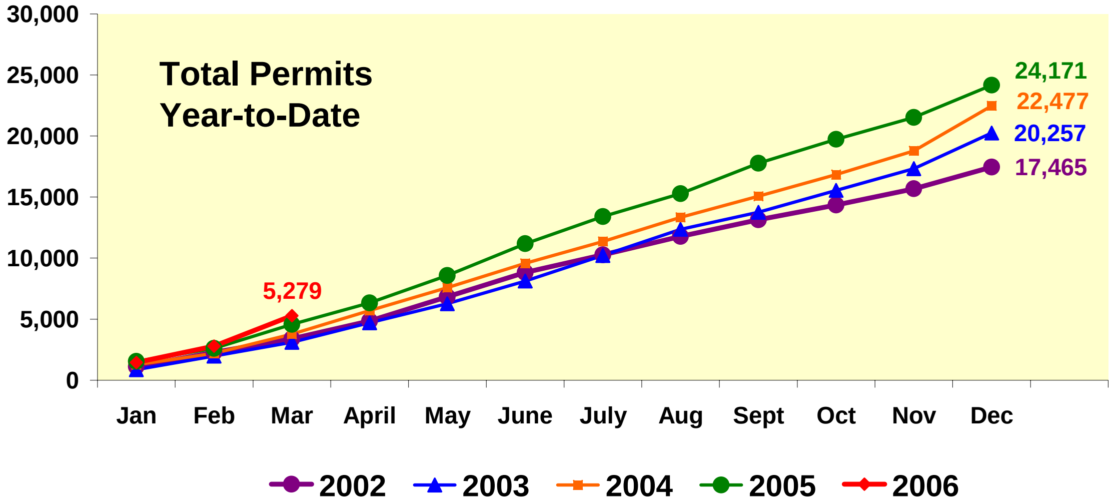


Figure 3.3: Year-to-Date Single-Family Permits Issued 2002 - 2006

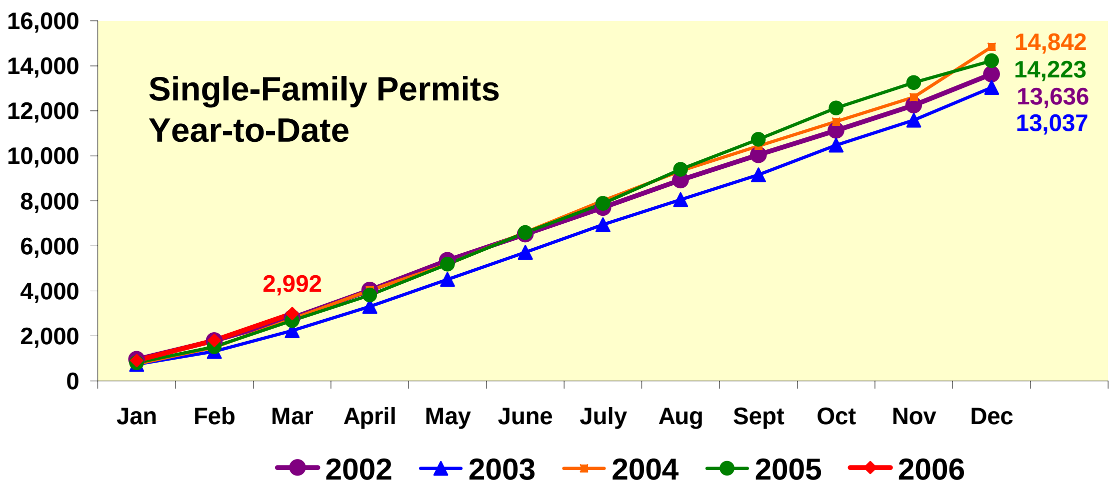


Figure 3.4: Year-to-Date Multi-Family Permits Issued 2002 - 2006

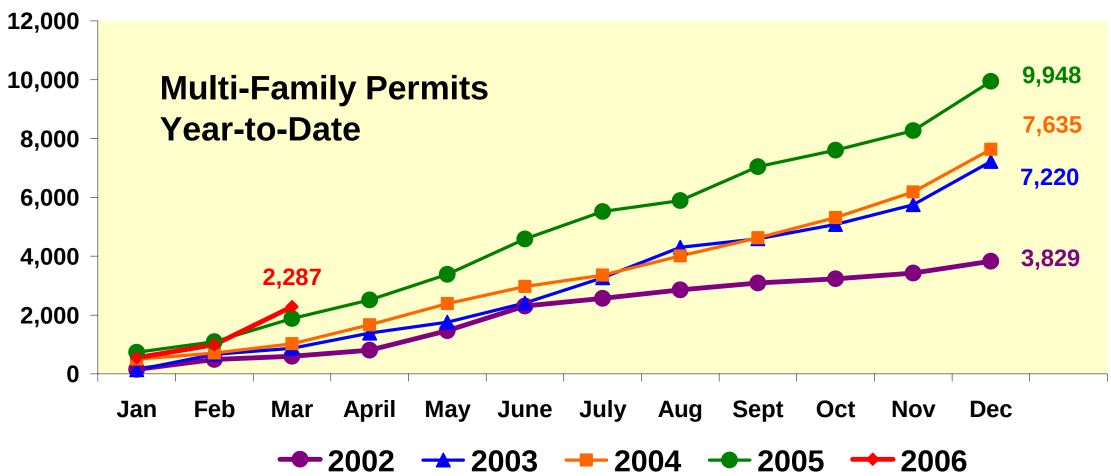
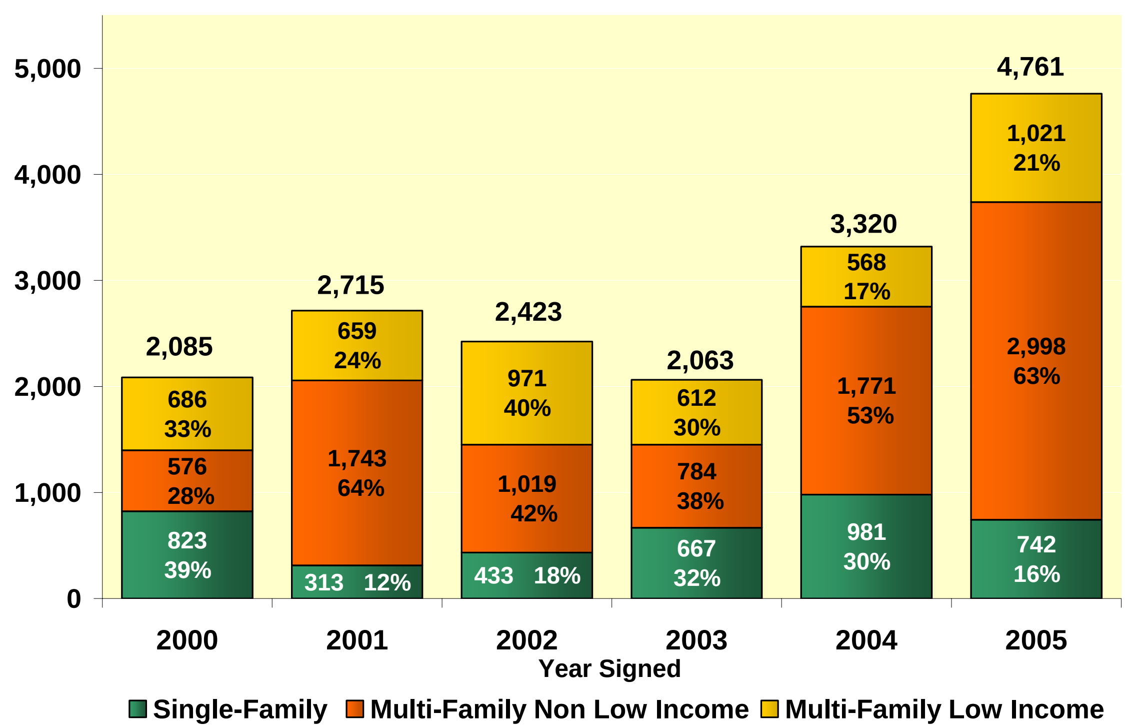


Figure 3.5 shows the number and percentage of housing units recruited in each year by housing category, based on rebate definitions. Historically, the JMC classified housing units as single-family or multi-family, with a further breakdown into low income or non low income housing units. The criteria for classifying participating units as single-family or multi-family were based on the rebates paid. Under this approach, single-family includes single home projects and detached single-family home developments; multi-family includes all attached single-family developments and all multi-story projects, where the builder receives the lower multi-family rebate per housing unit.

In order to present information using consistent definitions across all years, the numbers of multi-family low income housing units recruited in Figure 3.5 include **all** housing units in low income projects, whether or not all the units in the project are low income units. In 2003 the Program began tracking the percentage of units in each low income project that are actual low income units: 72% of units in multi-family low income projects in 2003, and 96% of units in multi-family low income projects in both 2004 and 2005 are actual low income units.[2]

Figure 3.5: Recruited Housing Units by Housing Category
(Rebate Definitions)



[2] The number of actual low income units is shown in subsequent tables that address 2003 to 2005 recruited housing units by Census Bureau housing categories.

3.2 Current Status of Signed Housing Units

Since its inception, the Massachusetts Program has certified over 9,200 housing units as ENERGY STAR-qualified. Figure 3.6 and Figure 3.7 show the status at the end of 2005 of the homes recruited in each of the years 1999 through 2005. Figure 3.6 shows the number of homes that have been completed, are currently active or have dropped out of the Program; Figure 3.7 presents the same information expressed as the percentage of homes. In both figures the blue areas represent the proportion of homes recruited in a given year that were certified by the end of 2005, the red areas represent the proportion of homes recruited in a given year that have not yet been completed, and the gold areas represent the proportion of homes recruited in a given year that have dropped out of the Program. Just over ten percent (1,968, or 11%) of the housing units signed up during the 1999 through 2005 period have dropped out of the Program, either because they did not meet ENERGY STAR standards or because construction plans were cancelled. There are currently over 7,100 active housing units in the Program; these are housing units that are either currently under construction or planned to be built. The housing units signed up prior to 2005 that are still active generally reflect housing units in large projects with construction plans that cover several years.

Figure 3.6: Current Status of Signed Housing Units
(1999-2005 Signings)

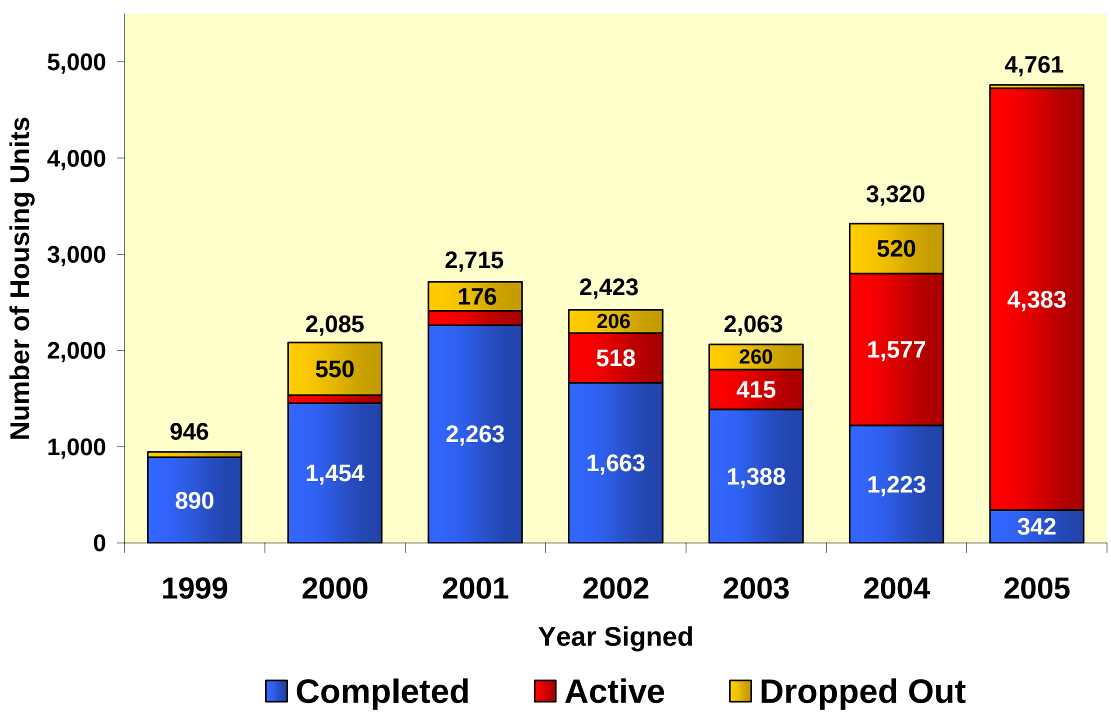
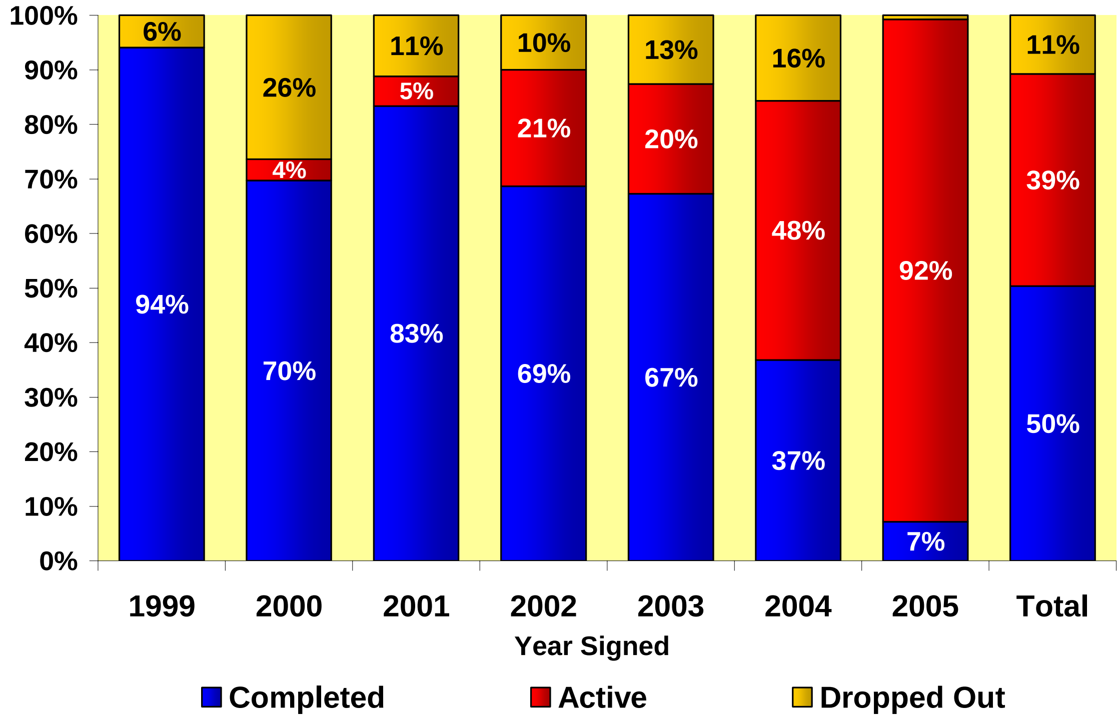


Figure 3.7: Current Status of Signed Housing Units
(Percentage of Homes Completed, Active, Dropped Out)



3.3 ENERGY STAR-Certified Homes

Figure 3.8 shows the number of homes recruited in each year that have been completed and certified as ENERGY STAR homes through the Program, broken down by housing category using the rebate definitions. The totals for each year in Figure 3.8 are the same as the blue areas in Figure 3.6.

Figure 3.8: Completed Housing Units by Housing Category
(Rebate Definitions)

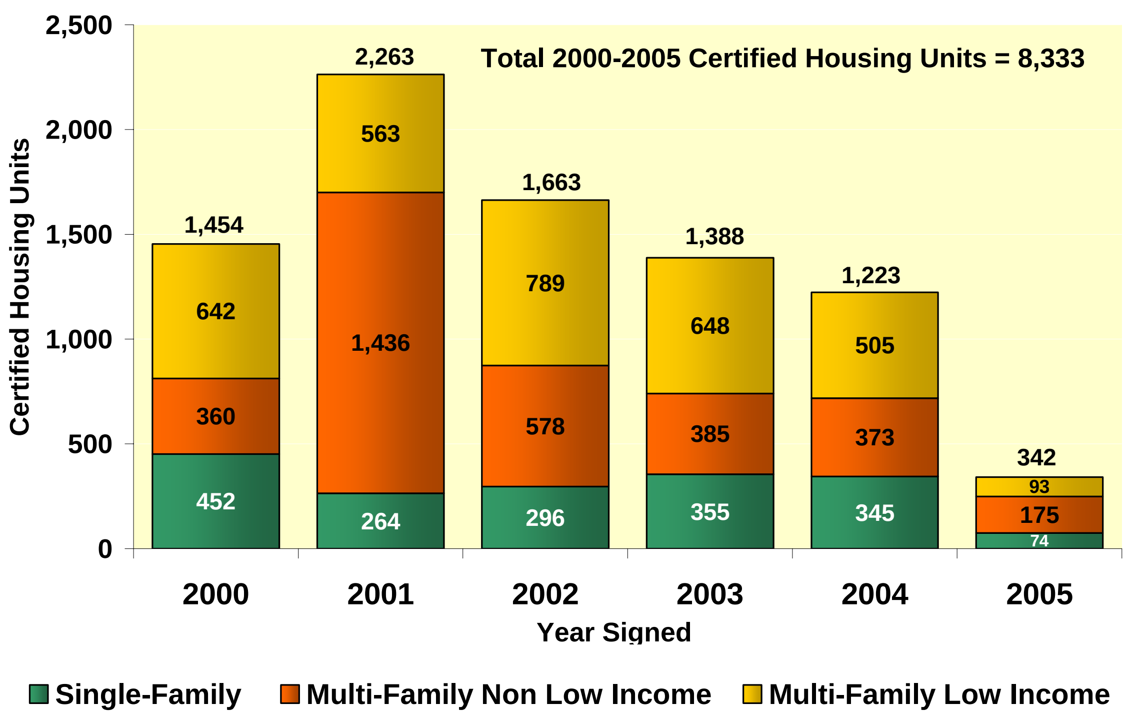
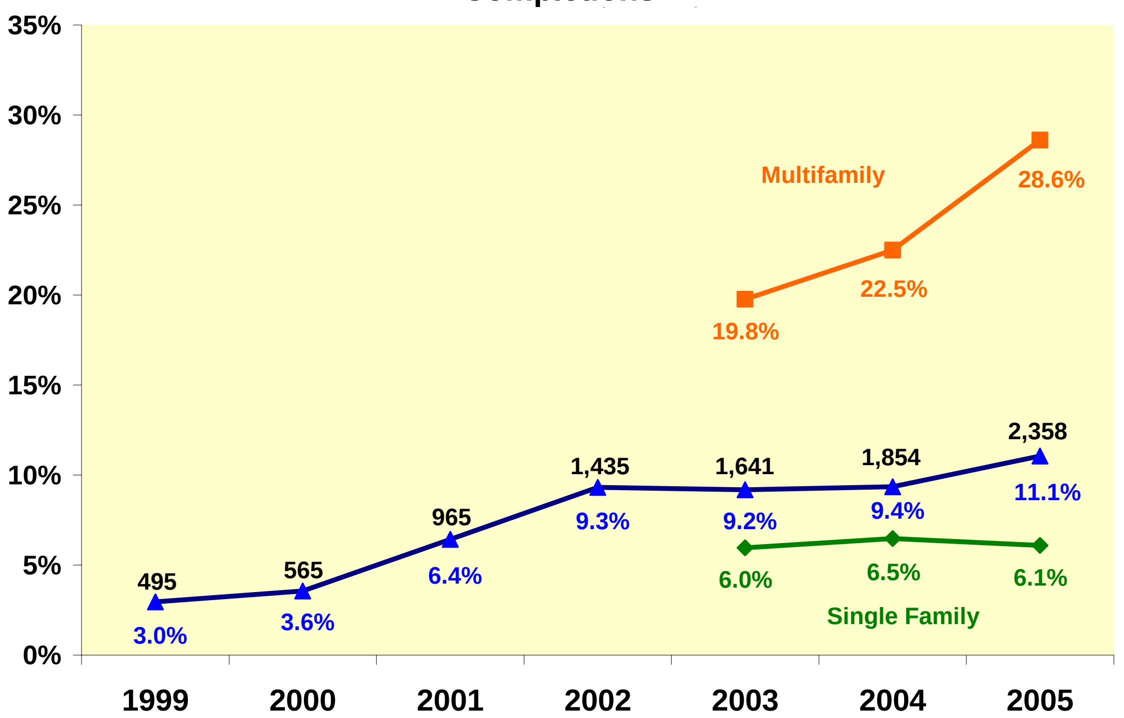


Figure 3.9 shows the number of housing units that have been certified each year through the Program and the percentage they represent of estimated total annual completed housing units in Massachusetts. The housing units certified in any year include housing units recruited in previous years. As shown, the number of housing units certified through the Program has increased each year, both in number and in percent of total completed housing units, reaching 2,358 housing units and 11.1% of the market in 2005.

