Commonwealth of Massachusetts

Office of Consumer Affairs and Business Regulation

2002 Energy Efficiency Activities
A Report by the Division of Energy Resources

An Annual Report to the Great and General Court on the Status of Energy Efficiency Activities in Massachusetts

Summer 2004

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ACKNOWLEDGEMENTS

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Please feel free to convey to the contributors listed above your reaction to this report and your thoughts with respect to energy efficiency activities in the state.

Readers may obtain additional information about the report from the Division at (617) 727-4732.

This report, as well as a summary report, is posted on the Division's website at:

www.mass.gov/doer.

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Introduction

As part of the Electric Restructuring Act of 1997 (St. 1997, c 164), or "the Act", the Legislature created electric ratepayer funded energy efficiency programs. Intended to provide energy efficiency services to all classes of electric utility customers, these programs must meet the standards of the Overall Statewide Energy Efficiency Goal and its supporting objectives provided for within the Act. Additionally, the Act mandates that Division of Energy Resources file annual reports with the Legislature on the results of the energy efficiency programs and whether they are meeting the Statewide Goal.

The following report chronicles the fifth year of the energy efficiency programs, beginning with the Statewide Energy Efficiency Goal and its objectives. The topics covered are:

- Program cost-effectiveness,
- Equitable allocation of funds between customer classes,
- Balancing of short-term and long-term saving objectives, and;
- The development of a competitive market for energy efficiency services.

The report concludes with a summary of the results and discussion of whether the programs are meeting the Statewide Energy Efficiency Goal.

This report represents the final year in the first five-year period of SBC-energy efficiency programs and monitoring and reporting efforts by the Division of Energy Resources (DOER) as mandated by the Act. In 2002, the Legislature renewed the programs and reaffirmed DOER's responsibilities through 2007, which the Governor signed into law on February 28, 2002.

Beginning with the 2003 annual report, DOER will be utilizing a new reporting system to enable (1) more consistent application of evaluation and reporting requirements among the utility program administrators, (2) greater transparency of reported data, and (3) greater administrative efficiency, including more timely availability of data and reports

1.0 Statewide Energy Efficiency Goal and Objectives

The Division of Energy Resources uses the Statewide Energy Efficiency Goal and Objectives as the basis for annually reporting to the Legislature on statewide energy efficiency activities (see Table 1). As such, they are still relevant and form the general outline of this report. The overall Statewide Energy Efficiency Goal and its supporting objectives largely come from key provisions of the Electric Industry Restructuring Act [St. 1997, c. 164], or "the Act," as well as extensive stakeholder input.

Table 1: Massachusetts Energy Efficiency Goal and Objectives

Overall Statewide Energy Efficiency Goal Strengthen the economy and protect the environment by increasing the efficiency of energy use
Energy Efficiency Operational Objectives: (1) Reduce the use of electricity cost-effectively. (2) Ensure that energy efficiency funds are allocated to low-income customers consistent with the requirements of the Act, and allocated equitably to other customer classes**.**
Energy Efficiency Programmatic Objectives: (3) Reduce customer energy costs by balancing short-run and long-run savings from energy efficiency programs. (4) Support the development of competitive markets for energy efficiency products and services.

The *overall statewide goal* of energy efficiency programs ("programs") is to strengthen the economy by reducing electricity costs to customers and to increase state employment and income, as well as to protect the environment by reducing harmful air emissions.

Two *operational objectives* of programs come largely from the Act. First, programs should be cost-effective (according to a methodology approved by the Department of Telecommunications and Energy). Second, funding levels for programs serving income eligible households should be the greater of 0.25 mills/kWh for all sales, 20 percent of the program funding level for all residential programs, or 2.5 mills/kWh multiplied by sales to customers who are at or below 60% of median income. Equitable allocation of program funds among customer sectors is a related goal of this objective. Equitable allocation means that the distribution of program expenditures to a customer sector is roughly equal to the funds collected from that customer sector. Further, the Division interprets this goal to require that residential and commercial and industrial (C&I) customer sectors equitably subsidize the low-income sector, to an extent deemed reasonable by the Division, the Program Administrators (i.e., investor owned electric distribution companies and the Cape Light Compact Municipal Aggregator), and key stakeholders.

Programmatic objectives call for programs to provide immediate as well as long-term electricity cost reductions to customers using a variety of program design and implementation strategies. In addition, programs should be designed to support the development of competitive markets for energy efficiency products and services.

2.0 Overall Goal: To Strengthen the Economy and Protect the Environment

2.1 Impact of Energy Efficiency Programs on the Commonwealth's Economy

The Overall Statewide Energy Efficiency goal acknowledges the important role of energy in our Commonwealth's economy. Conserving electricity through energy efficiency programs strengthens our economy by reducing energy bills. This is especially true for Massachusetts. According to 2002 data from the Department of Energy's Energy Information Administration (EIA), Massachusetts had the 8th highest electricity prices in the nation. This is a worsening in rank from 1998 (9th), but in an improvement from subsequent years--1999 (5th), 2000 (6th), and 2001 (2nd). Though Massachusetts has improved its standing from 2001, which featured high generation prices, the Commonwealth remains a high-energy-cost state. This section documents the benefits that accrued to program participants and the those that accrued to all consumers as a result of energy efficiency related system benefits, as summarized in Table 2.

Table 2: Summary of 2002 Economic Impacts of Program Activities

Electricity Bill Impacts	
Energy Savings	
• Total Participant Annual Energy Savings	$21.5 million
• Average Life of Energy Efficiency Measures	14 years
• Total Participant Lifetime Energy Savings	$249 million
• Average Cost for Conserved Energy	4.0 ¢/kWh
Demand Savings	
• Total Participant Annual Demand Savings	$1.2 million
System Impacts	
Savings to All Customers Due to Lower Wholesale Energy Clearing Prices*	$19.4 million
Economic Impacts	
Number of New Jobs Created in 2002	2,093
Disposable Income from Net Employment in 2002	$79 million

* Cumulative 5-year impact (1998-2002) over June-September peak hours.
Source: Division of Energy Resources

2.1.1 Savings to Program Participants

Energy efficiency program activities provided both short and long-term opportunities for participants to reduce bills by reducing electricity use. These reductions are achieved primarily through energy savings, and for some participants, through demand savings as well.

(a) Electricity Bill Savings Due to Energy (kWh) Savings

Energy savings represent electricity savings available to customers from decreases in kilowatt-hours (kWh) use. Energy savings can be described in two ways: ***annual savings*** and ***lifetime***

savings. Annual savings accrue in the year that energy efficiency measures are installed. Lifetime savings reflect the customer savings over the productive life of the energy conservation measures.

Table 3: Energy Savings from Energy Efficiency Programs (in million kWh)

Type of Savings	1998 Savings	1999 Savings	2000 Savings	2001 Savings	2002 Savings
Annual	263	272	273	309	241
Lifetime	3,417	3,822	4,147	4,571	3,428

Source: Division of Energy Resources - Compilation of 2002 Program Statistics Reported by Program Administrators

Table 3 shows that annual energy savings for 2002 Programs were estimated at 241 million kWh[1], the equivalent of annual electricity use for approximately 40,000 households[2]. Long-term energy savings resulting from 2002 equipment installations were estimated to be 3,428 million kWh over an average period of fourteen years. Compared to 2001, both savings figures fell by about 20%. Some of this decrease can be traced to greater application of certain programs relative to others, such as school-building measures, that may not produce as much savings as others. More importantly, the cost of conserved energy is comparable to 2001, indicating that overall spending on programs fell as well, and thus impacted the level of attained savings.

In order to estimate the average annual bill impacts resulting from 241 million kWh of energy savings in 2002, the Division analyzed program participation rates, average energy use per participant, and rate impacts for each customer sector specific to each distribution company service territory. The following summarizes program participation rates in 2002, and then provides estimated annual bill savings.

NSTAR's
ENERGY STAR® Homes

Cambridge Park Place Multi Family ENERGY STAR® Homes
An ENERGY STAR® Homes project called Cambridge Park Place, Cambridge, MA has 312 individual residential units. This property received various energy efficient measures from the NSTAR Residential New Construction program. Installed measures at this project include ENERGY STAR® rated fixtures, ENERGY STAR® refrigerators and dishwashers, and mechanical ventilation. NSTAR also fully funded the cost of HVAC commissioning and to inspect and certify the project as ENERGY STAR®.
Total Project Cost: $352,287.
Estimated Annual Savings: 176,949 kWh or $55,337
Estimated Lifetime Savings: 3,431,964 kWh or $977,833

[1] All information in this report regarding savings, program expenditures, bill impacts etc. is aggregated across all Massachusetts electric distribution companies. For information specific to a distribution company, contact DOER.
[2] This assumes an average electricity use of 600 kWh per month per household.

(b) Program Participation

In 2002 total annual program participation stayed at the 2001 level of 10%.[3] Participation was highest for the Large C&I and Residential sector, followed by the Low-Income and Medium C&I sectors (see Table 4). Despite potential bill savings and efforts to target these customers, Small C&I customers, and to a lesser extent Medium C&I customers, had the lowest participation rates. These lower participation rates was largely due to barriers these customers face to investing in energy efficiency. Among the barriers are both a lack of energy management resources and interest in reducing energy use. Given the demonstrated savings these customers can achieve through energy efficiency (as discussed below), opportunities to target these sectors should be further explored.

Table 4: 2002 and Cumulative Program Participation[4]

Customer Sector	Total Customers In 2002	Number of Participants in 2002	Percent Served in 2002	Cumulative Participation Since 1989[5]
Low-Income	589,654	21,748	4	N/A
Residential	1,488,961	219,333	15	70
Small C&I	230,054	2,897	1	12
Medium C&I	63,972	2,124	3	31
Large C&I	6,059	831	14	95
Total/Average	**2,378,700**	**246,933**	**10**	**72**

Source: Division of Energy Resources - Compilation of 2002Program Statistics Reported by Program Administrators

(c) Annual Electricity Bill Savings

The Division estimated average bill impacts (from energy savings only) for participating customers based on rate class tariff data and program participation levels. Table 5 summarizes these key findings:

- Total annual bill reductions for all participating customers from program savings;
- Average annual bill per participant;
- Average annual bill savings per participant; and
- Corresponding average annual bill reduction as a percent of the average participant's annual electricity bill.

[3] The 2001 value of 10 percent is also higher than the 1998 value of 8 percent, the first reported value in this format.

[4] For this report, C&I rate classes were aggregated and categorized into Small, Medium and Large C&I sub-sectors. Small C&I includes rate classes with average monthly use of less than or equal to 3,000 kWh/month. Medium C&I includes rate classes with average monthly use greater than 3,000 kWh/month, but less than or equal to 120,000 kWh/month. Large C&I includes rate classes with average monthly use greater than 120,000 kWh/month. Total customers in 2001 fell relative to 2002 due to improvements in how DOER accounts for customer data from program administrator.

[5] Includes repeat participation.

Table 5: 2002 Average Bill Impacts From Energy Savings

Customer Class	Total Annual Bill Reductions for Participants	Avg. Annual Bill Savings per Participant	Avg. Annual Bill per Participant	Avg. Savings As a Percent of Avg. Annual Bill
Low-Income	744,617	34	$670	5
Residential	6,275,505	30	$999	3
Small C&I	3,691,091	1106	$5,184	16
Medium C&I	4,287,686	2629	$17,484	15
Large C&I	6,470,443	7639	$175,681	4
Total/Average	**21,469,342**	**92**	**$1,766**	**6**

Source: Division of Energy Resources' Bill Impact Analysis

Program participants saved about $20 million in direct electricity costs in 2002. The reduction in total bill savings from the 2001 figures is a result of both a lower number of total kWhs saved from energy efficiency programs and lower generation prices for standard offer and default service customers in 2002.

The largest percent savings were for Small C&I at an average of 16 percent based on an average annual bill of $5,184. Residential customers saved an average of 3 percent on their annual bill, comparable to savings in previous years.

Low-income customers saved an average of 5 percent on their bills. As explained in the 2001 report, the low-income saving percentage is somewhat lower than prior years due to a correction that DOER made in its analytical methodology. DOER uses an expanded definition of low income to include customers at or below 60% of median income rather than simply including those customers on the utility discount rates. This definition of low-income is consistent with utility eligibility rules for low-income energy efficiency programs, but results in increases in the average annual bill for low-income customers, thus reducing the savings percentage.

For the Small C&I sector, average savings per participant were $1,106 annually, with total savings of about $3.7 million, both of which are significant increases (30%) from 2001. These savings represent roughly 16 percent savings on the average annual participant bill. The Medium and Large C&I participants reduced their average annual bills by an average of 15 and 4 percent, respectively. It is important to note that for the C&I customer sectors, the range of savings across energy efficiency projects can be considerable depending on the scope of the project.

(d) Long-Term Electricity Bill Savings

Table 5 presents only the *annual* bill impacts due to energy savings from the 2002 Programs. Over the productive *lifetime* that the equipment remains in place – an average of 14 years – total savings are projected to grow to approximately $276 million for participating customers.

Another way to quantify the impact of energy savings from 2002 Program activities is to compare program costs and energy saved over time (i.e., the cost of conserved energy), to the projected average retail electricity price over roughly the same period. Through the Programs, a total investment of $138 million was made in 2002 for higher efficient equipment.[6] These investments are projected to produce lifetime energy savings of 3,428 million kWh, translating to an average cost for conserved energy of 4.0¢/kWh[7] or 59 percent less expensive than the projected average retail price (9.7¢/kWh) over the same period.[8]

<u>Fitchburg Gas and Electric Light Company</u>
<u>Residential Low Income Retrofit Program</u>

Fitchburg, MA
An energy audit on the home, recommended a number of cost effective improvements. Installed measures included ENERGY STAR® CFLs, an appliance timer for a room a/c and low-flow aerators and showerheads. A combustion safety test was performed on the home's gas boiler, identifying improper ventilation and excessive carbon monoxide in the home. To remedy this problem, a vent pipe or chase was installed in the chimney. Lastly, insulation was added to the home's attic and basement to reduce the home's heat loss. Additional incentives provided by weatherization programs.

Project Cost: $595.10
- **Incentives:** $595.10
- **Participant Cost:** $0

Est. Annual Savings: 1,054 kWh; 0.2 kW, 246 Therms
Total Equivalent Savings: 8,262 kWh; 1.8 kW
Estimated Bill Savings
- Electric: $52, Gas: $190
- Lifetime: $4,800

(e) Electricity Bill Savings Due to Demand (kW) Reductions

Demand savings represent the impact that the energy efficiency programs have on reducing demand (in kilowatts or kW) on the electricity system during very high or "peak" periods, when electricity is most expensive. Customers participating in the Programs that had a demand charge component on their electricity bills, saved money directly by reducing their electricity demand.

In 2002, Programs resulted in 48 MW of demand savings[9], representing 0.5 percent of the distribution companies' combined summer coincident peak demand of 9,775 MW. Similar to 2001, a small but larger percentage (11 vs. 10% in 2001) of the demand savings was attributable to interruptible programs. Also as 2001, these interruptible programs were residential rather than commercial and industrial. The Division continues to view the development of a market-based demand-bidding program at the New England Independent System Operator (NE-ISO) as a more appropriate venue for reducing demand on the system. Moreover, to the extent distribution companies determine there is a continued need to reduce demand through "traditional" type interruptible credit type programs (e.g., in order to help maintain service

[6] This $138 million includes 2002 energy efficiency expenditures funded through the mandated ratepayer energy efficiency charge of $113 million, plus participant costs of $25 million.
[7] For 2002, the average cost of conserved energy is calculated as the total ratepayer funded energy efficiency expenditures plus participant costs ($113 million and $25 million, respectively) divided by projected lifetime energy savings 3,428 million kWh) due to energy efficiency measures installed in 2002.
[8] Source: The Division of Energy Resources - Energy 2020 Model. This average retail electricity price (in 2002$) reflects prices over the average productive life of the energy efficiency measures installed in 2002, and includes all components of electricity price (e.g., generation, transmission, distribution and customer charges).
[9] These KW savings are based on combined company summer coincident peak demand savings reported by the Program Administrators. Annual winter KW savings for all distribution companies were 48 MW.

reliability for generation, transmission and distribution), the Division believes these programs should be funded through sources other than the energy efficiency charge.