In 2003, the Program began tracking recruited and completed homes under the Census Bureau single-family and multi-family housing category definitions, which is how housing permit data are reported, as well as the rebate definitions. Under the Census Bureau definitions, single-family includes fully detached housing units, semi detached (semi attached, side-by-side) housing units, row houses, and townhouses. In the case of attached units, each must be separated from the adjacent unit by a ground-to-roof wall and must not share heating/air-conditioning systems or interstructural public utilities such as water supply, power supply, or sewage disposal lines. Because housing units certified as ENERGY STAR since 2003 are tracked using the Census Bureau definitions, it is possible to separately calculate the percentage of multi-family housing units completed in the state that are ENERGY STAR (19.8% in 2003, 22.5% in 2004 and 28.6% in 2005) and the percentage of single-family housing units completed in the state that are ENERGY STAR (6.0% in 2003, 6.5% in 2004 and 6.1% in 2005).

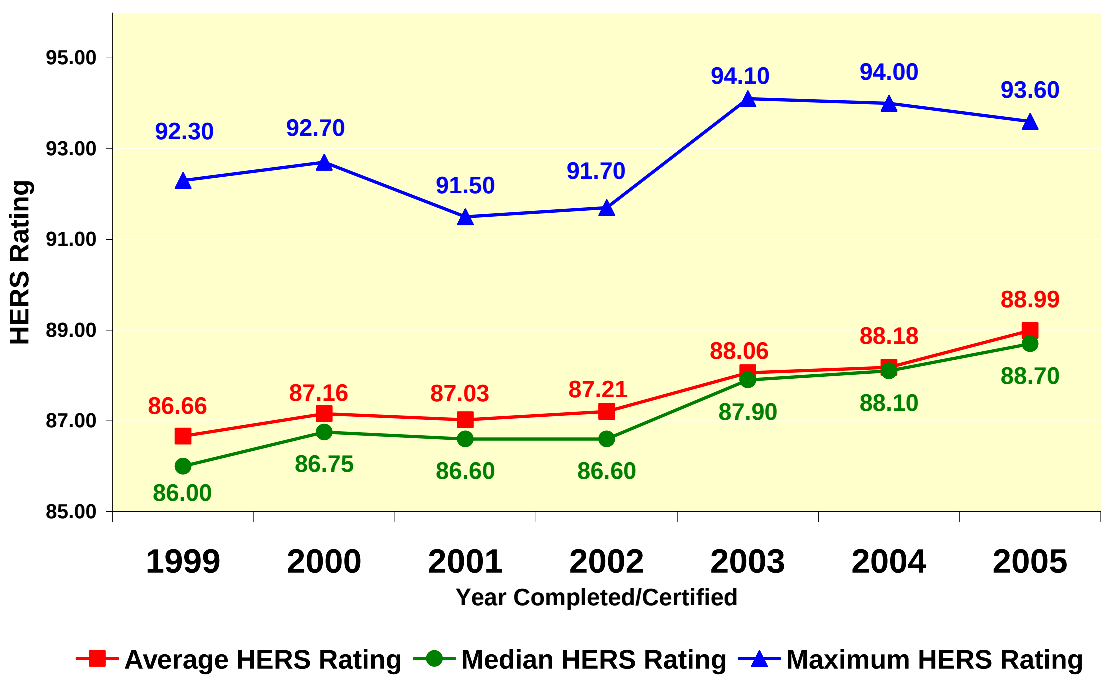
Figure 3.9: ENERGY STAR Completions as Percent of State-Wide Completions



3.4 HERS Ratings

The average HERS score for certified homes continues to rise. As shown in Figure 3.10, the average HERS score of homes certified in 1999 was 86.66 and in 2005 it is 88.99. This 2.33 point increase in the average HERS score equates to an increase of 11.6% in energy savings for certified homes.[3] Figure 3.10 also shows that each year some certified homes have achieved HERS scores that exceed the 86.00 score required for ENERGY STAR certification by more than five points. In 2003 and 2004 at least one home received a HERS score of 94.00 or higher, which represents energy savings of 40% over a home with a minimum ENERGY STAR qualifying HERS score of 86.00. To encourage builders to make their homes as energy efficient as feasible, instead of just meeting the 86 HERS score requirement, the Program offers higher incentives to homes with higher HERS scores.

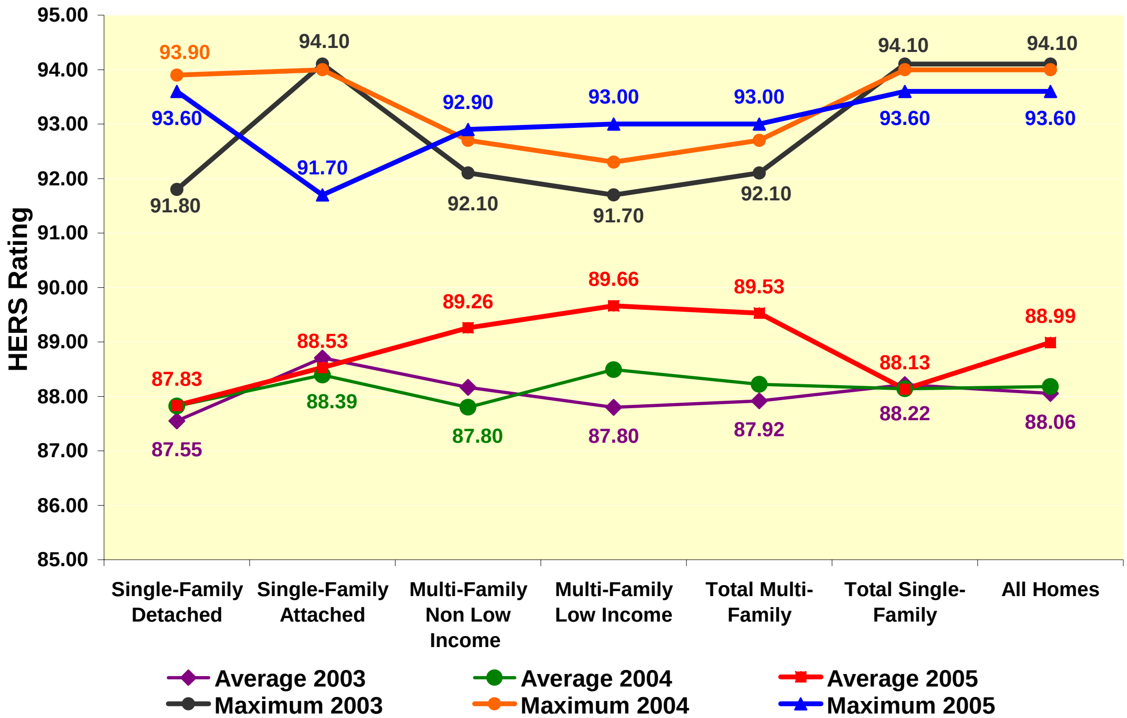
Figure 3.10: 1999 – 2005 HERS Ratings
(Completed Housing Units Each Year)



[3] Based on five percent increase in savings per point increase in HERS score.

Figure 3.11 shows the maximum and average HERS scores by housing type for homes certified in 2003, 2004 and 2005. As shown, the maximum HERS score for a single-family attached home in 2005 is much lower than in previous years, while the maximum HERS cores for multi-family units are higher than in previous years. The 2005 average HERS scores are virtually the same as in 2003 and 2004 for single-family homes and measurably higher than in 2003 and 2004 for multi-family housing units.

Figure 3.11: 2003 - 2005 Maximum and Average HERS Scores



3.5 Cost per Completed Housing Unit

Table 3.1 shows that the yearly number of housing units signed has more than doubled, from 2,085 in 2000 to 4,761 in 2005. Meanwhile the yearly number of housing units completed and certified has quadrupled, from 565 in 2000 to 2,358 in 2005.

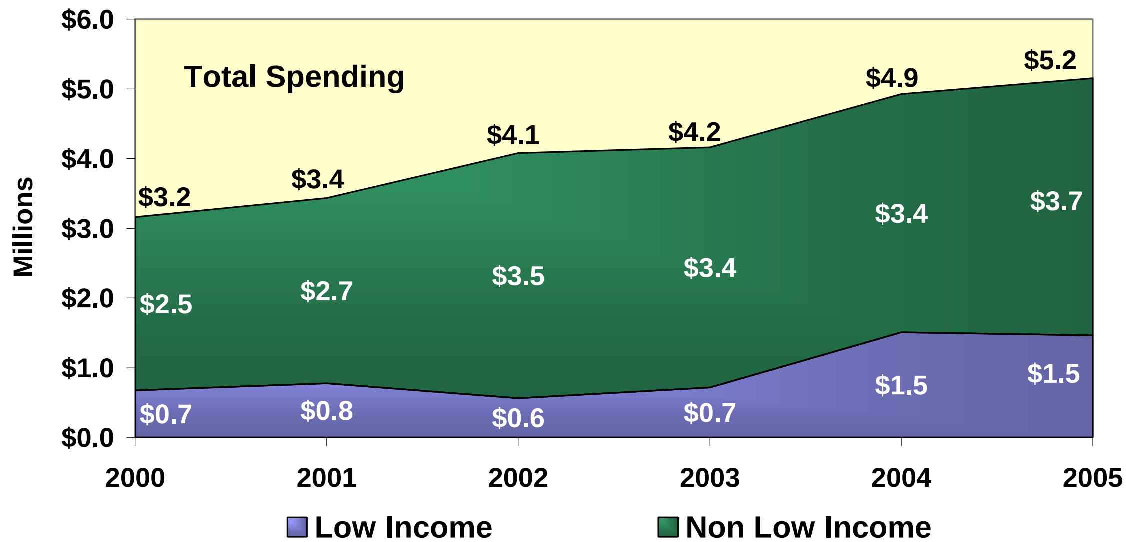
Table 3.1: Annual Program Spending, Signings and Completions

Year	Spending $Thousands	Housing Units Signed	Housing Units Completed
2000	$3,160	2,085	565
2001	$3,434	2,715	965
2002	$4,078	2,423	1,435
2003	$4,160	2,063	1,630
2004	$4,925	3,320	1,854
2005	$5,153*	4,761	2,358

*Preliminary Estimate

Error! Not a valid bookmark self-reference. shows annual spending by electric Program Sponsors has increased by 63%, from just over three million dollars in 2000 to over five million dollars in 2005.[4] **Error! Not a valid bookmark self-reference.** also shows that one and one-half million dollars, or 28% of total 2005 spending, was for low income projects.

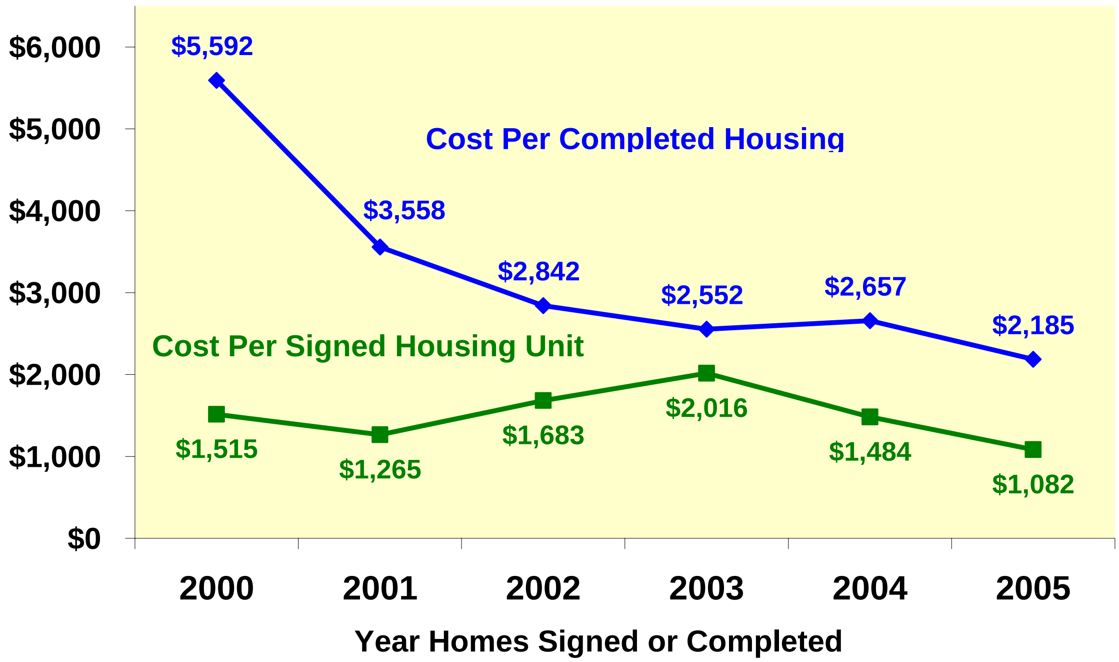
Figure 3.12: Annual Program Spending



[4] The cost data are from annual reports filed with the Division of Energy Resources (DOER) by the electric utilities and the Cape Light Compact. The cost data include customer incentives plus in-house and contracted out expenses for planning and administration, marketing, and implementation. The cost data do not include evaluation expenses, market research expenses, performance incentives, other costs or participant costs.

Figure 3.13 shows the annual cost per signed housing unit and per completed housing unit. The dramatic decrease in cost per completed housing unit from the early years of the Program is largely a reflection of the lag between the time housing units are signed up and the time they are certified.

Figure 3.13: Annual Cost per Housing Unit



4. 2005 Program Activity

The Program strives to recruit a mix of project and housing types and to bring new builders into the Program, as well as maintain the involvement of currently participating builders, to sustain the Program's momentum. The figures presented in this section address housing units signed up in 2003, 2004 and 2005.

4.1 2005 Housing Units Recruited

The Program strives to recruit a mix of housing types, including single-family detached, single-family attached and multi-family housing. As shown in Figure 4.1, approximately one-half of the housing units recruited in 2003 were single-family homes and one-half were in multi-family buildings, with just over one-third of the multi-family housing units qualifying as low income. In both 2004 and 2005, single-family homes accounted for just over one-third (36%) and multi-family housing units almost two-thirds (64%) of recruited housing units. Just under one-fourth of the multi-family housing units in 2004 (22%) and just under one-third (31%) of the multi-family housing units in 2005 are low income units.

As mentioned earlier, in some low income projects there is a mix of low income and non low income units. In 2003 the Program began tracking the number of actual low income units in low income projects. The numbers of low income housing units shown in Figure 4.1 are the actual numbers of low income units recruited. The total number of low income units signed in 2003 is 440 (359 multi-family, 80 single-family attached and one single-family detached). The total number of low income units signed in 2004 is 568 (461 multi-family, 83 single-family attached and 24 single-family detached). The total number of low income units signed in 2005 is 985 (929 multi-family, 54 single-family attached and two single-family detached).