A portion of these savings[10] provided direct savings during peak summer and winter to participating customers that have a demand charge component on their electricity bill, primarily Medium and Large C&I customers. The Division estimates these savings to be roughly $1.2 million annually for participating customers with demand charges. These demand savings will persist over the productive life of the energy efficiency measures installed in 2002, thus benefiting these participants over the long-term.

2.1.2 Electric System Benefits

In addition to the direct economic benefits program participants received, the 2002 Programs provided system-wide benefits to all customers by:

- Reducing wholesale energy clearing prices
- Enhancing generating system reliability during peak usage periods
- Enhancing reliability of local transmission and distribution networks

(a) Reducing Wholesale Energy Clearing Prices

Historically, energy efficiency programs postpone the need to build new power plants by reducing the growth of electricity demand and reducing the usage of existing power plants. Since the inception of programs in 1989, distribution companies have estimated the monetary value of reducing electricity demand for the purposes of determining program cost-effectiveness.[11] This valuation focuses on the system impact of programs over the *long-term* (i.e., the lifetime of the measures installed). An additional way to value the demand reduction impact of energy efficiency programs is to consider their *short-term* impact. As a consequence of the new competitive wholesale electricity market and transparent prices, the value of demand reductions can be estimated in terms of how they help avoid costs of generating electricity on the margin, thus reducing market-clearing prices. Since the market-clearing price for electricity is a function of overall system supply and demand, individual customer demand reductions help reduce this price, thus providing monetary benefits to all customers in the region. Given the availability of hourly market-clearing price data tracked by the Independent System Operation of New England (ISO-NE), it is possible to roughly estimate the short-term (e.g., hourly, monthly, summer, etc.) price impacts of energy efficiency programs (see text box below).

These avoided costs are modest for most hours but can be dramatic during peak hours when electricity is most expensive. The summer of 2002 illustrates the effect of energy efficiency program related demand reductions on electricity prices. It is estimated that ISO-NE system

[10] These savings, or nearly 14 MW, reflect the weighted average peak demand savings over summer and winter months. See Appendix A.

[11] The methodology used to value energy efficiency programs is based on estimates of avoided costs for generating energy, capacity, and avoided transmission and distribution costs. See discussion on cost-effectiveness in Section 4.0.

Procurement of Electricity in the Competitive Wholesale Market in New England

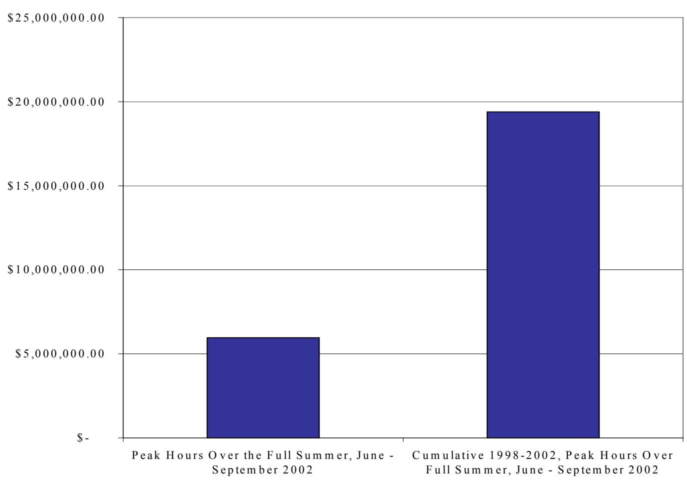
Under the current competitive market structure at ISO-NE, electricity from power plants is procured in order of increasing bids. The market-clearing price paid to all bidding power plant owners that are dispatched is set by the last, highest bid when the demand for electricity is met (e.g., in a particular hour). When energy efficiency programs lower demand for electricity in any given hour, they may displace the need for generation from this last bidder. In that case, the next highest bidder is the one that sets the market-clearing price. By eliminating the need for the last, highest bid, a lower clearing price is paid to all generators. This lower clearing price accrues to all customers in the form of lower wholesale (and ultimately retail) prices. These savings are a benefit over and above the direct savings that accrue to those customers who participate in the energy efficiency programs.

loads were reduced by an average of 48 MW across all hours as a result of Massachusetts efficiency programs.

The system recorded its peak summer load on August 14th , when the average price during the peak hours (8am to 9pm) of this day was $365.[12] Absent the demand reductions, the average peak demand may have been higher, resulting in higher bid prices setting the market-clearing price in each hour.

Figure 1 illustrates that the impact of demand reductions is not limited to days with unexpected high demand. Extending the analysis to all peak hours for the summer months June through September indicates that relatively small price changes spread over many hours add up to significant savings (roughly $5.9 million), where average demand reductions totaled 48 MW.

Figure 1. Potential Impact of Demand Reductions on Energy Spot Market



Source: Division of Energy Resources

[12] This compares to the peak summer day of August 9th for 2001,where the average price during the peak hours of this day was $251.

The cumulative impact of demand reductions is also significant. For example, if peak load reductions due to 1998, 1999, 2000, and 2001 energy conservation measure installations are added to the analysis of 2002 price impacts (with one-time interruptible program reductions removed) the estimated reduction rises to 263 MW. A reduction of this magnitude during the summer of 2002 increases the avoided costs to nearly $19.4 million on spot market load alone.

Finally, all of these estimated demand savings are based on the limited load in the spot energy market. Over time, however, there is an additional impact on the remainder of the energy market operating on bilateral contracts. Bilateral market prices directly depend on spot energy prices, as is the general case in other commodity markets.[13] Thus, the impact of demand savings on the bilateral contract energy market would increase savings significantly.

Western Massachusetts Electric Company Small Business Energy Advantage (SBEA)

Allston Supply, Springfield, MA
Allston is a growing distributor of chemical supplies, housed in a 15,000 square foot facility. This project retrofitted the existing T-12 HO fixtures (207 Watts) to T-5 (76 Watts), helping to transform the space from dark and dingy to bright and welcoming.
Project Cost: $10,830.00
Incentives: $5,806.00
Participant Cost: $5,024.00 (financed over two years via 0% SBEA Loan)
Estimated Annual Savings: 24 kW, 29,500 kWh per year and $3,000
Estimated Lifetime Savings: **$60,000**

It is important to note that this analysis is subject to a degree of uncertainty. Specifically, the day-ahead price bids, on which this analysis is based, only approximate the actual day-of supply curve.[14] A recent analysis performed for ISO-NE indicates that estimates of price difference based on the day-ahead bidstack are fundamentally conservative.[15] Therefore, The Division's analysis understates the impact energy efficiency programs had on reducing energy clearing prices in 2002.

Furthermore, the scope of the Division's analysis is conservative in two other ways. First, the Division's analysis focused only on Massachusetts, and did not include the impacts of demand reductions from ratepayer-funded energy efficiency activities in other New England states. Second, by reducing energy use during peak periods, energy efficiency efforts help displace the need to run generation plants at the margin, which tend to be higher polluting plants. While the Division does not estimate the monetary value of reduced emissions, the Division recognizes this as a societal benefit. A discussion of environmental impacts is discussed further in Section 2.2 below.

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[13] Patton, David B. 2001. An Assessment of Peak Energy Pricing In New England During Summer 2001. www.ISO-NE.com, page 50. While bilateral contract prices are set well in advance, especially for most retail customers, they reflect the basic supply and demand relationship in the overall system. The energy efficiency program related demand reductions and related price effect are reflected in future contracts by reducing the spot prices to which the prices in many of those contracts are linked, and by reducing risk premiums that are generally based on price volatility, and additional costs avoided at that point.

[14] There is substantial inherent uncertainty as to the actual generator that would have been setting the energy clearing price (ECP) on the margin if the system load had been higher (that is, without the impact of the state's energy efficiency programs). This is primarily due to the fact that some generators, after submitting their price bids on one day, may become unavailable to run on the next day, so that a different generating plant, having bid a different price, may actually be dispatched to meet load (thereby setting the ECP) in any particular hour.

[15] Patton, David B. 2001. An Assessment of Peak Energy Pricing In New England During Summer 2001. www.ISO-NE.com. In his analysis, Patton studied how the slope of the day-ahead bidstack changes in the real time supply curve. He identified four different ways that market rules adjust the shape of a day ahead bid stack, and that the combination of these shifts can only increase the overall slope of the supply curve relative to the day-ahead bidstack. (pp.5-15).