Figure 4.1: 2003 - 2005 Signings by Housing Category
(Census Bureau Definitions)

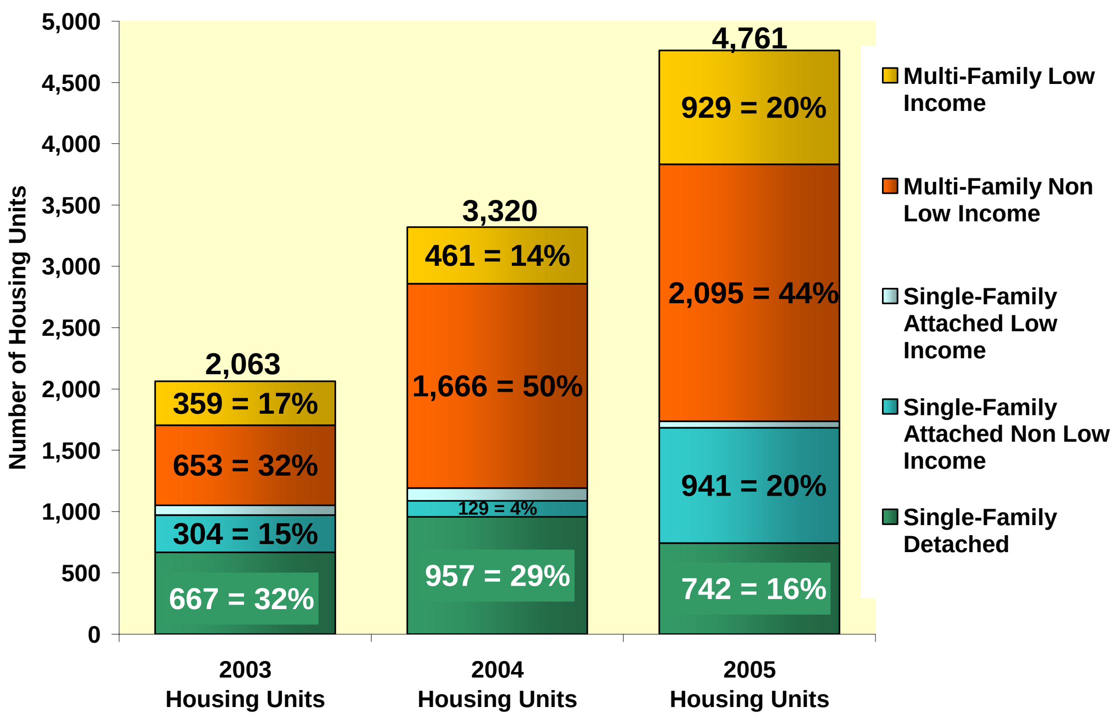
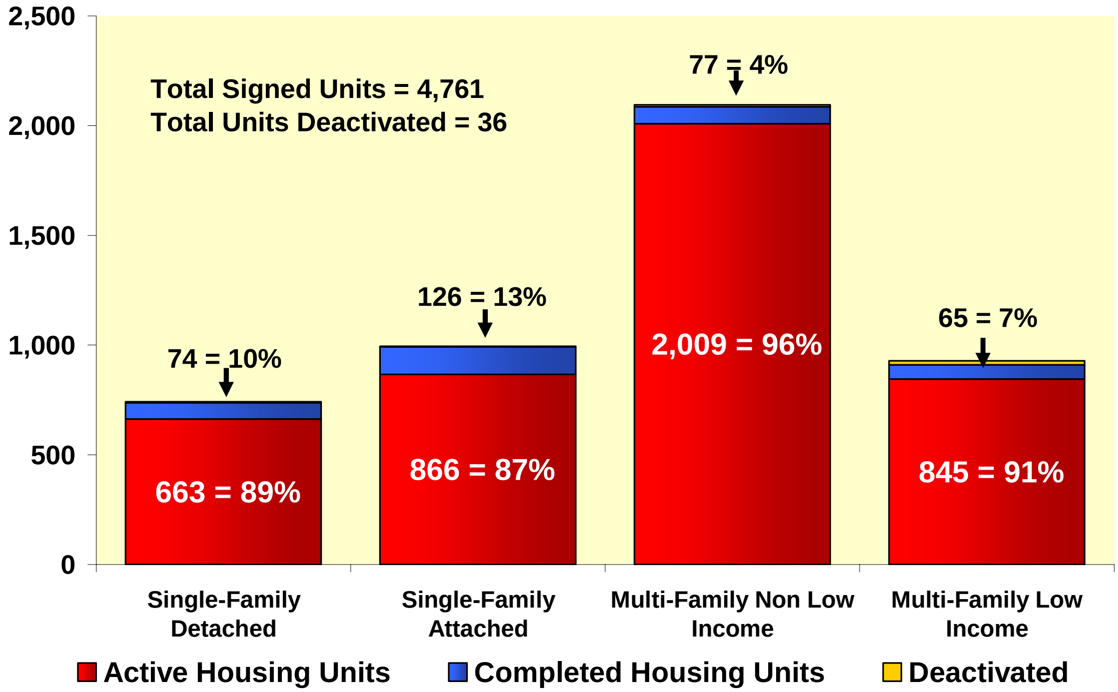


Figure 4.2 shows the status of the housing units recruited in 2005 as of the end of the year. Overall, seven percent of the housing units recruited in 2005 were also completed in 2005. By housing category, the percentage of housing units both recruited and completed in 2005 ranges from a low of four percent of multi-family non low income housing units to a high of 13% of single-family attached housing units

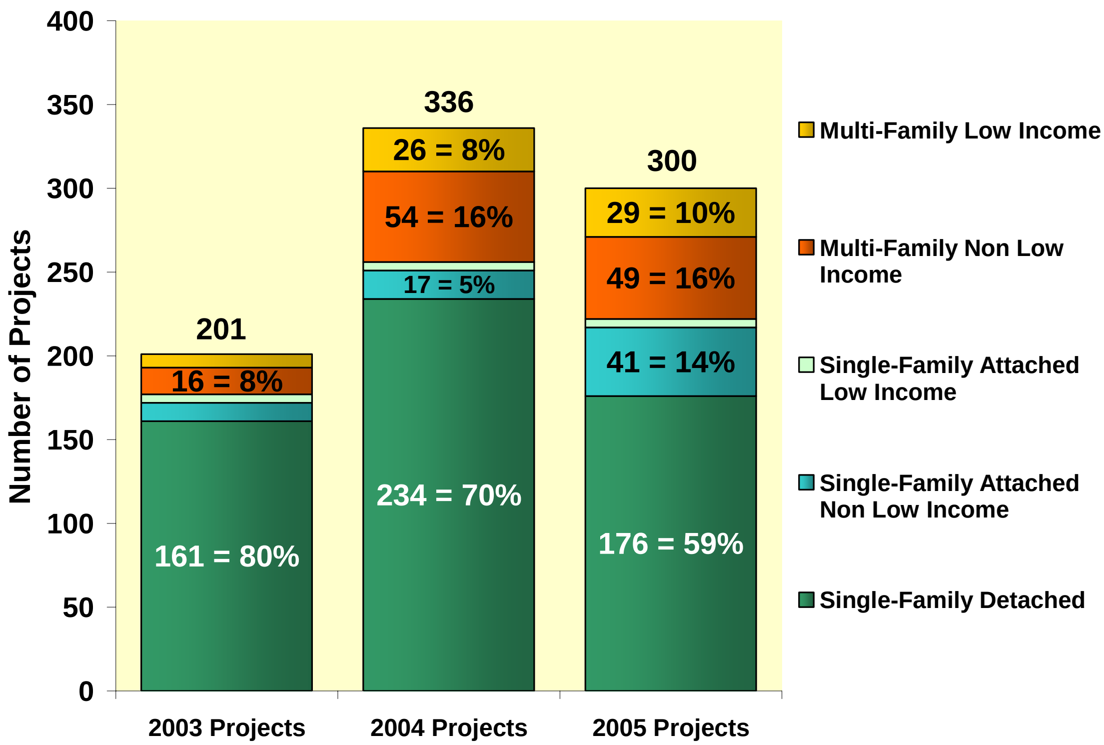
Figure 4.2: Status of 2005 Signed Housing Units by Housing Category
(Census Bureau Definitions)



4.2 2005 Housing Projects Recruited

Figure 4.3 shows the number of projects recruited in 2003, 2004 and 2005 by housing category. Recruitment efforts focus on builders with multi-home projects, but many people building their own homes or builders certifying just one home at a time participate in the Program. The number of single home projects was 186 in 2004 and 156 in 2005. These single-home projects are a small percentage of total housing units committing to be built to ENERGY STAR-standards, but they are valuable to the Program because they bring many local builders into the Program who may talk to other small builders, thereby increasing awareness of the Program and its benefits.

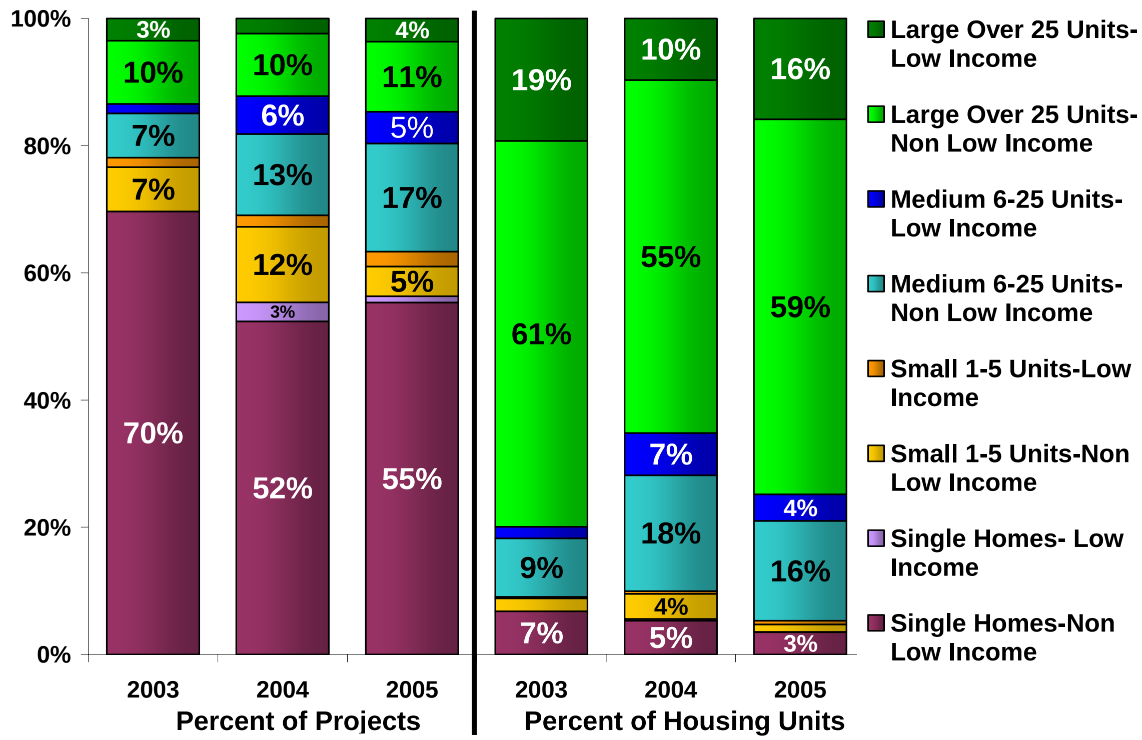
Figure 4.3: Number of 2003 - 2005 Signed Projects by Housing Category
(Census Bureau Definitions)



4.3 2005 Housing Units and Projects by Size Category

Figure 4.4 shows the percentage of housing units and the percent of projects signed in 2003, 2004 and 2005 falling into various size categories based on the number of housing units in the project. Not surprisingly single-homes account for more than one-half of all projects signed in each year, but a shrinking percent of housing units (seven percent in 2003, five percent in 2004 and three percent in 2005). The majority of housing units signed in every year are in non low income projects with over 25 housing units; 61% of all housing units signed up in 2003, 55% in 2004 and 59% in 2005..

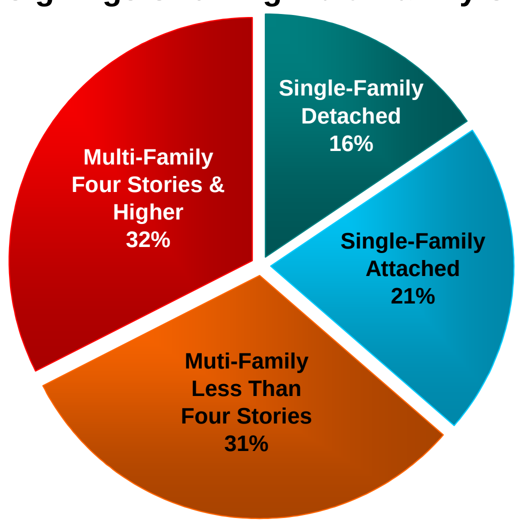
Figure 4.4: Percent of 2003 – 2005 Projects and Housing Units by Size



4.4 2005 Signings and Completions

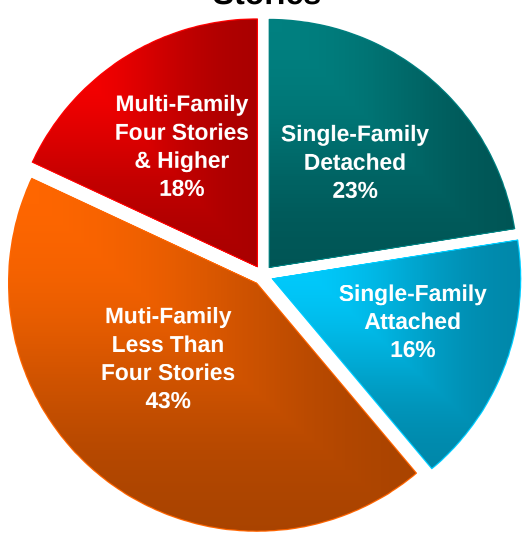
Figure 4.5 and Figure 4.6 below show the percentage of 2005 signings and completions by housing category, breaking the multi-family housing units into those in buildings less than four stories and those in buildings four stories and higher. Going forward, the Sponsors are working on combining efforts with their commercial and industrial energy efficiency programs to better serve multi-family building four stories and higher. As shown, housing units in multi-family buildings four stories and higher accounted for 32% of signings and 18% of completions in 2005.

Figure 4.5: 2005 Signings Showing Multi-Family Signings by Stories



2005 Signings

Figure 4.6: 2005 Completions Showing Multi-Family Completions by Stories



2005 Completions

4.5 Builder Mix—New and Repeat Participants

Figure 4.7 and Figure 4.8 show the percentages of projects and housing units recruited in 2005 coming from builders new to the Program (Figure 4.7) and builders who have previously participated in the Program (Figure 4.8).

Efforts to recruit new builders into the Program continue to be successful: 57% of the projects, representing 53% of the housing units recruited in 2005, are with builders new to the Program. (The comparable percentages for 2004 are 60% of projects and 59% of housing units, for 2003 are 63% of projects and 57% of housing units recruited and for 2002 are 76% of projects and 47% of housing units recruited.)

Figure 4.7: Percent of 2005 Signed Projects and Housing Units from New Builders

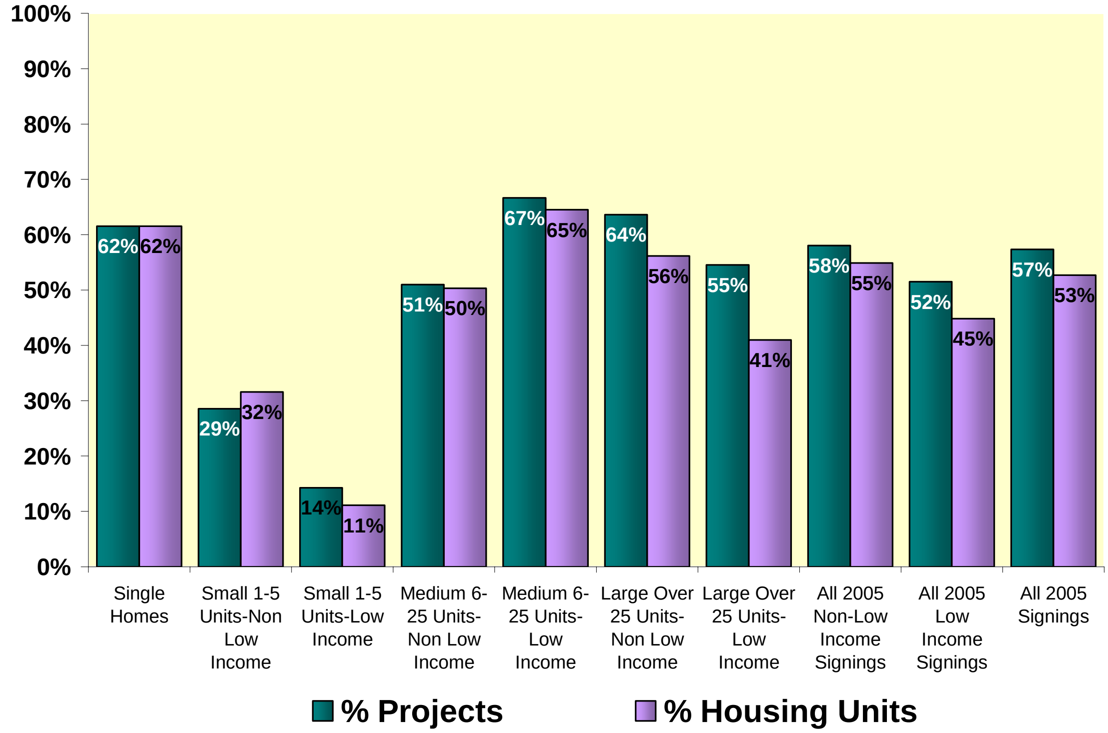
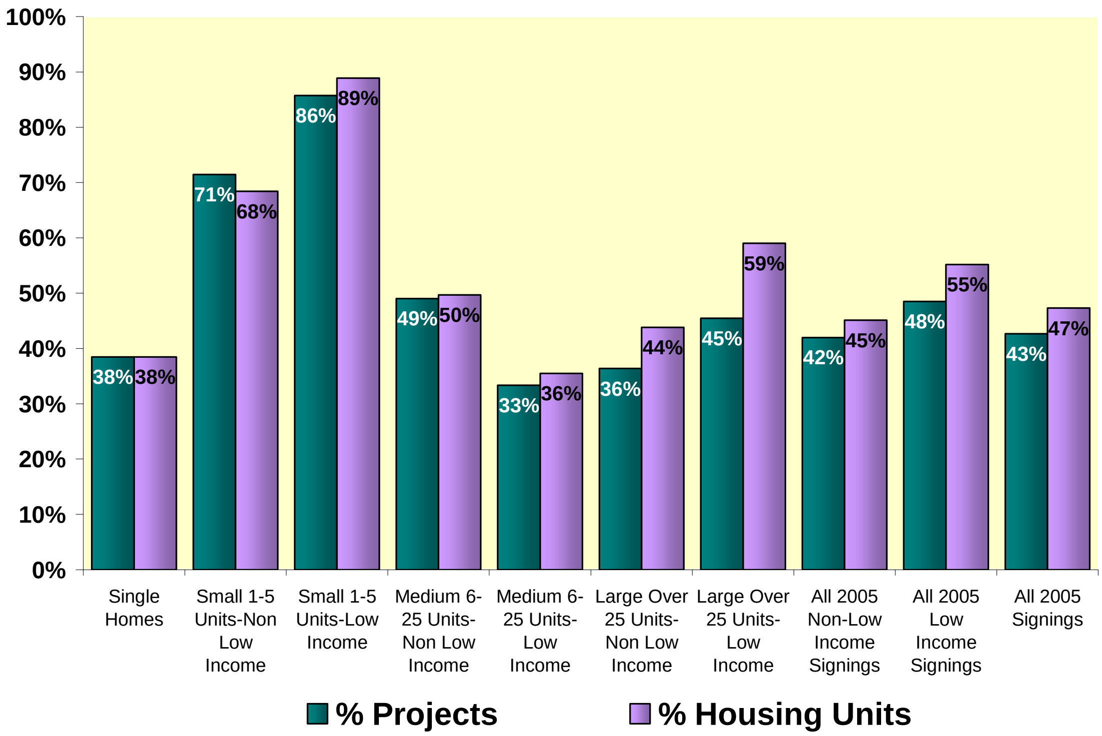


Figure 4.8 shows that at least one-third of the projects recruited in 2005 in each project size category and the housing units recruited in each project size category are from builders who have previously participated in the Program. They account for 43% of the projects and 47% of the housing units recruited in 2005. (The comparable percentages for 2004 are 40% of the projects and 41% of the housing units recruited, for 2003 are 37% of the projects and 43% of the housing units recruited and for 2002 are 24% of projects and 53% of housing units recruited.)