(b) Increasing System Reliability

By reducing demand, the Programs contribute to system reliability in terms of supply adequacy within a particular area or region. Their contribution depends on the technologies targeted. High efficiency lighting and refrigeration, for example, reduce base load, while more efficient air conditioners and chillers help reduce summer time peak load. All energy efficiency measures, however, help maintain adequate margins of generation supply, and can help deter brownouts and blackouts.

(c) Increasing Reliability of Local Transmission and Distribution Networks

A third system benefit of energy efficiency programs is enhanced reliability of local transmission and distribution (T&D) networks. This is especially important in Massachusetts where there is constrained transmission into the Boston area and the Cape and Islands. By reducing load and demand on the power distribution network, the Programs decrease the costly likelihood of failures. Over the long-term, energy efficiency programs can postpone the need for additional transmission lines and transformers, thus delaying upgrade costs for T&D paid by all customers.

In conclusion, the Division finds significant opportunities exist in Massachusetts to reduce summer peak demand through energy efficiency programs that provide system-wide benefits to all customers in the three key areas discussed above. This can be done by a) focusing on installing higher efficiency air conditioning and chiller units prior to summer for Residential and C&I customers; b) promoting higher efficiency standards for air conditioning equipment; and c) targeting C&I recommissioning opportunities. The Division is working with Program Administrators and key stakeholders to address these opportunities.

2.1.3 Economic Development Impacts

Economic development impacts of 2002 Programs are visible in two forms: job creation in the energy efficiency industry and other industries in Massachusetts, and direct bill savings to residential customers for spending on other consumption goods and to C&I customers for capital reinvestment and/or competitive improvements.

The Division examined employment impacts using the Regional Economic Model (REMI).[16] The Division estimates that 2002 Program expenditures (plus associated participant costs) added 1,778 new jobs to the Massachusetts economy in 2002. The majority of jobs were created in the services industry (44 percent), followed by manufacturing (17 percent) retail trade (14 percent), construction (9 percent), and wholesale trade (7 percent). These new jobs added $139 million to the gross state product, including $64 million in disposable income in 2002 alone. The 1,778 jobs created in 2002 are short-term jobs, lasting the length of time needed for installation and production of the energy efficiency measures. These positive economic impacts of energy efficiency programs are consistent with results from studies performed in other states,

[16] See Appendix C for a description of the Division's economic impact analysis.

including analyses in Iowa and Illinois, as well as a combined study in New York, New Jersey and Pennsylvania.[17]

In addition to these investment-related impacts, the bill savings enjoyed by consumers and businesses have longer-term impacts (over the 14-year life of the measures). These economic impacts result from additional spending on the part of consumers and businesses and increased competitiveness of businesses due to lower costs. The Division estimates that the lifetime bill savings generate 315 long-term jobs and increases in gross state product and disposable income of $22 million and $15 million, respectively, over the lifetime of the measures.

Summary: Overall Goal – To Strengthen the Economy

The Division concludes that 2002 Programs produced net gains for participants and the Commonwealth. Customers reduced their annual bills, and will continue to benefit over the lifetime of the conservation measures installed in their facility or home. In effect, these savings increased customers' discretionary spending, with corresponding benefits to the state economy. Moreover, analysis of benefits to the entire New England electricity system demonstrate that energy efficiency activities can play an important role in helping to reduce market clearing prices and increasing system reliability. The Division continues to work closely with Program Administrators and key stakeholders to identify further opportunities for bringing these types of benefits to all customers through Program activities.

2.2 Impact of Energy Efficiency Programs on Reducing Power Plant Emissions

The overall Statewide Energy Efficiency Goal also acknowledges the detrimental environmental effects of electricity generation. By reducing electricity consumption, energy efficiency programs can help reduce emissions caused by fossil fuel combustion used to generate electricity. In 2002, about 66 percent of all electricity generation in New England came from fossil-fueled generation plants. The environmental consequences of emissions from such plants include acid rain, ground-level ozone (smog), and climate change.

2.2.1 2002 Emission Reduction Impacts

The Division analyzed the impact of energy efficiency programs on reducing annual emissions due to 2002 installations alone, as well as the impact of emissions reductions over the lifetime (14 years) of measures installed in 2002. Table 6 provides a summary of these impacts for the primary pollutants: sulfur dioxide (SO_2), nitrogen oxides (NO_x), and carbon dioxide (CO_2). See Appendix D for a description of the Division's emission reduction analysis.

[17] These studies are: Weisbrod, Glen, Hagler Bailly Consulting Inc, et al, *Final Report: The Economic Impact of Energy Efficiency Programs and Renewable Power for Iowa,* Prepared for the Iowa Department of Natural Resources, December 1995; Goldberg, Marshall et al, *Energy Efficiency and Economic Development in Illinois,* American Council for an Energy-Efficient Economy (ACEEE), December 1998; and Nadel, Steven et al, *Energy Efficiency and Economic Development in New York, New Jersey and Pennsylvania,* ACEEE, February 1997.

Table 6: Impact of 2002 Programs on Reducing Emissions in New England

Pollutant	Environmental/Health Impact	Avoided Emissions (in tons)	
		Year 2002 Only	2002 Lifetime of Measures
Nitrogen Oxides (NO_X)	Smog (respiratory health damage) and acid rain (damage to natural habitats, etc.)	**135**	**1,890**
Sulfur Dioxide (SO_2)	Acid rain (damage to natural habitats, etc.) and acid aerosols (asthma & other respiratory health damage)	**394**	**5,516**
Carbon Dioxide (CO_2)	Global warming (climate change, with more extreme weather events, rising sea level, economic disruption, etc.)	**161,205**	**2,256,870**

Source: Division of Energy Resources – Energy 2020 Model Analysis

To provide more comprehensible reference points for the tons of avoided emissions listed in Table 6, the Division estimates the following:

- Emitting 135 fewer tons of NO_x from power plants is equivalent to removing more than 10,206 automobiles from New England roads of in 2001.[18]
- Emitting 394 fewer tons of SO_2 (if all were from coal burning power plants) is equivalent to burning 28,053 fewer tons of coal in New England.[19]
- Emitting 161,205 fewer tons of CO_2 is comparable to removing about 32,392 automobiles and other light vehicles from the roads.[20]

Similar to the demand reduction analysis, the Division's estimates of reduced emissions in year 2002 are conservative, reflecting only the impact of measures installed in year 2002. They do

[18] The NO_x equivalence is based on 1.0 grams of NOx emitted per mile for light duty vehicles (automobiles—not SUVs, vans, or pick-up trucks) and 12,000 miles per year per average vehicle (personal communication from the MA Department of Environmental Protection [DEP], January 2000).

[19] The SO_2 equivalence is based on 71.2 tons of coal per ton of SO_2, based on 1998 data from the Energy Information Agency's 1998 *Electric Power Annual*, Vol. 1, Tables 14 (8,136 thousand tons of coal burned by New England power plants) at http://www.eia.doe.gov/cneaf/electricity/epav1/ta14p1.html, and the EPA's "Emissions Scorecard 1998," Table B3 (114,275 tons of SO_2 emitted from New England coal burning power plants) at http://www.epa.gov/airmarkets/emissions/score98/tavble_b3.xls

[20] The CO_2 equivalence is based on 4.9767 tons of CO_2 emitted per vehicle per year, based on 1998 Massachusetts gasoline consumption data (per the MA DEP), the total number of gasoline vehicles registered in Massachusetts in 1998 (per the MA Department of Motor Vehicles via the MA DEP), and US EPA methodology.

not reflect the impact of energy efficiency measures installed in years prior to 2001, but still in place in 2002, thus helping to reduce emissions further.

Finally, the Division estimates that emission reductions for NO_x, SO_2, and CO_2 over the lifetime of energy efficiency measures (an average of 14 years) installed in 2002 will be 1,890 tons, 5,516 tons, and 2,256,870 tons, respectively. Thus, the air quality benefits from 2002 energy efficiency activities will continue over the long term.

Summary: Overall Goal – To Protect the Environment

There are many strategies – both regulatory and market-based – that can be used to combat the negative air quality effects of electricity generation. These include federal (e.g., Environmental Protection Agency and the Clean Air Act), regional (e.g., Northeast States Coordinated Air Use Management and the Ozone Transport Committee), and state regulatory efforts. Market-based programs include tradable allowances for SO_2 and NO_X, and voluntary programs promoting energy efficiency and renewable energy. Energy efficiency programs play an important and complementary role in this larger context of environmental protection by reducing harmful emissions and thereby improving air quality in the state and the New England region.

3.0 Program Cost-Effectiveness Objective

The Act requires that ratepayer-funded energy efficiency programs meet cost-effectiveness criteria defined by the Department of Telecommunications and Energy (the Department). The Department's required methodology compares the benefits and costs of each program and calculates a benefit-cost ratio. A program benefit-cost ratio of 1.0 or higher is considered cost-effective under the methodology.

3.1 Cost-Effectiveness Methodologies

Prior to year 2000, Program Administrators used several tests to evaluate programs. These methodologies included the electric system test (or utility test), the total resource cost test, and the societal test. The tests differ in how they define benefits and costs and from which perspective (i.e., that of the distribution company, and/or the participating customer, and/or society as a whole) one views the benefits and costs, as described in the text box below.

Overview of Key Cost-effectiveness Test Methodologies

Electric System Test - The Electric System Test (EST) considers benefits and costs to the electric system as a result of the energy efficiency programs, and is used to ensure that electric ratepayers receive net benefits from the energy efficiency programs they fund. Benefits include the value of avoided wholesale electricity costs, as well as avoided transmission and distribution costs to the distribution company that otherwise would be passed on to ratepayers. The denominator of the cost-effectiveness ratio using the EST is simply annual energy efficiency program costs funded by ratepayers, and does not include participant costs.

Total Resource Cost Test – The Total Resource Cost Test (TRC) considers a broader set of benefits and costs than the Electric System Test, including the direct benefits and costs to the participating customers. Specifically, benefits extend to quantifiable benefits that accrue to participating customers such as the impact that energy efficiency equipment has on avoiding other energy costs as well as measurable non-energy costs (e.g., reduced gas bills, decreased operating and maintenance costs). Costs extend beyond just program costs paid by ratepayer energy efficiency funds, and include the direct investment made by the customers that participate in the programs. For example, while a program may cover 75% of the incremental cost of installing more efficient equipment over standard equipment, a customer pays the balance of this incremental cost, known as the "participant cost." The TRC test is basically the Societal Test without externalities (see below), and is the test required by the Department in its 98-100 Order.

Societal Test – The Societal Cost Test is structurally similar to the TRC test, yet it goes beyond the TRC test in that it attempts to quantify total resource costs to society as a whole rather than to only the utility service territory (i.e., the distribution company and its ratepayers). In taking a broader perspective, the Societal Cost Test utilizes essentially the same cost variables as the TRC test, but has a greater scope of benefits that are defined with a societal point of view.

3.2 2002 Program Cost-Effectiveness

Starting in 2000, pursuant to the Department's 98-100 Order and Guidelines, Program Administrators screened their programs using the Total Resource Cost test, thus broadening the range of quantifiable benefits used to assess the cost-effectiveness of their programs. As a result, the cost-effectiveness of programs in 2002 can be compared to the 2001 values. Specifically, in

2001, a total of $371 million in benefits exceeded the $181 million in costs[21] for a net benefit of $154 million. Thus, programs were cost-effective with an overall benefit-cost ratio of 2.1 (a slight increase over the value of 2.0 for 2000 programs). Similar results were obtained in 2002, with a total of $307 million in benefits exceeding $138 million in costs. Benefit-cost ratios for the Low-Income, Residential and C&I programs are provided in Table 7.

For the C&I sector, program cost-effectiveness remained essentially unchanged from 2001 at 2.4. While the Department's 98-100 Order and Guidelines allow for the counting of increased worker productivity and property improvement for businesses due to the installation of higher efficiency equipment, these values can be difficult to estimate. Nonetheless, C&I programs remain more cost-effective than Residential programs, primarily because C&I customers can take advantage of economies of scale (i.e., their costs to purchase and install energy efficiency measures are less per unit) and residential programs involve greater transaction costs. Further, electricity is used by C&I customers for a greater proportion of each day, thus greater savings accrue from more frequent use of energy conservation measures.

Table 7. 2002 Program Cost-Effectiveness

Customer Class	Without Post-Program Effects	With Post-Program Effects
Low-Income	2.1	2.1
Residential	1.8	2.6
C&I	2.4	2.7
Total	**2.2**	**2.6**

Source: Division of Energy Resources - Compilation of 2002 Program Statistics Reported by Program Administrators

The Department's 98-100 Order and Guidelines also directed Program Administrators, for the first time, to report on post-program effects associated with market transformation programs (see Section 6.1). Post-program effects (i.e., savings) are a direct result of the programs that accrue to all customers, not just program participants, *after* the programs have ended. Although the estimates of these post-program effects are less certain than savings associated with traditional programs, they provide a good indication of the savings magnitude of market transformation programs. The Division calculates that the overall cost-effectiveness of 2002 programs was about 20 percent higher—or a benefit-cost ratio of 2.6—with the inclusion of post-program effects. Given the post-market effect estimates are considered rough, the Department plans to test the accuracy of these forecasts in the near future.

Summary: Program Cost-Effectiveness Objective

Pursuant to the Department's 98-100 Order and Guidelines, in 2002 all programs were cost-effective for all customer sectors. The cost-effectiveness of year 2002 programs was impacted by the application of the Department's revised methodology. The revised methodology effectively captured a broader range of program costs and benefits. The 2002 cost-effectiveness

[21] These costs include participant costs but exclude costs associated with the Integrated Resource Management (IRM) programs.

ratios represent a second application of a broader range of benefits and costs associated with energy programs, permitting an accurate comparison to prior-year results. Furthermore, the results incorporate another year's experience with valuing post-program effects associated with market transformation programs – a fundamental step to capturing the full benefits of these types of programs, as discussed in Section 6.

Massachusetts Electric Company
Large Commercial and Industrial
Energy Initiative

Brockton Water Dept / US Filter, Silver Lake Station - Pembroke MA
The Silver Lake Pumping Station pumps approximately 12 Million Gallons per day of municipal drinking water from Pembroke MA (elevation 59') to twin reservoir tanks in Brockton MA (elevation 250'). The focus of this project is to shift electrical demand from the on-peak period to the off-peak period, while still meeting operational requirements. Substantial water quality improvements are also being realized. Equipment included: HI lift pump with New Motor Control Centers, including Synchronous Motor Starters (2) 450 HP, and (2) 125 HP New Premium Efficiency Motors, Variable Speed Drives for each motor and SCADA Control System
Project Cost: $508,111.00
Incentives: $254,056.00
Participant Cost: $254,055.00
Estimated Annual Savings: 532,296 kWh or $45,000
Estimated Lifetime Savings: $675,000 (estimated on 15-year life)

4.0 Equitable Allocation of Funds Objective

The Act directs the Division to ensure that Program activities are equitably allocated among customer sectors. Absent an explicit definition provided by the Act, the Division interprets "equitable allocation" to mean that the amount of funds collected from a specific customer sector should ideally be expended on that sector, but that circumstances may not always warrant such proportional allocation.[22] However, judgement as to whether funds are equitably allocated is influenced by specific requirements set forth in the Act. The Legislature, acknowledging that Low-Income households are not likely to be served by the competitive energy market, directed funding levels for Low-Income programs to be no less than the greater of 0.25 mills per all kWh sold by electric distribution companies or 20 percent of the total residential budget. Therefore, a threshold portion of collected funds is allocated to this customer sector, and if necessary, is subsidized equitably by funds collected from the Residential and C&I sectors.[23] For the purposes of this analysis, the Division uses 60 percent of median income to define the Low-Income population. The Division's analysis herein considers total funds available in 2002 for different customer sectors, and compares them to expenditures (plus year-end fund balances) for each sector.

4.1 2002 Total Available Funds

The funds available in 2002 to support Program activities included 2001 carryover funds plus interest and 2002 ratepayer collections based on the mandated charge of 2.7 mills per kWh sales. Table 8 summarizes the funds available by customer sector. Total available funds in 2002 were $122.5 million ($8.2 million in 2001 carryover funds and $114.3 million in 2002 collections).