Figure 4.8: Percent of 2005 Signed Projects and Housing Units from Repeat Builders

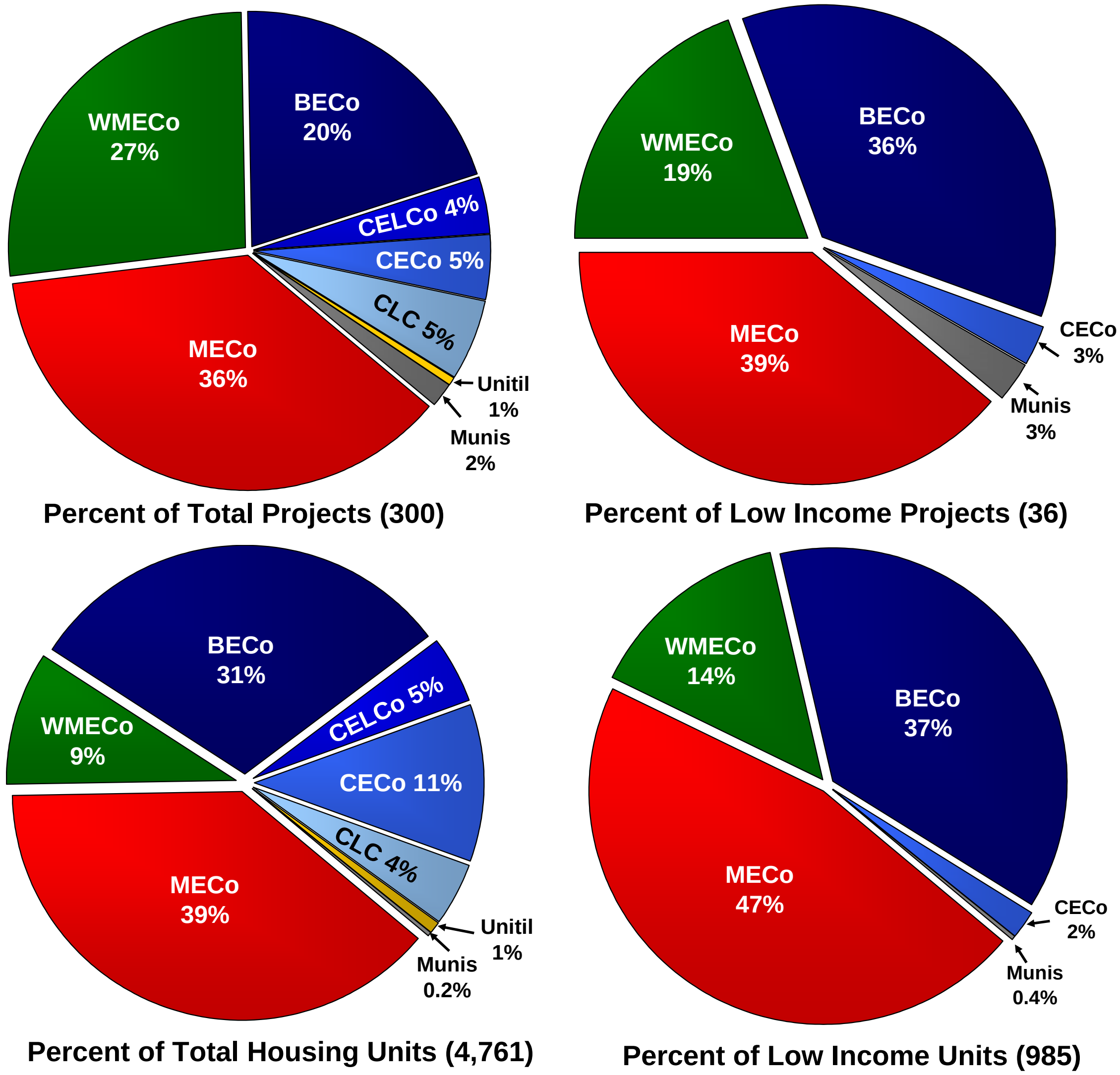


4.6 Distribution across Utility Territories

Figure 4.9 and Figure 4.10 on the following two pages show the number and percentage of projects and housing units signed in 2005 in each of the Sponsors' service areas. Figure 4.9 addresses electric Sponsors' service areas, and also municipal electric service areas, and Figure 4.10 addresses gas Sponsors' service areas. The figures show the number and percent of total and low income projects and housing units recruited in 2005 in each service area. The total number of 2005 signings in gas utility service areas is less than the total for participating electric utilities because some of the areas served by the Program do not have access to gas and are, therefore, not part of the gas utilities' service areas; 31% of all projects and ten percent of all housing units signed in 2005 are outside gas service areas.

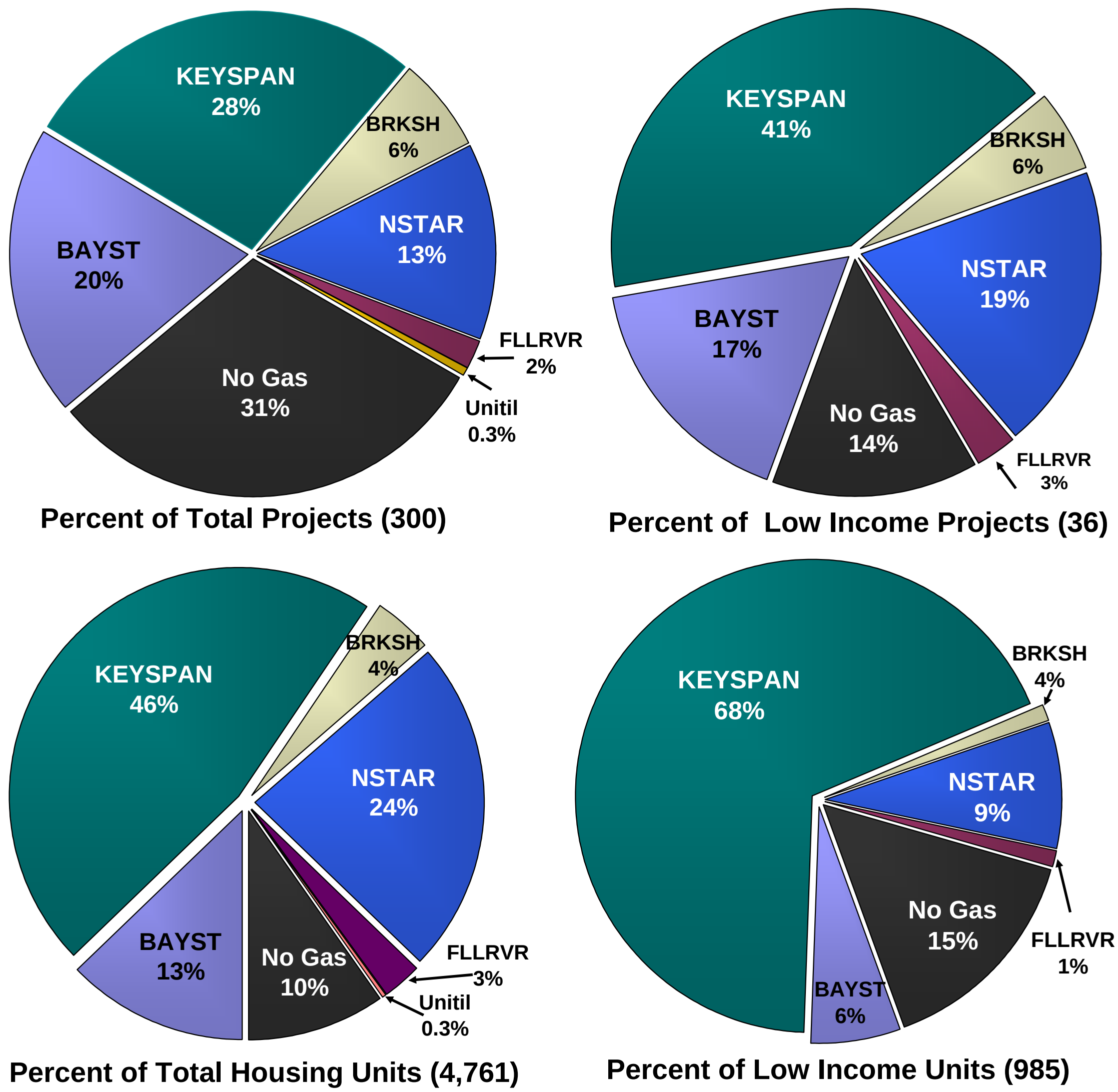
Clearly, the projects and housing units are not evenly distributed across electric or gas service areas. One of the biggest changes from 2004 is an increase in the number and percentage of low income housing units recruited in Massachusetts Electric territory; the number of low income units recruited in Massachusetts Electric territory increased from 60 housing units or 12% of all low income units recruited in 2004, to 454 housing units or 46% of all low income units recruited in 2005.

Figure 4.9: Electric Sponsor Signed Projects and Housing Units



Electric Utility	Total Projects	Non Low Income Projects	Low Income Projects	Total Units	Non Low Income Units	Low Income Units
Mass Electric (MECo)	111	97	14	1,844	1,390	454
Western Mass Electric (WMECo)	80	73	7	441	302	139
Boston Edison (BECo)	61	48	13	1,463	1,094	369
Cambridge Light (CELCo)	11	11	0	220	220	0
Commonwealth Electric (CECo)	14	13	1	529	510	19
Cape Light Compact (CLC)	16	16	0	208	208	0
Unitil	2	2	0	48	48	0
Municipals (Munis)	5	4	1	8	4	4
Totals:	**300**	**264**	**36**	**4,761**	**3,776**	**985**

Figure 4.10: Gas Sponsor Signed Projects and Housing Units



Gas Utility	Total Projects	Non Low Income Projects	Low Income Projects	Total Units	Non Low Income Units	Low Income Units
Bay State (BAYST)	59	53	6	611	552	59
KeySpan Gas	83	68	15	2,222	1,551	671
Berkshire Gas (BRKSH)	19	17	2	193	181	12
NSTAR Gas	40	33	7	1,124	1,039	85
Fall River Gas (FLLRVR)	6	5	1	132	121	11
Unitil	1	1	0	12	12	0
Blank	92	87	5	467	320	147
Totals:	**300**	**264**	**36**	**4,761**	**3,776**	**966**

5. Point Score Data

Figure 5.1 shows the percentage of points earned from several measures in each year from 2002 through 2005. ENERGY STAR heating systems earn four points and installing ENERGY STAR windows earns four points. ENERGY STAR refrigerators, room air conditioners, dishwashers, clothes washers and central air conditioning (SEER 13+) each earn three points. Each ENERGY STAR lighting fixture installed earns two points and each ENERGY STAR compact fluorescent light (CFL) bulb earns one point. Installing photovoltaics earns one point. The large majority of points come from lighting measures, with almost one-half of all points coming from CFL bulbs. The percentage of points coming from lighting fixtures continues to decline while the percentage of points from CFLs continues to rise, although the increase in 2005 is minimal following two years of very large increases.

Several measures that earn points, and account for less than one percent of points, are not included in Figure 5.1. The measures not included in Figure 5.1 and the percentage of total points they accounted for in 2005 are: room air conditioners (0.3%), 13+ SEER central air conditioning (0.3%), clothes washers (0.1%) and photovoltaics (0.1%).

Figure 5.1: Percent of Points from Measures 2002 - 2005

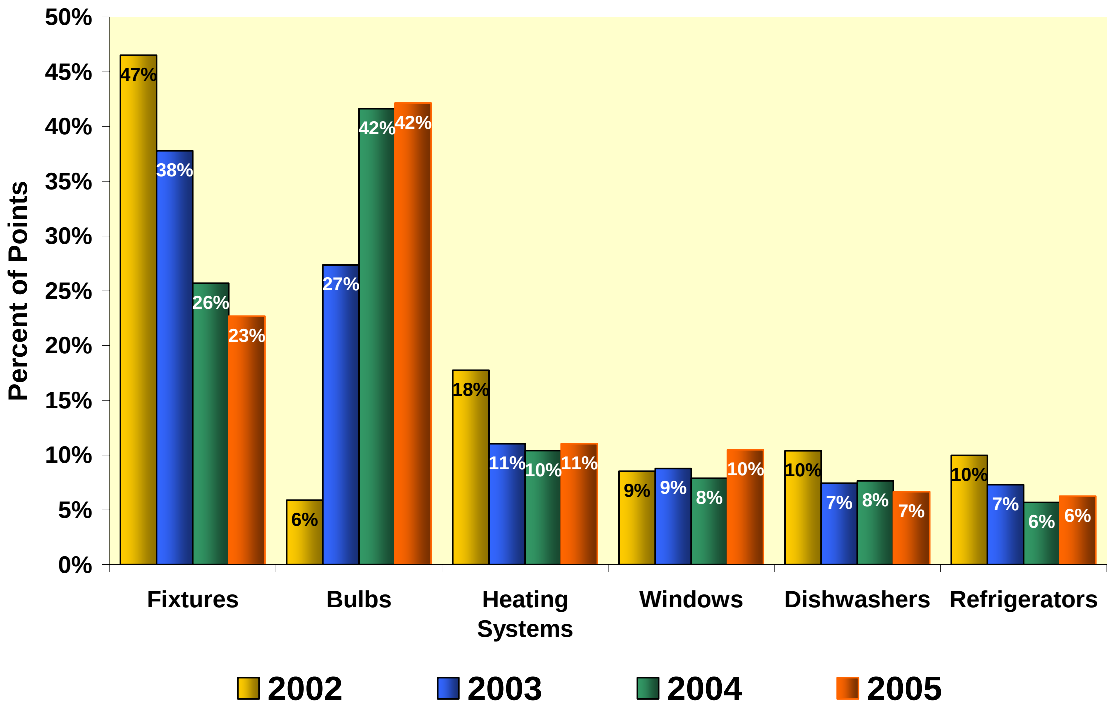


Figure 5.2 shows the percentage of housing units certified in each year from 2002 through 2005 that installed lighting and appliance measures. The percentages of housing units installing lighting and appliance measures changed little in 2005.

Figure 5.2: Percent of Certified Housing Units Installing ENERGY STAR Lighting and Appliance Measures 2002 - 2005

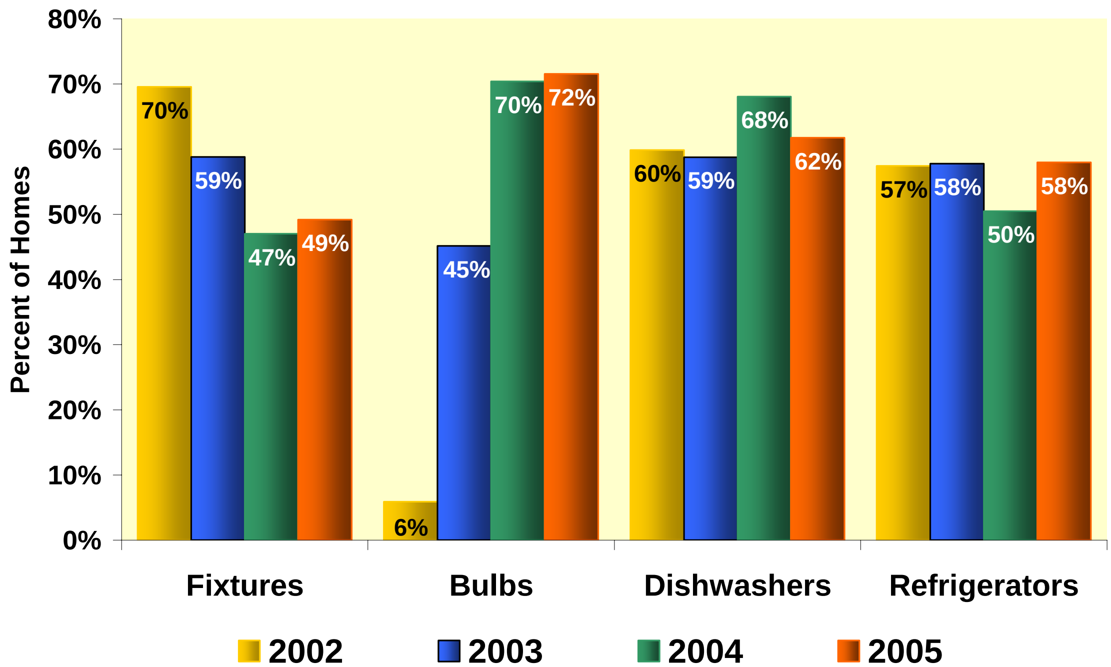
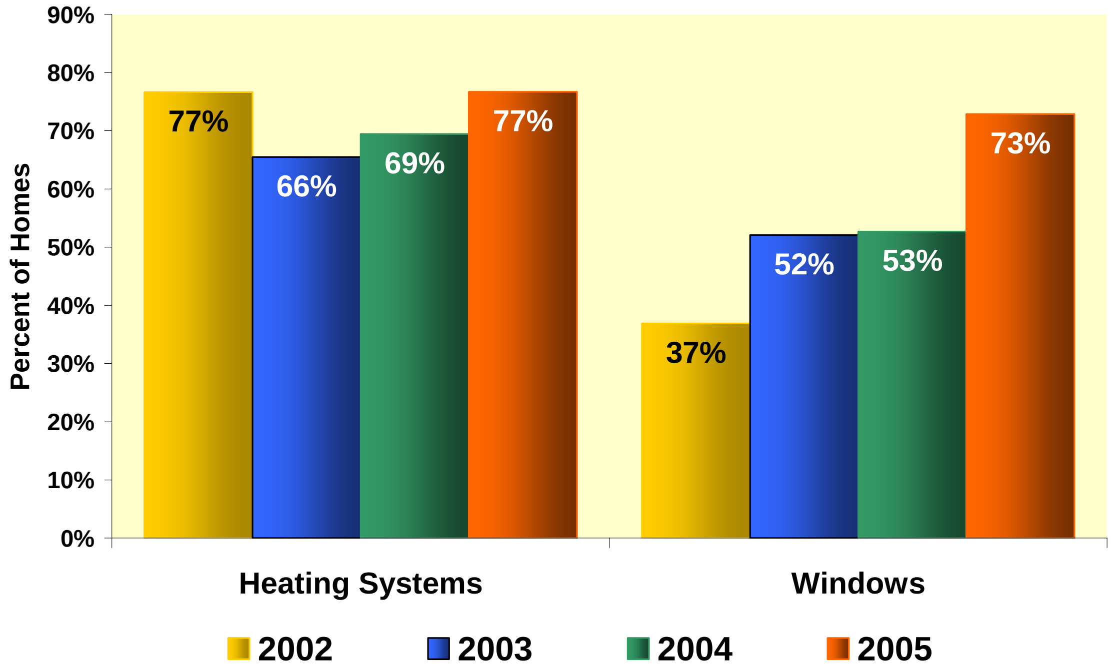


Figure 5.3 shows the percent of ENERGY STAR-certified housing units that installed ENERGY STAR heating systems and windows. As shown, the percentage of homes installing ENERGY STAR heating systems has been relatively stable over the last four years while the percentage of homes installing ENERGY STAR windows increased by more than one-third in 2005.