Table 8: 2002 Total Available Funds

Customer Sector	2001 Carryover		2002 Collections		Total Available Funds	
	million $	percent	million $	percent	million $	percent
Low-Income	2.3	27.8	6.1	5.4	8.4	6.9
Residential	7.5	92.4	36.3	31.8	43.8	35.8
C&I	-1.7	-20.2	71.8	62.9	70.2	57.3
Total	8.2	100	114.3	100	122.5	100

Source: Division of Energy Resources – Compilation of 2002 Program Statistics Reported by Program Administrators.
Note: Percent totals may not add up due to rounding.

[22] A strictly proportional allocation of funds (i.e., $1 collected from a customer sector is allocated to same customer sector) could cause Program Administrators to forgo inequitable investment opportunities that significantly lower electric system costs, thus benefiting all customers. Furthermore, due to the vagaries of program implementation, exact allocations would be a goal that would be difficult to implement since many implementation activities are beyond the control of the Program Administrators (e.g., vendors become behind schedule, customers do not respond to marketing, etc.) Also, program plans are often altered significantly before they become actual program expenditures.

[23] See Division's Energy Efficiency Oversight Guidelines supporting its regulation 225 CMR 11.0.

Total 2002 collections represented about 2.7% of customers' annual electricity charges. The availability of funds for the C&I, Residential and Low-Income sectors were 58, 36, and 7 percent, respectively.

4.2 2002 Expenditures and Year-End Fund Balance

Total Available Funds were $121.7[24] million in 2002 and Total Expenditures were $113.5 million, leaving an $8.2 million fund balance at the end of the year (Table 9). Note that expenditures reported include all 2002 energy efficiency expenditures, including administration, marketing, program implementation, program evaluation, and performance incentives paid to the Program Administrators, but does not include costs incurred by participants.

Table 9: 2002 Expenditures and Fund Balance

Customer Sector	2002 Expenditures		2002 Fund Balance		Expenditures Plus Fund Balance	
	million $	Percent	million $	percent	million $	percent
Low-Income	13.4	11.8	-3.9	-47.5	9.5	7.8
Residential	27.0	23.8	15.4	188.7	42.4	34.9
C&I	73.1	64.4	-3.4	-41.2	69.7	57.3
Total	**113.5**	**100**	**8.2**	**100**	**121.7**	**100**

Source: Division of Energy Resources – Compilation of 2002 Program Statistics Reported by Program Administrators.
Note: Percent totals may not add up due to rounding.

There are three main reasons for the year-end carryover. First, part of this year-end balance represented committed payments set-aside for future payment of performance contracts.[25] Second, actual sales were higher than forecasted sales (which were used to develop program budgets), thus producing a surplus of funds. Third, a portion of 2002 funds was committed to energy efficiency projects, but not yet expended as of year-end 2002. Unexpended funds in 2002, plus interest, were carried forward to 2003.

The largest portion of 2002 expenditures was spent on the C&I sector (64 percent), followed by the Residential and Low-Income sectors at 24 and 12 percent, respectively. These percentages represent a shift to C&I programs compared to last year, when the percentage spent on C&I programs was 57 percent. The year-end fund balance for 2002 was 8.2 million, with only the residential sector have a positive balance. The portions of Total Expenditures Plus Fund Balance was 57 percent to the C&I sector, 35 percent to the Residential sector, and 8 percent to the Low-Income sector. These are the values that the Division compares to the percentage breakout of Total Available Funds to analyze equitable allocation, discussed in the following section.

[24] The difference between this estimate and the one on the prior page is due to rounding.
[25] These performance contracts are for the IRM program at NSTAR.

4.3 Equitable Allocation Analysis

In reporting on whether Total Available Funds were allocated equitably across the different customer sectors in 2002, the Division looked at both Expenditures and Expenditures Plus Fund Balance at year-end for each customer sector. The latter provides the more accurate representation of whether funds were allocated equitably relative to Total Available Funds. For example, while actual expenditures in 2002 may not have been equitably expended for various reasons, equitability may have been preserved if an appropriate amount of funds at year-end was carried forward to the following year's budget and used for the same customer sector.

Table 10 compares 2002 Total Available Funds from Table 8 to Expenditures Plus Fund Balance from Table 9 in dollar and percentage terms. The totals do not equal because of rounding.

Table 10: Comparison of 2002Total Available Funds to Expenditures Plus Fund Balance

Customer Sector	2002 Total Available Funds (from Table 8)*		2002Expenditures + Fund Balance (from Table 9)	
	million $	percent	million $	percent
Low-Income	8.4	7	9.5	8
Residential	43.8	36	42.4	35
C&I	70.2	57	69.7	57
Total	**122.4**	**100.0**	**121.7**	**100**

Source: Division of Energy Resources – Compilation of 2002 Program Statistics Reported by Program Administrators.
Note: Percent totals may not add up due to rounding.

For the Low-Income sector, a comparison of Total Available Funds in percentage terms (7 percent) versus Expenditures Plus Fund Balance (8 percent) suggests that a small portion of Low-Income expenditures were subsidized by the residential sector, which was similar to last year. For the C&I sector, Total Available Funds in percentage terms (57 percent) was equal to Expenditures Plus Fund Balance (57 percent).

Summary: Equitable Allocation of Funds Objective

The Division concludes that 2002 program funds were equitably allocated pursuant to the Act.

5.0 Balancing Short- and Long-Term Savings Objective

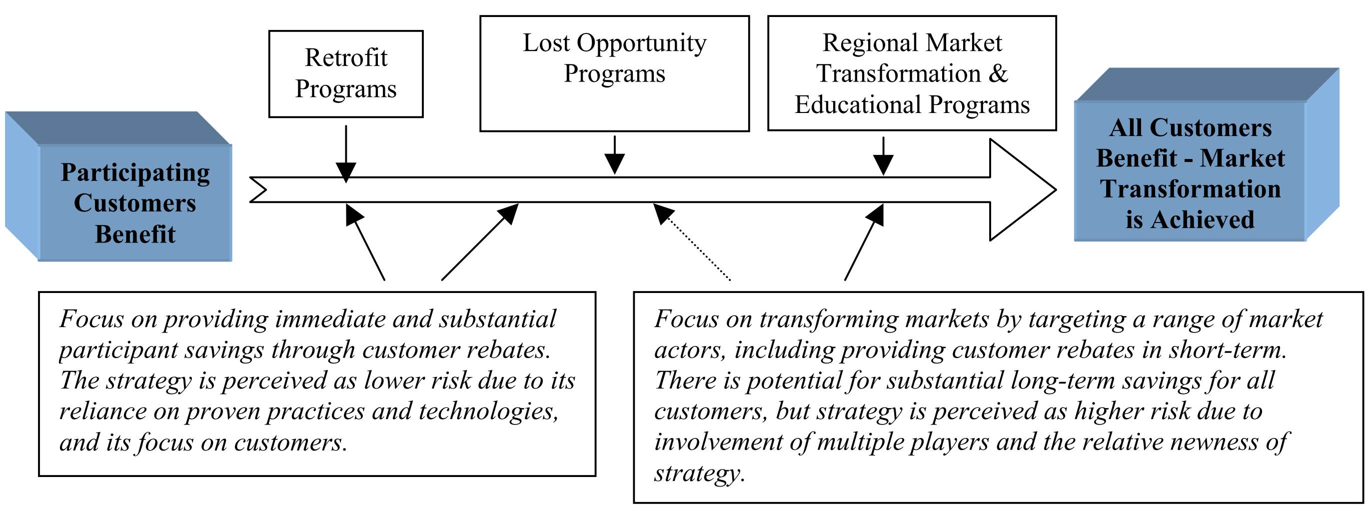
5.1 Types of Energy Efficiency Programs

Ratepayer-funded energy efficiency programs are intended to serve two fundamental purposes: to provide immediate savings for participating customers and lay a broader foundation for future savings for all customers through the development of competitive energy efficiency markets. This latter objective requires that programs be designed to tackle existing market barriers to the competitive market for energy efficiency products and services to all classes of customers.

Removing market barriers to the use of energy efficient products and services helps to change – or transform – those markets so that more fully competitive markets develop in the future. Thus, "market transformation" is not a label that uniquely identifies certain energy efficiency programs at the exclusion of others. Rather, market transformation is an objective that all energy efficiency programs have the potential to achieve, to at least some extent. While some programs are designed to accomplish specific market changes, others may have effects on markets without necessarily targeting those effects as a program objective.

Market transformation may be thought of as a continuum along which energy efficiency program designs fall. The major types of energy efficiency programs offered in 2002 were Retrofit programs (a.k.a. "In Home Services"), Lost Opportunity (a.k.a. "New Construction") programs, and Regional Market Transformation programs (a.k.a. "Products and Services") which are coordinated with other states in the region. These program strategies span across this market transformation continuum, as shown in Figure 2.

Figure 2. Market Transformation Continuum



A summary of the program strategies that fall along the market transformation continuum is provided in Table 11.

Table 11. Summary of Program Types

Program Type	Short-term Energy Savings	Long-term Energy Savings
Retrofit Programs (aka In-Home Services Programs)	Substantial immediate energy savings and cost reductions to participating customers, primarily through the provision of rebates.	Programs have long-term savings impacts over the life of the conservation measures installed. However, savings beyond the life of the measures may not be achieved if markets have not been transformed.
Lost Opportunity Programs (aka New Construction Programs)	Substantial immediate energy savings and cost reductions to participating customers through the provision of rebates.	Programs have long-term savings impacts over the life of the conservation measures installed. Savings beyond the life of the measures may be achieved as a result of changing standard building practice and upgrading building codes and standards.
Regional Market Transformation Programs (aka Products and Services Programs)	Some immediate savings for participating customers through rebates, but these ramp-down as energy efficient product market begins to transform.	Potential for long-term savings is large if technology markets are successfully transformed, thus benefiting not only participating customers, but also all customers.
Educational Programs	Focuses on increasing customer awareness about energy efficiency products, and helping customers understand how they can reduce their electricity bills. Difficult to quantify energy savings in short-run.	Focuses on increasing customer awareness about energy efficiency products, and helping customers understand how they can reduce their electricity bills. Difficult to quantify energy savings in long run.
Other Programs (e.g., Load Management Programs)	Helps customers achieve immediate savings by shifting electricity use to less costly periods of the day, or paying credits to customers for interrupting service during capacity shortage and emergency periods.	Historically, load management programs have helped to reduce demand for electricity, and thus costs to all customers over time by postponing the need to build new generation capacity.

5.2 2002 Program Expenditures/Savings by Program Type and Customer Sector

In 2002, a total of $113.4 million of ratepayer-funds was invested in Program activities. The majority of these investments was in Retrofit programs, representing 60 percent of all program expenditures, while Lost Opportunity (New Construction) programs represented about 27 percent of total expenditures. Funding for Regional Market Transformation programs was 12 percent in 2002, while Educational and Other Program expenditures accounted for 1 percent. For the prior year, educational expenditures alone accounted for 3 percent of the total.

Figure 3 summarizes program spending by the types of programs discussed above. Table 12 further summarizes 2002 expenditures[26] and savings by program type and customer sector.

[26] Expenditures reported in Table 11 include *all* 2002 energy efficiency expenditures, including administration, marketing, program implementation, program evaluation and performance incentives paid to the distribution companies.

Figure 3. 2002 Allocation of Expenditures by Program Type

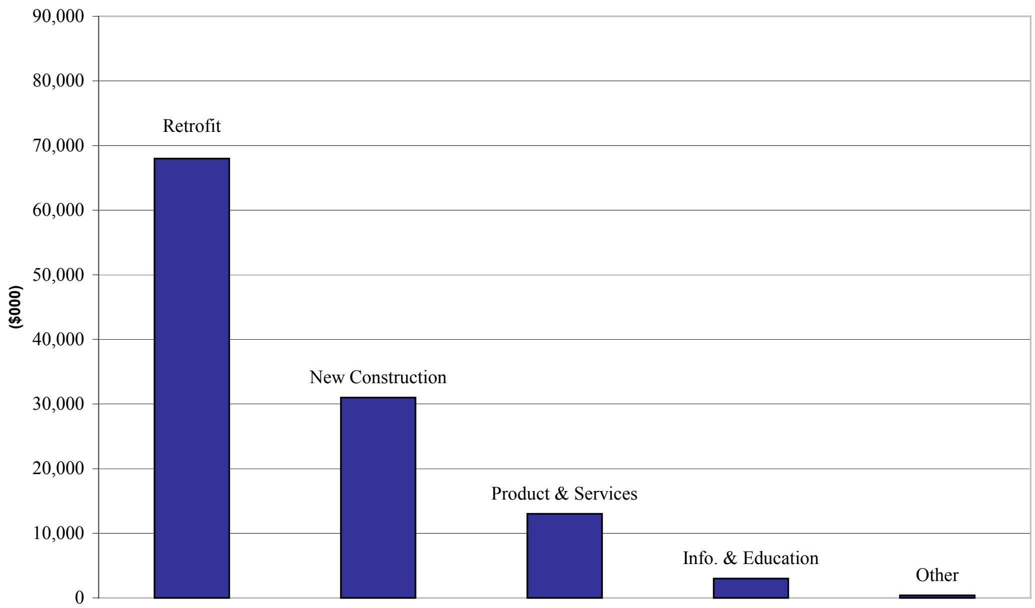


Table 12. 2002 Expenditures and Savings by Program Type and Customer Sector

Customer Sector	Program Expenditures		Program Savings		
	Million $	% of Total	Annual (million kWh)	Lifetime	Lifetime % of Total
Low-Income					
In-home Services	$12.9	11.5%	16	212	6.2%
New Construction	$0.6	0.5%	0	4	0.1%
Product & Services	$0.4	*0.4%*	*2*	*18*	*0.5%*
Subtotal	***13.9***	***12.4%***	***18.0***	***234***	***6.8%***
Residential					
In-home Services	$12.1	9.9%	14	214	6.2%
New Construction	$4.2	3.7%	1	19	0.6%
Product & Services	$10.6	9.3%	40	387	11.3%
Info. & Education	$0.2	0.2%	0	2	0.1%
Other	$0.4	0.4%	0	0	0.0%
Subtotal	***$27.5***	***23.5%***	***55.0***	***622***	***18.1%***
C&I					
Retrofit	$43.6	38.8%	108	1,595	46.5%
New Construction	$26.0	23.2%	53	856	25.0%
Product & Services	$2.4	2.1%	7	120	3.5%
Info. & Education	$0	0.0%	0	0	0.0%
Other	$0	0.0%	0	0	0.0%
Subtotal	***$72.0***	***64.1%***	***168.0***	***2,571***	***75.0%***
TOTAL	**$113.4**	**100%**	**241**	**3,427**	**100.0%**

Source: Division of Energy Resources – Compilation of 2002 Program Statistics Reported by Program Administrators.
Note: Percent totals may not add up due to rounding.

Summary: Balanced Savings Objective

A balanced program portfolio aims to provide immediate savings to participating customers, while also providing for the transformation of energy efficiency markets on a permanent basis. Achieving this broader objective of market transformation requires that programs, where possible, be designed to leverage non-ratepayer funds. The extent to which ratepayer funds are able to leverage private funds is an important indicator of success in transforming energy markets.

The portfolio of program strategies within each sector in 2002 did not change dramatically relative to the prior year. Within the Residential sector, the most significant change occurred with greater investments in Retrofit (In-Home Services) and a reduction in Lost Opportunity (New Construction) programs.

The most notable difference in the 2002 data presented in Table 12 compared to 2001 is the increase in the residential program expenditures relative to the C&I programs. This shift reflects more attention of the Program Administrators to ensuring equitable allocation for all large customer sector groups.

For the C&I sector, the majority of funds was spent on Retrofit programs, followed by Lost Opportunity programs – all of which provided participating customers with substantial and important immediate savings.

If experience with Regional Market Transformation programs demonstrates quantifiable changes in market share for specific energy efficiency technologies, funding for these types of programs should be expanded.

Finally, the Division recommends that, with increasing concerns about system reliability issues, Program Administrators should place greater emphasis on designing certain residential and C&I programs to specifically address the goal of reducing electric energy use during peak demand periods. This is especially critical during peak summer hours when electricity demand is typically at its highest, and the system can become seriously constrained. The Division is working with Program Administrators and key stakeholders to further explore this issue.