Figure 5.3: Percent of Certified Housing Units Installing ENERGY STAR Heating Systems and Windows 2002 - 2005



NMR
Nexus Market Research, Inc.

Evaluation of the MassSAVE Program:

Market Survey Results

Final

December 30, 2005

Submitted to:
Bay State Gas
Berkshire Gas
Cape Light Compact
KeySpan Energy Delivery
National Grid
New England Gas Company
NSTAR Electric and Gas Corporation
Unitil
Northeast Utilities/Western Massachusetts Electric

Submitted by:
Nexus Market Research, Inc.

22 Haskell Street   Cambridge, MA 02140
Phone: 617-497-7544 Fax: 617-497-7543
www.nexusmarketresearch.com

Nexus Market Research, Inc.

Table of Contents

Nexus Market Research, Inc.

Executive Summary

This report summarizes the findings of the MassSAVE Market Survey conducted from a sample of Massachusetts residents selected at random. A total of 779 individuals were surveyed in September of 2005; of these, 668 are considered targeted by the program. Targeted customers live in a one to four family structure and either own their homes or pay for their own heat or electricity. The survey is designed to measure:

- Name recognition and where residents are hearing of the program
- Understanding and valuing of the program offerings
- Likelihood of installing energy efficiency measures with rebates, loans, or some combination of the two
- Payback requirements for energy efficiency measures
- Where appropriate, landlord receptiveness to MassSAVE offerings for their rental units
- Proportion of housing units in one to four family structures, owner occupied units, and renters who pay for their own heating

The survey is also designed to recruit qualified homeowners for on-sites to assess the remaining technical and market potential in existing housing stock.

The survey was developed by Nexus Market Research, Inc. as part of a larger evaluation of the MassSAVE Program directed by RLW Analytics. Findings from this survey as they relate to the Multi-Year Evaluation Plan for the MassSAVE Program (submitted November 1, 2004) are shown in Appendix A. It is our intention to update the Table for Market/Program Indicators in Appendix A as more components of the overall evaluation are completed.

Kingman Yacht Center
Energy Audit Report

January 2006

Prepared for

Kingman Yacht Center
1 Shipyard Lane
P.O. Box 408
Cataumet, MA 02534
and
Cape Light Compact
P.O. Box 427, Superior Courthouse
Barnstable, MA 02630

by

RLW ANALYTICS
179 Main Street, 3rd Floor
Middletown, CT 06457

Table of Contents

Listing of Tables

Listing of Figures

1 INTRODUCTION

Customer Name	Kingman Yacht Center
Account Number	427332300
Location	Cataumet, MA
Industry	Marina/Boatyard Services
Date visited	7/22/05
Site contact	Scott Zayne
Sponsor Contact	Kevin Galligan, Energy Efficiency Program Manager, Cape Light Compact, (508) 375-6828

In 2005, RLW Analytics, Inc. was approached by Cape Light Compact to help Kingman Yacht Center understand their energy consumption, suggest conservation and energy management opportunities, and investigate several overloaded circuits. In late July of 2005, an RLW engineer visited the yacht center to perform a broad-scope energy audit.

2 FACILITY DESCRIPTION

Kingman Yacht Center is Cape Cod's largest, full-service marina, boatyard and cruising center. The facility has 235 slips and 130 moorings available for daily or seasonal rental, and capacity for vessels up to 120' in length. All slips are serviced by fresh water, 110V and, at some slips, 220V electricity[1]. Many boat slips at Kingman Yacht Center are available for "dockominium" ownership through the center's 99-year slip leasing program.

As a full-service marina, KYC also provides overnight guest services such as restrooms & showers, laundry, office services, and wireless Internet. Kingman Yacht Center is also home to the Chart Room Restaurant & Piano Bar, one of the Cape's most popular dockside spots. Crews Ltd. serves up breakfast and newspapers in season and stocks basic convenience items, while Periwinkles Gifts sells boating gifts, souvenirs, and more.

[1] This is according to the Kingman Yacht Center website. As we will explain, this is not accurate.

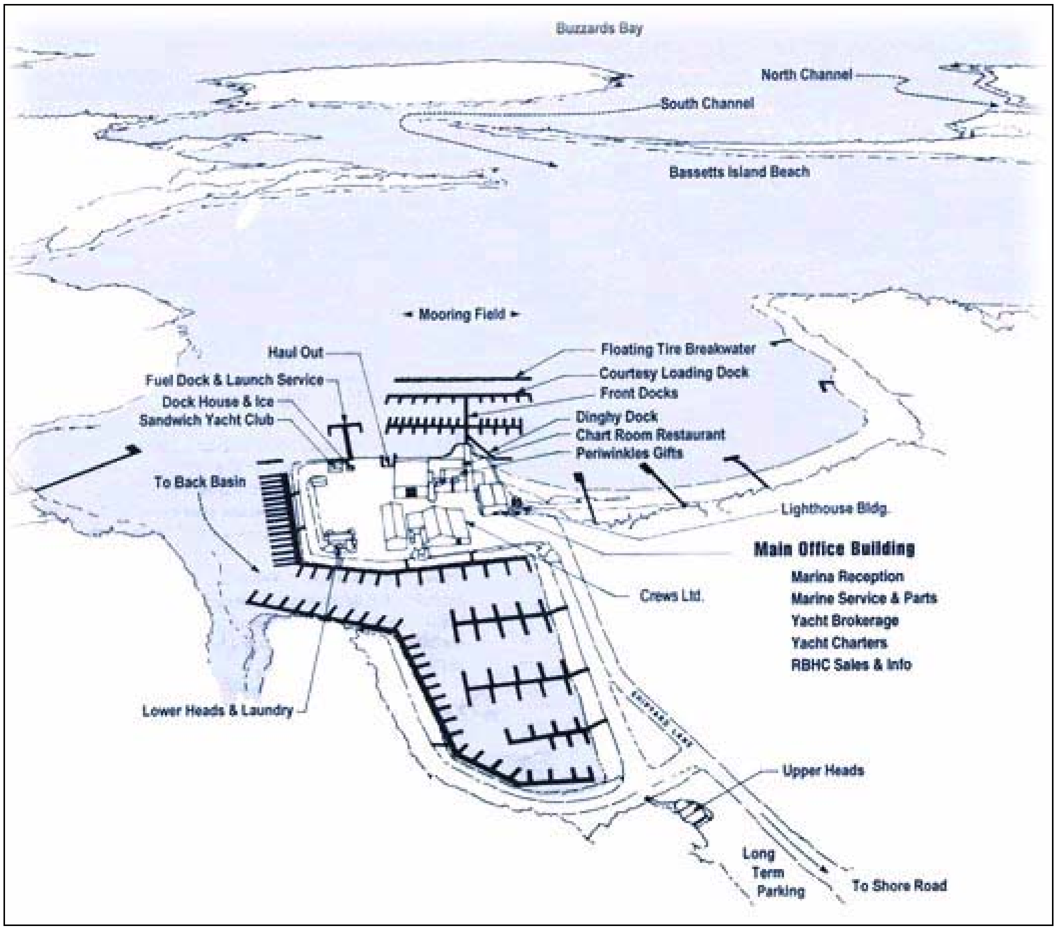


Figure 1: Overview of Kingman Yacht Center

3 LOAD CHARACTERISTICS

This section examines the load characteristics of the site in detail. A thorough load analysis contributes to understanding how the facility uses electricity both in aggregate (e.g. total monthly kWh) and dynamically (e.g. kW by hour) and can ultimately lead to identification of energy and demand reduction opportunities.

3.1 SUMMARY STATISTICS

Table 1 presents a broad summary of the annual energy statistics for KYC for the years 2003, 2004 and 2005[2]. Energy and demand has been notably stable over the past three years, with a slight decline in peak demand and <1% increase in annual energy consumption.

[2] December 2005 data was not available at the time of report production, so the average of the prior two Decembers was used as a proxy for estimating annual kWh and peak kW.

	2003	2004	2005
Annual kWh	562,883	566,604	572,065
Peak kW	199.0	199.0	196.0
Load Factor	32%	33%	33%

Table 1: 2003-2005 Annual Energy Statistics

Load factor is a measure of the average demand of a facility relative to its peak demand. AA facility with a load factor of 100% would have a peak demand and average demand that were equal, and the hourly load profile would be a flat line. In this case, KYC had a 2005 load factor of 33% percent which is fairly low and indicates that average annual demand of 65.3 kW (572,065 kWh/8,760 hours) is 33% of the peak demand of 196.0 kW.

3.2 MONTHLY BILLING HISTORY

Kingman Yacht Center's billing history for 2003-2005 is depicted graphically in Figure 2. The monthly usage patterns are remarkably similar across these three years.

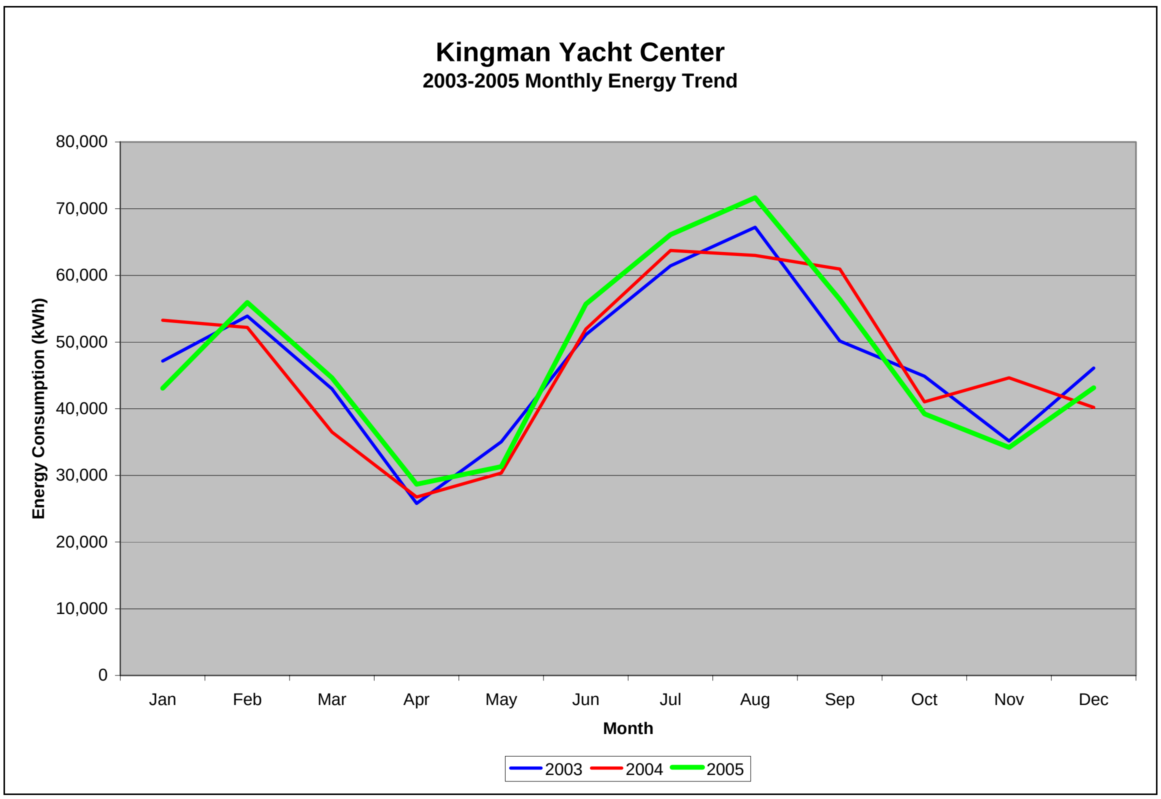


Figure 2: 2003-2005 Monthly Electricity Trend

Higher usage in the summer of 2005 is likely explained by ambient temperature. In 2005, average and peak temperatures were approximately 5°F and 10°F higher, respectively, than 2004. Incidentally, there seems to be a lot of winter electricity consumption for a summertime facility. The correlation with the two coldest months of

January and February suggests electric heating loads, and fairly significant ones at that. If facility management cannot readily explain this wintertime usage, further investigation is warranted.

3.3 Detailed Energy Profiles

Four 4-channel 3-phase true-RMS power recorders were installed to monitor dock power consumption from July 22nd through August 16th of 2005. This power meter sampled voltage, current, active power, and power factor at high frequency and recorded integrated fifteen-minute interval data.

Demand (kW)

As seen in Figure 3, the hourly peak demand ranged from about 28 kW to nearly 90 kW on the docks. The black line in the figure below represents the peak demand day of Friday, August 5, 2005, and the dashed red line indicates outdoor temperature. Peaking at 98 °F just after noon, this was the hottest day of 2005. Note the dramatic rise in demand from noon to 6pm as temperatures rise and, presumably, boaters prepared for weekend departure. In comparison, the average weekday/weekend profiles are considerably lower and more consistent.

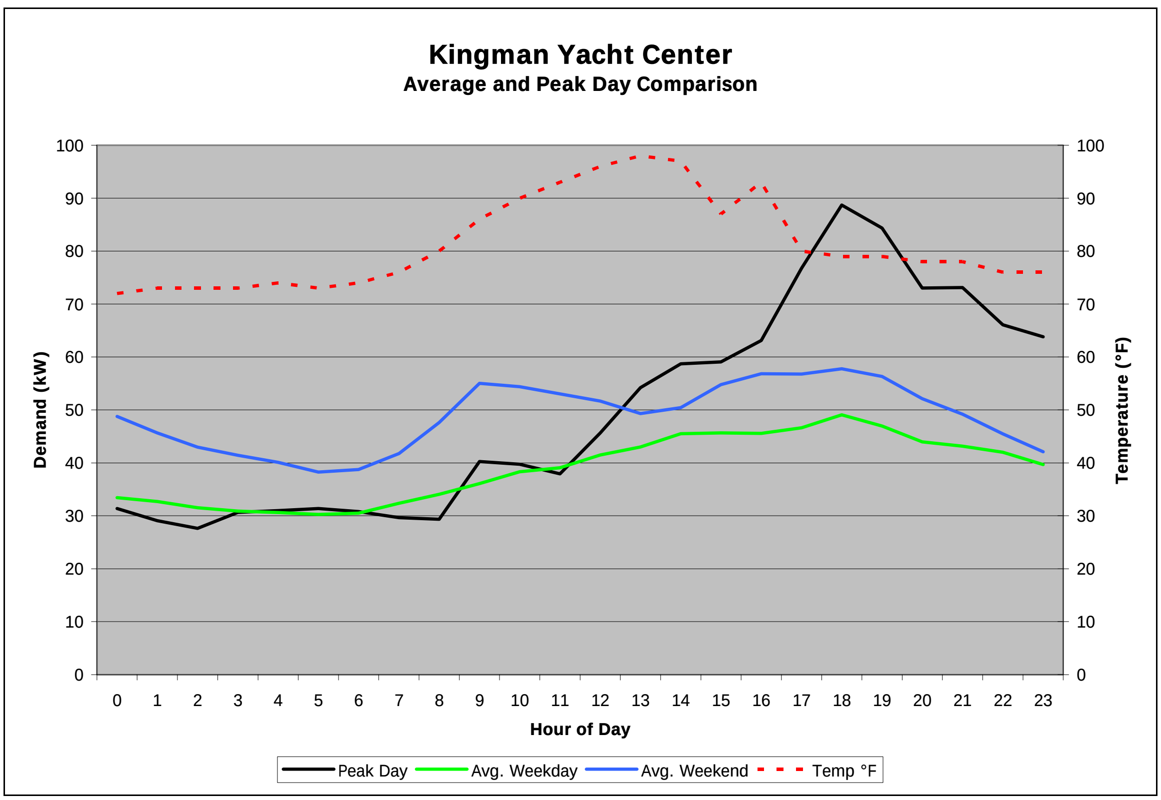
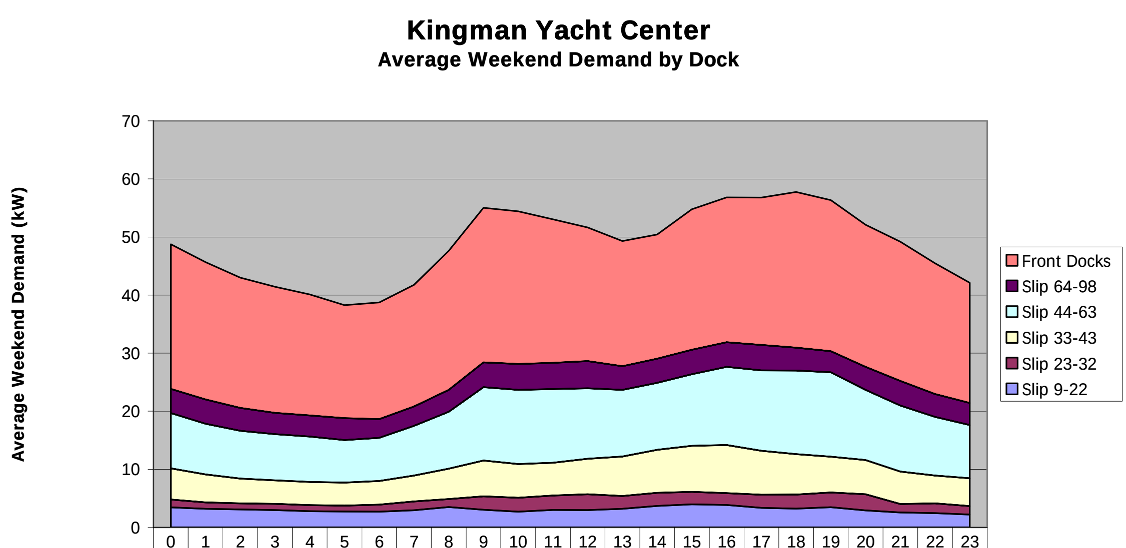


Figure 3: Average and Peak Day Comparison

Figure 4 is interesting, as it shows the relative contribution of each dock to the average weekend load profile. The top cumulative line follows the blue 'Avg. Weekend' line in Figure 3 above. This stacked chart clearly indicates that the front docks are the most significant load at the yacht center. The front docks are also distinguished by a more pronounced 8-9 am crest in demand, yielding comparable demand in both the morning and evening hours, probably due to departures and arrivals.



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Front Docks	24.9	23.7	22.4	21.7	20.8	19.5	20.1	20.9	24.0	26.6	26.3	24.7	23.0	21.6	21.4	24.2	25.0	25.4	26.8	26.0	24.5	24.0	22.5	20.7
Slip 64-98	4.1	4.2	3.9	3.7	3.6	3.8	3.3	3.3	3.8	4.3	4.5	4.5	4.7	4.1	4.2	4.2	4.2	4.3	3.9	3.6	3.9	4.2	4.0	3.8
Slip 44-63	9.5	8.7	8.2	8.0	7.8	7.3	7.4	8.6	9.8	12.7	12.8	12.7	12.1	11.5	11.5	12.3	13.4	13.8	14.4	14.5	12.1	11.4	10.1	9.2
Slip 33-43	5.4	4.8	4.3	4.0	4.0	4.0	4.1	4.4	5.2	6.1	5.8	5.7	6.1	6.8	7.4	7.9	8.3	7.6	7.0	6.2	5.9	5.6	4.8	4.8
Slip 23-32	1.4	1.1	1.0	1.1	1.0	1.0	1.2	1.5	1.4	2.3	2.4	2.5	2.7	2.2	2.2	2.1	2.1	2.3	2.4	2.5	2.8	1.5	1.7	1.5
Slip 9-22	3.4	3.2	3.1	3.0	2.8	2.7	2.7	2.9	3.5	3.0	2.7	3.0	3.0	3.2	3.7	4.0	3.9	3.3	3.2	3.5	2.9	2.6	2.4	2.2

Hour of Day

Figure 4: Average Weekend Demand by Dock

We have included a data table at the bottom of Figure 4 to provide KYC with useful hourly estimates of demand on each dock. We do not have confident estimates of the number of boats contributing to these values, but KYC could divide these values by the total number of slips to ascertain the mean kW per slip in each dock area. Additional correlation of this information by average boat size or type might also prove insightful.

Power Factor

Power factor is defined as the ratio of real power to the apparent power and may be thought of as the fraction of electrical current that performs useful work. Resistive linear loads such as incandescent light bulbs, resistance heating, and electric motors maintain sinusoidal waveforms where the current waveform is in-phase with the voltage waveform and the power factor is one. Non-linear or inductive loads such as electronic ballasts, personal computer power supplies, and variable speed drives distort the current waveform and bring the current and voltage waveforms out of phase, thus lowering the power factor. Figure 5 displays the peak demand and corresponding power factor by hour as monitored in July and August 2005.

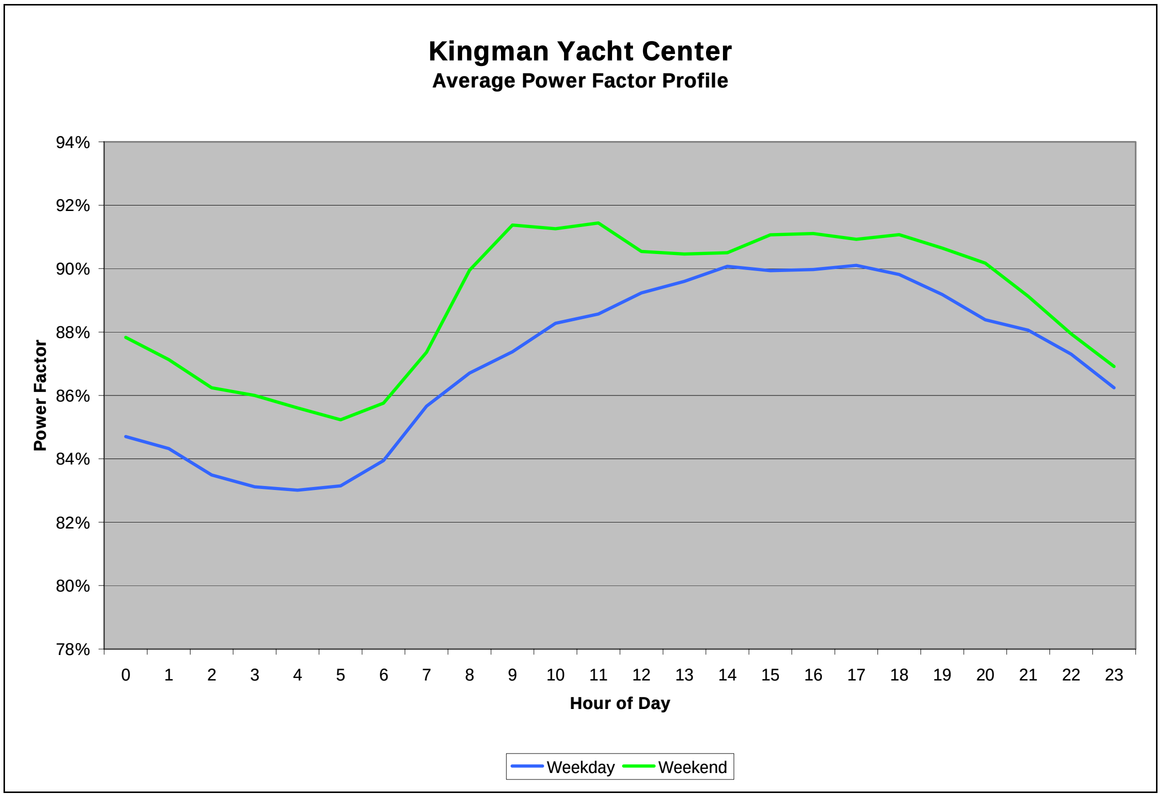


Figure 5: Average Power Factor

The hourly power factor at KYC averages between 83% and 92%, which is reasonable by most standards. Power factor fluctuations can be quite dynamic, and over the monitoring study the 15-minute integrated power factor ranged from 78% to 99%. A proper power quality study involves much more rigorous metering at very high frequency, while this cursory review is merely a screen for significant disturbances or out-of-range values. We consider these power factor findings to be quite acceptable.

VOLTAGE

Sub-metering was performed in a vintage power house fed by 120/208V WYE service, and voltage was generally in range at KYC. However, there are several observations of note. First, facility personnel spoke of voltage as 120/240V, when in fact the docks were provisioned for 120/208V. RLW engineers are not highly knowledgeable of marine equipment, but much 240V equipment on-land is rated for 208/240V. Nonetheless, Kingman Yacht Center may want to review the electrical requirements of their vessels and display the supply voltage clearly on the docks to mitigate potential liability issues.

Second, there were several periods of extremely low voltage. On Thursday, July 28th from 1:00-1:30pm, voltage dropped as low as 32V on the circuit feeding Slips 44 through 98. Facility management had suggested that this circuit was problematic for them and that the breaker serving Dock 7 periodically trips. The low voltage anomaly was not related to a period of high amperage. We recommend specialized diagnostic testing on this circuit to check for a ground fault, voltage leak, or corroded splice connection.

The voltage range measured throughout the study ranged from a low of 107V to a high of 126V, which is very broad. Nominal voltage is 120V and a +5% feed of 126V is typical at substation output, but not at the end of a shoreline road. Acceptable voltage levels are ±10%, so 108V is generally considered the low voltage threshold, and voltage at KYC reached or broke this level on several occasions. Further investigation should be performed by utility distribution experts, but these findings suggest constraint or overload of the delivery system feeding the yacht center.

3.4 COMPARISON OF SLIPS 11 AND 12

In addition to all of the circuits feeding the docks, a power logger was installed specifically on two adjacent slips 11 and 12 for the purposes of contrasting power consumption of two similar sized boats. Besides the minor difference in length, the key differentiator was the air-conditioning practice of the owners. The owner of the 38' Sabreline rarely runs his air-conditioner, while the 42' Maxum runs fairly continuously.

Table 2 presents a summary of the monitoring findings over a 26-day period. This data suggests that air-conditioning operating costs are about $2.50/day for a boat of this size.

Slip	Boat	Average kWh/day	Average $/day	Average kW	Peak kW
11	38' Sabreline	3.38	$ 0.45	0.14	2.59
12	42' Maxum	21.87	$ 2.92	0.91	4.26

Table 2: Summary of Slips 11 and 12

Originally, we had intended to use these two boats in an air-conditioning experiment, setting one boat for a cabin temperature of 70 °F and another for 80 °F. However, the boat owners forgot to maintain these settings, so the study reverted to a simple comparison of air-conditioning versus non-air-conditioning for presumably otherwise similar boats. Figure 6 compares the average demand profiles of the two boats.

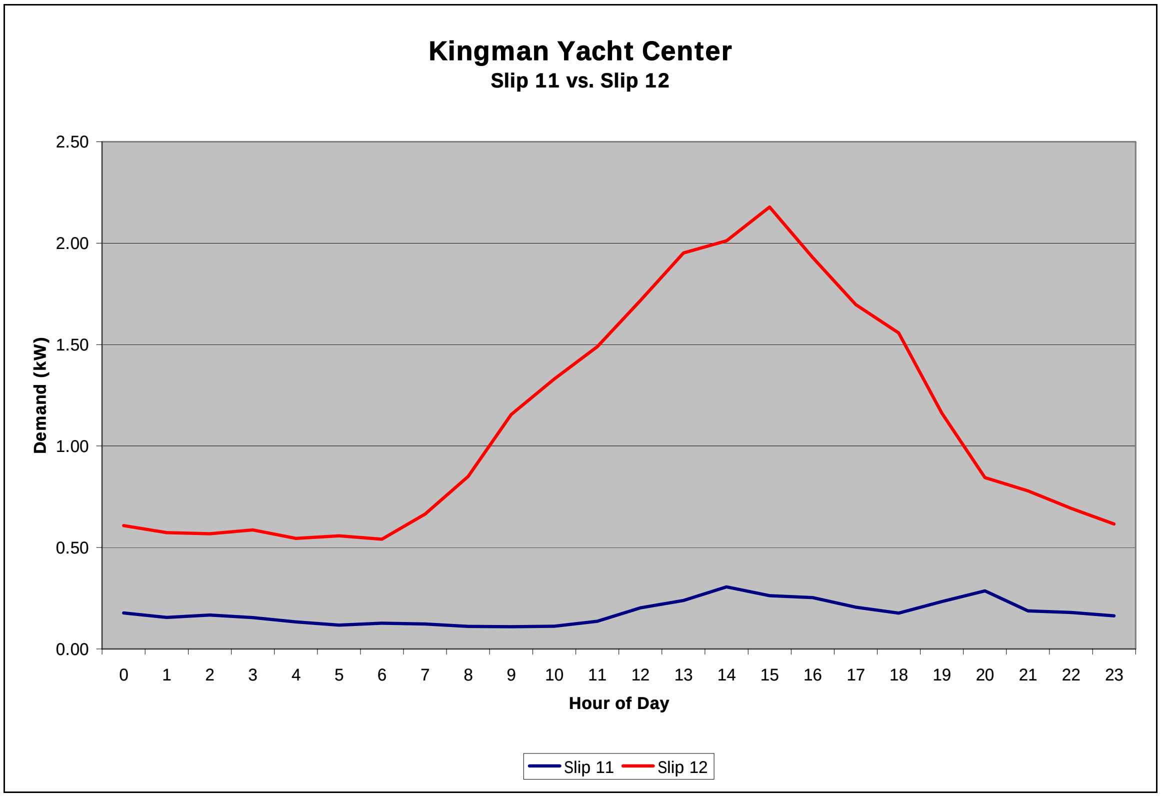


Figure 6: Comparison of Slips 11 and 12

As evidenced by the figure above, while on average these two loadshapes differ by just 0.77 kW, the hourly profiles differ significantly. At roughly a 2 kW peak impact, fifty boats operating similarly to Slip 12 would contribute about 100 kW to the peak load on a 90+ °F day. With the seasonal and variable components of modern demand charges, it is difficult to estimate the cost impacts of demand. But it is clear that the coincident effect of multiple boats operating AC could accumulate a hefty kW load on a hot summer day. This would translate to a high demand charge and potential reliability problems, as the rear/side dock power distribution network at KYC is fairly constrained.

4 Demand Response

Demand response is a concerted effort to temporarily reduce electrical consumption during specific times of need, in response to high real-time wholesale electricity prices or when the reliability of the region's power grid is stressed. Some uses of electricity are discretionary, or easily done without, while others are mission-critical. Some uses are somewhere in between, depending on the urgency of the need or the magnitude of incentives that might be available.

Demand response events are triggered by high loads or capacity shortfalls or forecasted high wholesale prices. These hours of peak demand typically occur in the middle of the week during daytime hours, and are often associated with adverse weather conditions.

Customers can contribute demand reduction in a variety of ways:

- Load shedding, such as turning off non-essential lights, office equipment, and processes or adjusting HVAC set points
- Load shifting, for example delaying (until off peak times) or reducing manufacturing levels
- Operating on-site generators

Figure 7 presents a graphic depiction of load shedding and load shifting. The base load in blue is the profile if no reduction actions were taken. For both methods, the reduction event itself is shown in the dashed black line.

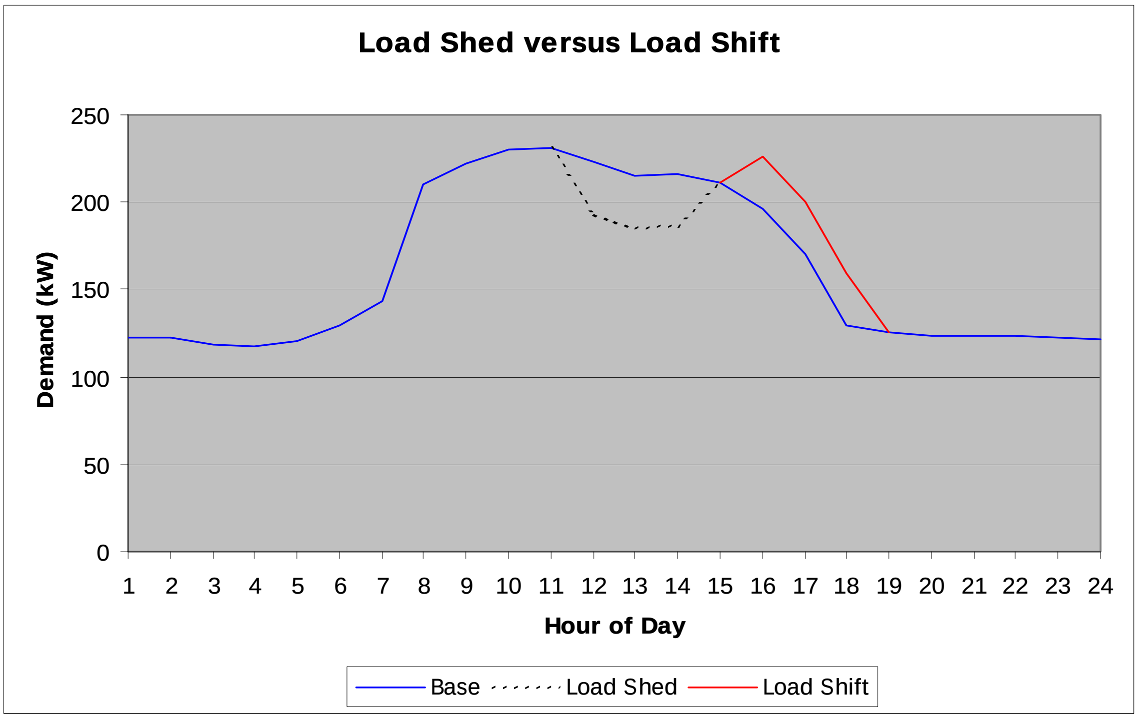


Figure 7: Illustration of Load Shed vs. Load Shift

In a **load shed**, electrical consumption is restored to original levels after the event. Load sheds impose no usage consequences of significance after the event is over. The dashed load shed returns to the base load in blue after the event.

A **load shift** is a demand reduction that necessitates delaying electrical consumption until after the event. A manufacturing firm that shuts down a production line for a few hours but must 'make up' that lost production at the end of the event is enacting a load shift. The dashed-line load shift results in the deferred usage in red to compensate for the duration of the event.

Incidentally, demand reductions by increasing space temperatures on air conditioning equipment exhibit characteristics of each method. The energy usage of cooling systems will rebound after the demand reduction event to restore space temperatures, however the resultant cooling 'backlash' is typically of a shorter duration that the event itself. We categorize such a reduction as a load shed, although it tends to include a small load shift.

If generation is used to provide load reduction, the customer does not necessarily use any less electricity. However, the customer's load profile as seen by the electrical grid will look like the load shed illustration, with the amount of shed equal to the amount of energy provided by the generator when it is running.

Incentive payments are available to commercial and industrial electricity users in New England through ISO-New England's Demand Response Programs, offered to all customers in New England. Incentives vary with the level of reduction and the length of notice needed by the customer to respond. The variety of programs gives customers the flexibility to choose the program that best fits their individual needs. Contact the Cape Light Compact person identified on page 1 for more information about available programs and incentives.

Customers who understand their hourly energy profile and can manage their consumption in response to wholesale prices or reliability events can become more attractive and valued customers to competitive electricity suppliers, which may translate into the customer negotiating a lower retail electricity price. Plus, the hourly usage information and software systems available to participating customers can be used to help manage energy consumption and demands every day of the year, helping to improve the customer's energy efficiency.

In addition to direct customer benefits, demand response participants provide an important resource for New England. They help ensure the power grid's reliability--potentially avoiding power outages during times of high demand--reduce wholesale price volatility that drives up the cost of power for everyone, and reduce air pollution by enabling older, less efficient power plants to run less often.

Kingman Yacht Center does not have enough discretionary kW to participate in regional load response programs. The minimum load shed for the ISO-NE Load Response Programs is 100 kW, and it is highly improbably that KYC could drop that much load.

5 CONCLUSION AND RECOMMENDATIONS

Considerable effort was spent collecting and analyzing detailed electrical data on the docks at Kingman Yacht Center. KYC is now armed with excellent information on the kW load profiles of their docks. This data should prove useful for future expansion purposes and also in project or cost-sharing calculations.

While this study was useful in characterizing the average dock profiles, more important, however, are some of the following findings and recommendations.

INVESTIGATE WINTER ELECTRICAL USAGE

A billing review shows considerable electricity consumption in the winter months. Correlation with the two coldest months of January and February suggests fairly significant electric heating loads. An examination of wintertime loads may be in order. RLW would gladly revisit the marina to review any excessive loads or conservation opportunities.

AUDIT OR SUB-METER KYC BUILDINGS

This 'stage one' audit of KYC focused upon dock power and did not examine the usage of the office building, restaurant, or other surrounding structures. With approximately 100 kW of load unaccounted for, much of which appears in winter months, there is additional load that may benefit from energy conservation measures.

DOCUMENT DOCK VOLTAGE SUPPLY

The docks are provisioned for 120/208V, not 120/240V. As we are not experts on marine power, this may not be an area of concern, but we recommend that facility management review vessel power requirements and rental agreements to ensure there is no misunderstanding or potential liability on this issue.

TEST SERVICE SUPPLY VOLTAGE

The voltage range measured throughout the study ranged from a low of 107V to a high of 126V, which is very broad and nearly out of the acceptable range. KYC should request further study by local utility distribution engineers. The extent that KYC voltage varies with load suggests a possible constraint in the delivery system, transformers, or feeders servicing the yacht center.

INVENTORY REMAINING ELECTRICAL LOAD

As an account, Kingman Yacht Center peaks at 199 kW. It is interesting to note, then, that the 89 kW of dock load (see Section 3.3) comprise less than half of the demand of the entire facility. At the facility manager's direction, the audit focused mainly upon on dock power, but it turns out that the majority of the facility's load remains yet unidentified. We speculate that the bulk of the remaining electrical load probably exists in the Chart Room Restaurant (electric ovens/warmers) and also in maintenance buildings (air compressors/high-bay lighting). The office and gift shop spaces are likely insignificant with expected total electrical density below 2.5 W/sqft.

MANAGE PEAK DOCK LOAD

Peak load, at least on the docks, correlates with two variables: day-of-week and outdoor temperature. Docks are used more on Fridays and weekends, and boats draw more air conditioning power on hot days.

- Ask boaters to conserve power on hot days by minimizing air conditioning and other dock power usage. A polite appeal and awareness campaign with emphasis on electrical conservation and reliability tends to be quite effective. For example, ventilating a cabin naturally for 15-minutes to exhaust the built-up heat can dramatically reduce cabin temperatures and the resultant cooling load.

TEST DOCK 7 CIRCUIT

Facility management declared at our initial meeting that the feeders for Dock 7 are undersized, particularly when a large vessel docks at the end of the pier. As this was a trouble area for KYC, our engineer isolated this circuit for a short-term metering study. The occurrence of a voltage anomaly on just this circuit on July 28th suggests a deeper problem.

- Perform rigorous diagnostic testing on this circuit for losses and/or leaks. At minimum, replace the circuit breaker feeding the dock, as circuit breakers tend to trip more readily with each successive over-current incident.
- To the extent practical, try to stagger electrical usage on Dock 7 when a large vessel docks until additional electrical capacity can be added.

ENERGY CONSERVATION MEASURES

The preceding recommendations should take priority over energy conservation measures. Surely there will be opportunities to retrofit lights, HVAC, motors, etc. at Kingman Yacht Center. However, we strongly recommend addressing the aforementioned issues before getting involved in a significant conservation project, for there may be some work warranted on the marina's customer-side distribution system.

REMAIN VIGILANT

Even though the Kingman Yacht Center does not have enough discretionary kW to participate in regional load response programs, it is wise for facility management to remain aware of load response and demand management initiatives in the region. There are opportunities for customers, organizations, or consortiums to *aggregate* loads and participate in these programs. As demand management becomes more important with each passing summer, seasonal facilities may find themselves under more scrutiny. Kingman Yacht Center should remain vigilant in the search for conservation and load management opportunities.

Evaluation of Cape Light Compact Residential New Construction Green Building 2003 Demonstration Project

Prepared for
the Cape Light Compact

March 8, 2006

Jan Harris and Peter Schneider
Vermont Energy Investment Corporation

VERMONT ENERGY INVESTMENT CORPORATION

255 South Champlain Street, Suite 7

Burlington, Vermont 05401

(802) 658 - 6060

www.veic.org

I. Executive Summary

The 2003 Cape Light Compact's Residential New Construction Green Building Demonstration Project was originated to maximize cost-effective energy savings and other non energy green benefits in four pilot homes. The project also set out to identify market barriers that inhibit the development of green or high-performance homes to inform its actions going forward. The evaluation team was asked to compare the Demonstration Project with the existing ENERGY STAR Homes program and to identify costs and benefits of the program in comparison to ENERGY STAR. The pilot involved the construction of four homes built to the Vermont Builds Greener (VBG) residential green building standard. The evaluation team visited each of the four houses, interviewed the homeowners and builders, and conducted a performance evaluation of each house to determine if they were performing as originally modeled.

Overall Findings:

- All participants are very happy with their homes in terms of size, functionality, aesthetics, maintenance, energy costs and comfort, and recommend the use of a green building standard on Cape Cod.
- The VBG checklist was found to be a very useful/helpful tool which needs to be supplemented with additional information resources.
- The energy benefits were found to be cost-effective, i.e. the incremental costs were more than offset by the associated savings. However the energy savings were not the primary customer motivation for building to a green standard.

Other areas covered in this report include:

- What were the challenges to building green?
- The need for green building professional training;
- Access to green building materials;
- Subcontractors and suppliers gaps in knowledge of green building methods and materials; and
- Non energy benefits.

Recommendations:

- Continue to collaborate with and support the work of programs with similar goals such as ENERGY STAR Homes;

- Leverage other resources that support green homebuilding objectives such as Federal tax credits, Massachusetts Technology Collaboartive (MTC) incentive programs, the Green Homes Northeast (GHNE) effort and others;
- Utilize past participants as information resources;
- Quantify and track non-energy benefits; and
- Use the U.S. Green Building Council's (USGBC) LEED for Homes green building standard going forward.

II. Introduction

The practice of green home building utilizes methods and materials that are environmentally responsible and creates a building that is healthy to occupy, cost effective to build, own and operate and durable. This practice has been around for centuries, but has had a resurgence in the last few decades in response to the increased number of buildings constructed that were unhealthy, expensive to operate and were not lasting as long as they should. In response to an increasing problem of "green washing," or invalid claims of green, standards were developed, along with third party verification to ensure that claims of green are well founded. In the residential sector several rating systems have emerged. For this pilot, the Cape Light Compact selected the Vermont Built Green standard as this was widely accepted as the most aggressive of the many U.S. sustainable residential building standards. Since that time, the LEED for Homes program has been developed by the USGBC with input from local and national stakeholder groups. As with all residential green building programs, it is a voluntary initiative promoting the transformation of the mainstream home building industry towards more sustainable practices. Like VBG, LEED for Homes helps define green buildings by establishing a common standard of measurement, promoting integrated, whole-building design practices and materials, stimulating green competition, raising consumer awareness of green building benefits, and working toward transforming the building market to more sustainable practices.

III. Methodology

The evaluation team and the Cape Light Compact agreed to the following methodology for the evaluation:

1. Interview all homeowners and builders who participated in the demo to determine the amount of effort and/or specific dollar amount that was required to achieve the score on the Vermont Builds Greener (VBG) scorecard. (Additionally two perspective green home builders on the Cape were interviewed as well as two building suppliers and all staff who worked on the project: CLC, Honeywell, CSG, VEIC, NEEP.)

2. Conduct a performance assessment using blower door and other performance evaluation equipment to determine if the houses are performing as modeled.
3. Update the REM energy use assessment software files for the four homes with the post occupancy performance data
4. Create a user defined reference home in REM taking a Cape Cod specific set of information from the 234 ENERGY STAR homes built on the Cape during the same time period to establish a baseline for comparison.
5. Create a user defined reference home in REM taking a Cape Cod specific set of information from the Massachusetts new construction baseline study of homes built on the Cape during the same time period to establish a standard practice baseline for comparison.
6. Collect, evaluate and analyze cost and savings data provided to the team from the homeowners and builders of the four demonstration homes and perform a life cycle cost assessment.
7. Evaluate the input on the scorecards and suggest a revised scorecard for use in an ongoing program

IV. Interview results

The interviews were central to the evaluation. All four homeowners and home builders were interviewed as well as two potential new green homeowners, and two building suppliers. The participants were all extremely cooperative and had a lot to say about their experiences in the program and/or with green building in general. In order to most directly convey these experiences, we are providing you with a list of direct quotes from program participants. We have organized them into several numbered topics:

1. Universally the participants found the **checklist** useful:

The VBG checklist was created over the span of six years by independent regional experts; builders, architects, and energy consultants. Since the development team was comprised of volunteers without any sponsorship or affiliation, the VBG program presents straight-forward answers to questions about sustainable building that are specific to Vermont and untainted by green washing or specific product sponsorship. The resulting VBG checklist is widely considered to be the greenest residential green building standard in the country. The approaches have been customized for use in Vermont and are supported by local experts in construction, energy efficiency, and environmental sustainability. All builders and homeowners found that the checklist helped them understand the design elements and choices inherent in a green home as well as evaluate how environmentally considerate their home really is. Comments from the interviewees include the following:

- “It helped to make me think about things that I might not have thought about.”
- “The VBG checklist gave us ideas about where to focus our efforts.”
- “Having to meet the requirements makes us more diligent to ensure that what we’d like to have happen actually does happen.”
- “The scorecard gives us a benchmark, so we are not making arbitrary decisions about what is really important.”
- “Because of the scorecard, we can understand where we should not negotiate on Green.”
- “VBG is also a motivational tool! We are considering more than what we thought about originally. For example, a friend is redoing her kitchen and her ‘old’ cabinets are just fine, so I told her the story of VBG and the scorecard and asked what she was doing with her old cabinets. She is considering letting us use them in the house!”
- “My top suggestion is finding ways of using the VBG scorecard more proactively: Having a scorecard means that the specific things to do are in black and white. This is very helpful. The scorecard also implies that it is both possible and better to do things as listed in the scorecard. This makes it objective – it is not just one wacky environmentalist’s idea. The organization, validation of practices and objectivity of VBG makes it a great tool for educating and motivating. No one can legitimately say ‘that doesn’t work’ if it’s on the scorecard! And with people backing up the scorecard who can explain HOW to do the things listed, the loop is closed.”
- “We both learned from this project and without the drive from the program and checklist we likely would not have gone as far as we did”

2. There was difficulty locating **green products** locally**:**

Several participants expressed difficulty finding products locally that complied with certain approaches on the checklist. An interview with a local hardware and lumber supplier indicates that his customer’s top priority is quality and there is not evidence of a demand for environmentally-friendly products adequate to change his supply at this point. The lumber supplier interviewed had developed a relationship with a mill over time and is assured a certain level of quality (i.e. straight dimensional lumber). Unless their current mill was to begin offering FSC-certified lumber, they would be forced to establish a relationship with a new mill and risk losing the quality they were assured from their previous mill, The lumber supplier did suggest that if he could get sustainably harvested lumber with the same quality assurance, he would sign on because he understood the benefits of a well-managed forest. He further expressed that it is simply not practicable for him to offer both green certified lumber and non-certified lumber.

At the same time a long standing hardware and lumber supply outfit in Provincetown will be changing hands and the new owner has expressed an intention to highlight environmentally friendly products. He plans to call his business the Northeast Green Building Supply Center and serve not only the tip of the Cape but also sell and deliver products throughout New England by truck, mail, and E-commerce. There is a growing demand, and concurrent education among other building material suppliers on the Cape regarding green products. As a result of these developments, and the potential for an ongoing CLC green building program, we perceive the barrier of access to green materials to be a temporary one.

Some of the comments from the interviewees on green products included the following:

- "Having green materials showcased locally would help."
- "My customers are demanding quality, not environmentally friendly products"
- "Inventory space is too limited to carry two types of products"

3. Clearly and repeatedly there was a need expressed for additional **information resources.** This need goes all the way from a preliminary plan review prior to the commencement of construction, to phone support throughout construction, to on site inspection. As the quotes point out, participants feel that one of the highest and best uses of program funding going forward would be to provide an accessible and responsive information resource. One participant suggested using the past participants as resources to future perspective green homeowners and builders. This approach could be a critical resource for future program success. This could be in the form of case studies, home tours, volunteer time to answer questions, or all of the above.

Some of the quotes related to information resources included the following:

- "If I could have accessed more information, I would have been able to do a lot more."
- "I would have liked to talk to a person for really specific questions."
- "There is nothing better than sitting down with a real person after going through the checklist. A face to face, where questions are answered and approaches are validated, is key. I would even volunteer to help others after we get certified!"
- "This is only as good as the person who is the expert, but if volunteer experts can be trained, it would do a lot for educating less knowledgeable and skeptical homeowners and builders."

- "I would gladly have traded the incentives for more technical support. For example, I would have liked someone from the Cape Light to come to the site and assist me in explaining to a building inspector why I don't need to vent a particular sloped attic. I felt like I was on my own."

In summary, participants foresaw a need to provide a plan review early on to identify problems and/or ways of enhancing the proposed design for sustainability. There was a suggestion to make sure air sealing and insulation are included in original construction documents to ensure their inclusion in the base contract and avoid change order extras. One of the VBG requirements is to provide the new homeowner with a user's manual describing the systems and appliances in their new home. It was identified as a helpful suggestion that there should be a template for this manual to ensure that all the pertinent information is captured and conveyed to the new owners.

4. Provide builder and subcontractor **training**, and a list of qualified and/or certified sub-contractors (for example BPI (Building Performance Institute) certification).
Homeowners and builders noted a gap in the knowledgebase of many of the subcontractors, builders, architects and suppliers on the Cape. One of the participants was representative of others when he said he felt there was a need to "Develop a community of contractors and builders with the skill and know how to quote, cost, and accomplish. If builders do not have the knowledge, they are unlikely to offer the options nor will they be capable of presenting the costs to owners in such a way as the owner can evaluate the options." For example, it was difficult to locate a cellulose installer, or to get competitive quotes for a renewable energy system or to find local cotton insulation. Participants suggested a comprehensive training effort to bring subcontractors up to speed. A list of certified individuals and organizations would ease the process of implementing green building.

- Based on our conversations, suggested training topics include the following:
    - Understanding green building standards and strategies;
    - Proper design and installation of renewable energy systems;
    - Sizing and appropriate design of HVAC systems;
    - Air sealing techniques;
    - Insulation options and proper installation;
    - Ventilation techniques (How to achieve good IAQ);
    - Waste reduction practices;
    - Advanced framing (Optimal Value Engineering); and
    - Include factory builders in education efforts.

Some of the comments from the Demonstration Project included:

- There are "huge knowledge gaps in the supplier/contractor community regarding building methods/techniques and materials."
- "A network of trained volunteers/staff that can reduce to practice the concept of green would be a way to keep homeowners excited, and keep builders from talking people out of their good intentions."

5. **Incentives** allowed participants to achieve approaches they otherwise would not have committed to, for example renewable energy systems, additional air sealing and insulation, and high performance heating and hot water systems were all installed because of the incentives offered as part of the Demonstration Program.

IV. Costs and Savings:

We found it difficult to obtain accurate and thorough incremental cost and savings data from participants. Participants complained that it is difficult to gather accurate cost and savings data 2 years after project completion. It is recommended that the program provider require tracking and verification of costs and savings for all participants who receive incentives in any future program. This could be accomplished through a hold back on some of the incentive dollars until data is provided. We received excellent incremental cost data from the Habitat homes, but their cost of construction is not a reasonable proxy for average building costs. The other two homes provided partial cost and savings information. However, combining the information from all four homes with our own information regarding construction costs, we determined an average incremental cost of approximately 2% of total construction costs. This incremental cost is primarily for energy efficiency features such as HVAC, water heating, air sealing, insulation, lighting and appliance upgrades. To calculate savings, we used the REM/Rate software and actual post occupancy measurements of air infiltration and lighting and appliances in the four homes. We created two reference homes, one is a composite home created from Cape Cod specific homes in the MA residential new construction baseline study. The other reference home was created using information from the ENERGY STAR Homes program files to build a Cape Cod-specific ENERGY STAR reference home.

The summary in table 1 below details the energy savings of the green homes compared to the MA new construction baseline home.

Savings from Cape Cod Green Homes compared to MA RNC Baseline Homes

kW and kWh Savings Include Line Loss Savings

No.	House Size (sqft)	Rating Date	HERS Score (v11.4)	Space Heating Therms Savings	DHW Therms Savings	Cooling Peak kW Savings (w/line loss)	Heating Peak kW Savings (w/line loss)	kWh Heating Savings	kWh - Cooling Savings	REM/ Rate kWh - L&A Savings	Est. kWh from E-Star Lights and Appliances	Total Annual kWh Savings / House
1	1041	03-29-04	94	174.70	143.08		0.06	0.00	0.00	-31.32	962.50	931
2	2405	03/31/04	92	346.38	0.00	1.08	0.09	28.22	592.61	-103.36	962.50	1,480
3	1120	11/21/03	91.1	60.14	49.19		0.14	0.00	0.00	-32.89	962.50	930
4	1120	11/21/03	91.9	136.86	55.21		0.14	0.00	0.00	-32.89	962.50	930
TOTA	**5686**			**718.1**	**247.5**	**1.1**	**0.4**	**28**	**593**	**-200.5**	**3,850.0**	**4,270.4**
Avera	**1,422**		**92.3**	**179.5**	**61.9**	**0.27**	**0.10**	**7**	**148**	**-50.11**	**962.50**	**1067.60**

Notes:
1) Negative entry equals an increase in kWh, postive entry is a reduction in kWh
2) VEIC is evaluating the cooling kWh savings algorthims from REM/Rate compared to the Cool Homes savings algorthims (Proctor).
   As such, RNC cooling savings methodology may vary in the future.
3) L&A Savings are negative primarily because the UDRH home did not have mechanical ventilation and the rated homes do.
4) All kW and kWh reported savings include savings attributed to reduced line losses.
5) E-star Bulbs: 50 kWh; E-Star Fixtures 75 kWh; E-Star RF 100kWh, E-Star CW 75 kWh, E-Star DW, 40 kWh; Gas Furnace with ECM Motor,
6) Estimate 10 bulbs, 5 fixtures, 50% E-Star CW, 50% E-Star RF, and Gas Furnace with ECM Motor
7) Assumed baseline CAC was 13 SEER, with an actual adjusted SEER rating of 10.0. Assumed Green Home SEER was 13.0 as installed.

Savings estimates compiled by: Toben Galvin/Richard Faesy, VEIC, (802) 658-6060 x1110, tgalvin@veic.org

Table 1

The summary in table 2 below compares the green homes to an ENERGY STAR baseline home:

Savings from Cape Cod Green Homes compared to Avg. Cape Cod ENERGY STAR Home

kW and kWh Savings Include Line Loss Savings

No.	House Size (sqft)	Rating Date	HERS Score	Space Heating Therms Savings	DHW Therms Savings	Cooling Peak kW Savings (w/line loss)	Heating Peak kW Savings (w/line loss)	kWh Heating Savings	kWh - Cooling Savings	REM/ Rate kWh - L&A Savings	Est. kWh from E-Star Lights and Appliances	Total Annual kWh Savings / House
1	1041	03-29-04	94	136.92	143.08		0.05	0.00	0.00	62.64	0.00	63
2	2405	03/31/04	92	260.79	0.00	1.26	0.08	24.34	538.74	-93.96	0.00	469
3	1120	11/21/03	91.1	35.54	52.62		0.12	0.00	0.00	61.08	0.00	61
4	1120	11/21/03	91.9	79.29	59.07		0.12	0.00	0.00	61.08	0.00	61
TOT	**5,686**			**512.5**	**254.8**	**1.3**	**0.4**	**24**	**539**	**90.8**	**0.0**	**654**
Ave	**1,422**		**92.3**	**128.1**	**63.7**	**0.32**	**0.09**	**6**	**135**	**22.71**	**0.00**	**163.48**

Notes:
1) Negative entry equals an increase in kWh, postive entry is a reduction in kWh
2) VEIC is evaluating the cooling kWh savings algorthims from REM/Rate compared to the Cool Homes savings algorthims (Proctor).
   As such, RNC cooling savings methodology may vary in the future.
3) L&A Savings are negative primarily because the UDRH home did not have mechanical ventilation and the rated homes do.
4) All kW and kWh reported savings include savings attributed to reduced line losses.
5) Assume no L&A savings for the Green Homes as the penetration of efficient L&A would be the same as the E-Star Homes
6) Assumed baseline CAC was 13 SEER, with an actual adjusted SEER rating of 10.0. Assumed Green Home SEER was 13.0 as installed.
7) Assume Lighting and Appliance types in the Green Homes vs. the E-Star Homes are the same
Savings estimates compiled by: Toben Galvin/Richard Faesy, VEIC, (802) 658-6060 x1110, tgalvin@veic.org

Table 2

Taking the savings outlined above for an average of the four houses, and the incremental costs as 2% of the average home construction cost ($165/sq ft X 1400 sq ft X 2% = ~ $4,600) and calculating the cash flow impacts to homeowners, yields the following results for the average home compared to 1) the average new Massachusetts home (table 3) and 2) an average Cape Cod ENERGY STAR Home (table 4):

CLC green homes compared to MA res new con baseline		
Cash Flow Forecast	Present Value	**cash flows** YR 1
Savings	$ 404	$ 416
Loan payments	$ (360)	-$371
Net cash flow	$44	$46
Cummulative cash flow		$46
Net Presednt Value-NPV	$44	
Benefit to Cost ratio-B/C	1.12	
Inputs:	Loan term years	30
	Loan rate	7.00%
	Total Installed Cost	$4,600
	Incentive Buy Down	$0
	Incremental cost	$4,600
	Energy escalation	2.5%
	Real discount rate	3%

Table 3

CLC green homes compared to Cape Cod ENERGY STAR home baselin		
Cash Flow Forecast	Present Value	**cash flows** YR 1
Savings	$ 235	$ 242
Loan payments	$ (454)	-$467
Net cash flow	-$219	-$226
Cummulative cash flow		-$226
Net Present Value-NPV	-$219	
Benefit to Cost ratio-B/C	0.52	
Inputs:	Loan term years	30
	Loan rate	7.00%
	Total Installed Cost	$5,800
	Incentive Buy Down	$0
	Incremental cost	$5,800
	Energy escalation	2.5%
	Real discount rate	3%

Table 4

Year one cash flows in table 3 show the investments in energy savings pay for themselves when compared to the typical new home being built on the Cape (savings in year one are greater than the loan payment for the upgrades, $416-$371.) However, when the average of the four homes is compared to the average ENERGY STAR home in table 4, the analysis shows that the incremental costs to go above ENERGY STAR are not offset by the energy savings.

When we add in the cost of the solar water heating system installed on one of the four homes it pushes the incremental cost of the average home to $5,800. (Cost of solar system ~ $4,800. We used ¼ of this cost and ¼ of the associated savings in the average home.) In this scenario outlined in table 5 below, when compared to the Massachusetts baseline home, there is a negative cash flow in years 1-5, then the cash flows go positive, cumulative cash flow goes positive in year 11, and ultimately lead to a positive net present value and a benefit cost ratio > 1. Performing this calculation for the green home with solar water heating compared to the ENERGY STAR baseline (not shown), the net present value is negative and benefit to cost ratio is < 1.

CLC green homes compared to MA res new con baseline												
Cash Flow Forecast	Present Value	**cash flows** YR 1	Year 2	3	4	5	6	7	8	9	10	11
Savings	$ 7,723	$ 416	$ 427	$ 437	$ 448	$ 460	$ 471	$ 483	$ 495	$ 507	$ 520	$ 533
Loan payments	$ (6,954)	-$467	-$467	-$467	-$467	-$467	-$467	-$467	-$467	-$467	-$467	-$467
Net cash flow	$769	-$51	-$41	-$30	-$19	-$8	$4	$15	$28	$40	$53	$66
Cummulative cash flow		-$51	-$92	-$122	-$140	-$148	-$145	-$129	-$101	-$62	-$9	$57
NPV	$769											
benefit to cost ratio	1.11											
Inputs:	Loan term years	30										
	Loan rate	7.00%										
	Total Installed Cost	$5,800										
	Incentive Buy Down	$0										
	Incremental cost	$5,800										
	Energy escalation	2.5%										
	Real discount rate	3%										

Table 5

Below are the results of running the pilot program impacts through the Massachusetts screening tool to consider societal cost effectiveness in terms of total resource benefits compared with total resource costs.

Total Resource	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
1 Green homes without solar water heating				
Program Total	$4,996	$5,350	$(354)	0.93
Non-Measure		$1,000		
Total Measure	$4,996	$4,350	$646	1.15
2 Green homes with solar water heating				
Program Total	$4,955	$6,600	$(1,645)	0.75
Non-Measure		$1,000		
Total Measure	$4,955	$5,600	$(645)	0.88

The results show that without solar water heating (labeled program 1) The savings measures on their own pass the screen, and show positive net benefits of $646, however the benefits are not adequate to cover the program costs, (estimated at $1,000 per house to administer the program) resulting in an overall program benefit-cost ratio of 0.93.

The results further show that with solar water heating (program 2) neither the measures nor the program pass the cost effectiveness screen.[1] [2] Again, it is critical to reiterate the size of the pilot, only four homes, and the inaccuracy of the cost information in considering our findings. Societal cost effectiveness screening is beyond the scope of this project. If this information were to be used to determine future program viability, we recommend further analysis of the screening assumptions used here.

V. Non energy benefits

Residential green building programs and standards typically include a host of strategies materials and methods that fall under the following general headings:

- Siting and land use;
- Building design;
- Materials and resource use;
- Energy and water use;
- Indoor environmental quality; and

[1] Regarding screening tool use; we conglomerated all savings data and created one average house to analyze. We used a 20 year measure life as an average aggregate of all savings measures. We did NOT calculate a weighted average measure life weighted by the benefits associated with individual measures. If further analysis were to be performed, we recommend screening each of the end use components with appropriate load shapes.

[2] Water savings estimate: an ENERGY STAR washing machine save 4413 gallons/yr (Efficiency Vermont Technical Reference manual.) All houses reported using this technology. We captured the savings from the composting toilet and the xeriscaping from the following information sources: Water use information from the Town of Shrewsbury, MA sewer and water department. (We presumed 2 people per house, 4 flushes per person, and 1.6 gallons per flush) and 40 gallons per day outdoor water use. We then spread these savings over the 4 houses and came to an average annual water savings of 9213 gallons/year, which we considered a conservative estimate.

- Homeowner awareness.

Costs, and perceptions about costs, are typically one of the largest hurdles to adoption of green building practices. In calculating costs and benefits of green construction, the easiest items to monetize are those related to energy. However there are many benefits of green building beyond energy savings, some of which are more difficult to quantify. In relation to these four pilot houses, some of the non-energy benefits (NEB's) include the following:

- Siting and Land Use – siting on an existing site, reduced lawn area, lawn mowing and water use, site impacts (i.e. protecting root zones, ecological preservation…);
- Building Design – solar orientation, multi-use spaces, daylight strategies, smaller house size;
- Quality/Durability - flashing details, long lasting materials with commensurate warranty, stainless fasteners, these equate to maintenance savings, occupant health;
- Occupant health and IAQ - non-toxic materials selection, proper ventilation, reduce introduction of outdoor pollutants, sealed ductwork, amounting to reduced health care costs, higher productivity and occupant happiness;
- Resource impacts -recycled/ reused products and materials, advanced framing techniques, engineered lumber, local materials, waste reduction, etc. These equate to the numerous societal benefits associated with minimizing overall impact of construction;
- Reduced emissions – reduced need for combustion of fossil fuels and the resulting emissions into the atmosphere;
- Occupant education (Owners manual, photo-journal of construction, properly functioning mechanicals.) This practice saves time and money for the homeowner for years after construction, and helps ensure the proper functioning of mechanical systems;
- Personal integrity/ consistency of word and deed. This is very important to many home owners and home buyers. "We all like to think of ourselves as people who care about the environment. It is time we started building that way!"
- Improved quality of life, "The joy of living". Overall homeowner happiness; and
- Comfort, as a result of well sized, properly distributed and responsive heating and cooling systems.

Research has demonstrated consumer indifference to energy savings alone. In order for a green building program to stand on its own merits, there is a need to monetize non-energy benefits. Considerable work has been done in this area, and more needs to be done. Specifically some of the more easily quantified NEB's are:

- Property value increase and salability;

- Reduced litigation expense;
- Reduction in mold and mildew risks; averted health and building maintenance expenses;
- Productivity – level of education, increased salaries, reduced incarceration rates;
- Durability – averted maintenance;
- Promoting in-fill development; and
- National security, reduce foreign dependency.

Participant perceptions of costs and savings and the value of non-energy benefits are summarized in the following quotes:

- "I know of nothing I would eliminate to save money as it all adds to the comfort and energy efficiency of the building."
- "We think that the marginal added costs are more than offset by lower energy bills and quality of life. Even the PV has a 10 year payback period, so we see it not as an expense but an investment. We just bought all our energy up front!"

VI. Residential green building standards going forward

The Cape Light Compact's residential demonstration project utilized the Vermont Built Green checklist as the standard for the four pilot homes. The Vermont Built Green (now Vermont Builds Greener) checklist has been updated and edited since CLC used the VBG checklist with the participants at the beginning of the pilot. In addition, a guidebook has also been developed which describes each approach in more detail, defines the rationale behind each approach, and lists resources available to help individuals achieve each approach. The guidebook, like the checklist, is an on-going work in progress and the VBG Committee has not had an opportunity to fully review nor update the checklist or guidebook's contents over the past two years.

While the VBG checklist was being used as a guide for builders, architects and homeowners on Cape Cod and in Vermont, the USGBC (United States Green Building Council) was using the checklist as a guide to develop a national residential green building standard, LEED for Homes. The resulting LEED (Leadership in Energy and Environmental Design) for Homes Green Building Rating System® is a voluntary, consensus-based national standard for developing high-performance, sustainable residential buildings.

When the USGBC took a new approach and requested local and regional organizations to provide technical, marketing and verification support to builders throughout a pilot phase, the Vermont Builds Greener Committee and VEIC decided to pursue becoming a LEED for Homes pilot provider. Both organizations felt that the LEED for Homes standard was similar enough to the VBG standard that they could begin utilizing the LEED for Homes checklist and supporting documents to provide a dual certification for VBG and LEED for Homes.

VEIC spent a great deal of time comparing the various residential green building standards available to residents of Massachusetts through our work developing the Green Homes Northeast (GHNE) residential green building standard. Through that project, we determined that there was a great deal of overlap between the VBG and the LEED for Homes checklists. A few notable features incorporated in the LEED for Homes checklist include a house size factor, a comprehensive durability checklist and a foundation in the ENERGY STAR Homes program. Both VBG and LEED categorized their checklists using similar focus areas including siting and land use, indoor environmental quality, energy use, resource impacts, and homeowner awareness. In addition, an opportunity was provided in both VBG and LEED for Homes to achieve points/credits for approaches that were not listed but met the goal of the program.

The analysis and comparison of green building programs in the development of the GHNE standard also identified some differences between LEED for Homes and VBG. While both programs factored in house size and penalized larger than average homes similarly, VBG awarded smaller than average homes more points than LEED for Homes. VBG also requires that homes not be built on prime agricultural land, 100-year flood plains, wetlands and critical wildlife habitat while LEED for Homes has these as optional. There are also a number of durability approaches required in VBG that are optional approaches in LEED for Homes such as a minimum 25-year roof warranty requirement in VBG. There are several other approaches required in VBG but not LEED such as non-mercury thermostats; keeping mechanical equipment accessible; and insulating ducts to at least R-7.5 when run in outside walls. At the same time, there are requirements in LEED for Homes that are optional or not listed in VBG including leaving 40% of the lot undisturbed; installing permeable material for at least 65% of the lot; sealing off ducts during construction; and minimizing construction waste to less than 2.5 lbs per square foot of conditioned floor area.

Through this pilot, the VBG Committee has been working with the USGBC to set up a protocol which will allow State's to regionalize the LEED standard. There is a need for the USGBC to recognize regional concerns or issues that are not sufficiently addressed in the LEED for Homes standard. The VBG committee feels there is also a need to maintain an optional more rigorous or stringent standard or requirement that encourages environmentally conscious builders or homeowners to strive for and be recognized for a higher standard of green building.

The VBG Committee shall determine issues or elements of specific concern that it feels the LEED for Homes checklist does not adequately address; it shall establish added or altered criteria that address these; and it shall work with LEED for Homes personnel to addend or integrate these criteria into the VBG / LEED for Homes standard here in Vermont.

As the Cape Light Compact moves forward with a green building standard, we recommend that it consider taking the same approach as VEIC and the VBG Committee and utilize the USGBC's LEED for Homes program. We believe this is a great opportunity to reduce market confusion, utilize the strong brand name and resources of the USGBC, and support an effort to shift the current residential home building industry towards more sustainable practices. Currently, there are over 19,000 LEED Accredited Professionals supporting the commercial building industry, many of whom also design or assist residential projects in some capacity. As a LEED accredited certification becomes available for residential projects, we believe there will be a large support network for homeowners and builders who want to design and build LEED certified homes. Positioning the Cape Light Compact now for the inevitable green building marketplace will give the Compact and it's customers a head start in the future if residential construction while working to minimize environmental impact on the Cape and its surroundings.

VII. Conclusions

Builders feel there is pent up demand for green building in the residential sector. A recent zero net energy home workshop on the Cape with no advertising, was overflowing with participants. As one builder on the Cape put it, "It is amazing sometimes what an easy sale this is. Who is going to say I don't want a healthy house, don't put that in the budget. I can't afford this." We see education as the primary barrier to wider spread understanding and adoption of green building practices. Once the market understands what is meant by "green" and knows how to value it appropriately, green building will be on a trajectory to becoming standard practice. Programs like that offered on the Cape are necessary to meet the demand for information about this burgeoning field.

The Pilot Houses

Builder: Peter Wade; Location: South Orleans, MA

- VBG – 245.5 pts.
- House Size - 83 pts.
- Total – 328.5 pts.
- HERS – 91.5 pts.

Example of approaches achieved:

- In-fill development
- Restoration of damaged ecosystem
- Permeable paving driveway
- Optimal Value Engineering
- High-quality lighting design
- Dedicated Home Office

Builder: Habitat for Humanity; Location: South Chatham, MA

- VBG – 133 pts.
- House Size - 175 pts.
- Total – 308 pts.
- HERS – 91.0 pts

Example of approaches achieved:

- Deed-protected affordable housing lot
- Restoration of damaged ecosystem
- No air conditioning installed
- No carpet in the house
- Engineered roof framing
- Cellulose installed in walls and ceilings

Builder: Habitat for Humanity; Location: South Chatham, MA

- VBG – 133 pts.
- House Size - 175 pts.
- Total – 308 pts.
- HERS – 91.0 pts

Example of approaches achieved:

- Natural-based product for finish siding and trim
- Space provided for recycling
- Landscape that requires no irrigation
- No old growth wood used
- Low-VOC paints, solvents and adhesives

Builder: Bruce Torrey; Location: East Falmouth, MA

- VBG – 184 pts.
- House Size - 127 pts.
- Total – 311 pts.
- HERS – 90.7 pts

Example of approaches achieved:

- Previously built-on site
- Landscaped with wildlife enhancing species
- Permeable paving driveway
- Mudroom
- Solar water heating
- Hydronic distribution designed and sized to match room-by-room loads
- Salvaged and recycled materials used