Cape Light Compact
Commercial & Industrial/Government
Traffic Signal Retrofit to LEDs

The Towns of Barnstable, Bourne, Brewster, Dennis, Falmouth, Harwich, Orleans, Sandwich, Truro and Yarmouth.
The retrofit to LED's of more than 900 traffic signal lamps operated by the ten participating towns and the State Mass Highway intersections were aggregated and competitively bid over the Fall/Winter period and installed by a single contractor in time for the busy Spring/Summer period on Cape Cod. As the project total cost presented significant savings and benefited all consumers, a 100% subsidy for municipal projects, was provided by the Cape Light Compact.
Project Cost: $114,000
Incentives: $114,000
Participant Cost: $0
Estimated Annual kWh Savings: 300,000
Estimated Annual Electric Bill Savings: $37,000

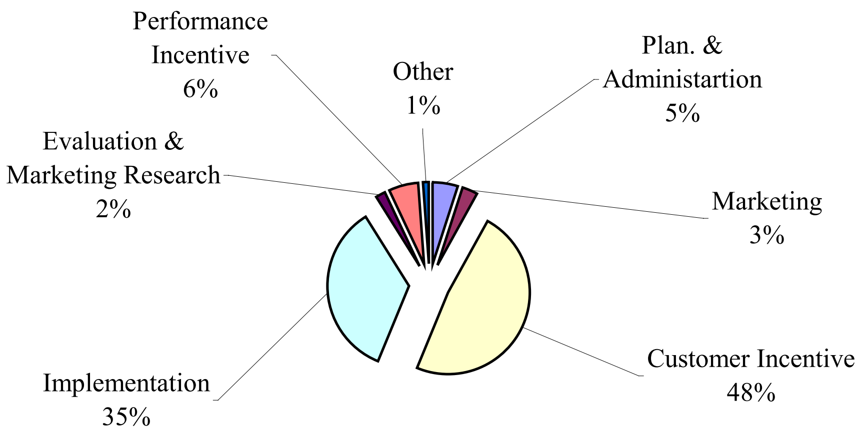
6. 0 Development of Competitive Market Objective

The Division continues to observe a lack of energy efficiency services offered by competitive retail suppliers. This appears to be largely due to limited activity in the electricity market in general, but also due to certain barriers customers face (e.g., paying for up front costs of energy audits) to investing in energy efficiency.

While little or no progress was made in increasing competition for energy efficiency services through competitive retail electric energy suppliers, another measure of competition in the energy efficiency market is the extent to which ratepayer-funded program services (e.g., program implementation) are competitively procured. The Act requires that competitive procurement processes be used to the greatest extent practicable when delivering programs to Massachusetts' customers. These procurement processes benefit customers by providing lower, competitively set program costs, as well as by introducing innovative elements to program designs and/or implementation.

Competitive procurement processes are typically utilized by Program Administrators to obtain services in some aspects of program administration, program marketing, program implementation, customer rebates, and program evaluation. In 2002, these cost categories represented 82 percent of total ratepayer-funded energy efficiency expenditures. Only the 18 percent of costs for performance incentives (those rewards earned by the distribution company for achieving specific program performance goals) and internal administrative expenses were not subject to competitive procurement. Figure 4 shows the breakdown of company expenditures by cost category.

Figure 4. 2002 Electric Distribution Company Expenditures by Cost
Total=$113.4 million



Source: Division of Energy Resources – Compilation of 2002 Program Statistics Reported by Program Administrators.
Note: Percent totals may not add up due to rounding

Of the $113.4 million spent on Program activities in 2001, $93.0 million (or 82 percent) was spent on services contracted through energy efficiency service providers, as shown in Table 13.

The majority of these competitively procured services were related to customer rebate related expenditures, followed by program implementation, evaluation, and marketing. Program administrative costs and performance incentives accounted for 18 percent of total expenditures, slightly higher than the 16% featured in 2001, but still lower in absolute dollar amounts.

Table 13: Procurement of Ratepayer-Funded Energy Efficiency Activities (Percent of Total Expenditures = $113.4 million)

Cost Category	Internally Expended Activities	Contracted Out Services	Total Expenditures
Rebates to Customers	0%	51%	51%
Implementation	3%	26%	29%
Performance Incentives	7%	0%	7%
Administration	6%	1%	7%
Evaluation	1%	2%	3%
Marketing	0%	2%	2%
Other	1%	0%	1%
Total	**18%**	**82%**	**100%**

Source: Division of Energy Resources – Compilation of 2002 Program Statistics Reported by Program Administrators.
Note: Percent totals may not add up due to rounding.

Conclusion

The Division concludes that 2002 energy efficiency program activities continued to effectively address the objectives of the Statewide Energy Efficiency Goals. The Programs provided substantial net economic benefit in terms of bill savings to participating customers, and system savings for all customers in the form of generation, transmission and distribution cost savings over the long-term. They also helped to reduce wholesale energy prices in the short-term, costs that would ultimately be paid for by all customers. Moreover, the Programs helped to create new jobs in the state both in the short term due to investments in energy efficiency industries, and in the long term through continued bill savings over the lifetime of these investments. Finally, they reduced harmful emissions from fossil-fueled power plants, thus helping to improve air quality. These direct and indirect impacts of the energy efficiency programs continue to benefit the Commonwealth's economy and its citizens.

The Division also found that more work is needed to ensure that a competitive market is created for energy efficiency products and services. Continued competitive procurement by Program Administrators will help provide the impetus for market development.

Currently, the energy efficiency programs are scheduled to continue through 2007.

For further information on 2001 energy efficiency activities, including the eight page Executive Summary, please visit the Division's web site: http://www.mass.gov/doer.

APPENDICES

Appendix A: 2002 Electricity Bill Impact Analysis Methodology

The Division's 2002 energy efficiency bill impact analysis consisted of two parts. First, the Division analyzed the bill impact of energy efficiency program energy (kWh) savings for participating customers by key customer segments: Low-Income, Residential, and Small, Medium and Large C&I. This involved estimating the average annual energy charges that participants avoided as a result of energy savings due to energy efficiency equipment installations in 2002. These estimated avoided charges were based on the *variable* portion (i.e., $ per kWh) of the tariff for each rate class for each electric distribution company.

Second, the Division performed a bill impact analysis of the total avoided annual demand (KW) charges due to energy efficiency programs for those participants with such a component on their electricity bill. The calculation of avoided annual demand charges was based upon a state weighted average demand charge for demand savings over the year.

1. Energy Savings Bill Impact Analysis

Calculation of Avoided Energy Charges. Avoided energy charges (i.e. charges based on kWh consumption) over the period of 2002 were estimated for each distribution company by adding up all variable charges (i.e., not including fixed charges such as the customer charge) for each rate class, and then weighting the avoided charges by the number of months they applied during the year. Thus, the resulting rate was a weighted average of the avoidable energy charges by rate class for each distribution company. Note that the energy savings data submitted by NSTAR were broken down by NSTAR categories, yet the rate data continue to be classified as either Boston Edison, Cambridge, and Commonwealth Electric. Thus these rates had to first be combined to fit the appropriate NSTAR categories. The combined rates in this case, were also weighted by number of customers.

Estimate Average and Total Annual Bill Savings. Using energy efficiency program energy savings data for each rate class (provided by the distribution companies), the Division estimated average annual bill savings by multiplying the savings for each rate class by the avoidable energy charge for that rate class. The total of these bill savings was estimated to be more than $21 million, as follows:

Total Annual Bill Savings = Σ (S*AEC), where:
S = kWh savings from programs by rate class for each distribution company
AEC = Weighted avoidable energy charge by rate class for each distribution company

The Division aggregated the results for the rate classes for each distribution company into the following customer segments:

1) Low-Income
2) Residential
3) Small C&I - rate classes with average monthly use of less than or equal to 3,000 kWh/month.

4) Medium C&I - Medium C&I includes rate classes with average monthly use greater than 3,000 kWh/month, but less than or equal to 120,000 kWh/month
5) Large C&I - rate classes with average monthly use greater than 120,000 kWh/month.

Total bill savings for each rate class were also divided by the number of participants reported by each distribution company to determine the average bill savings per participant.

Average Bill Reductions as a Percent of Total Average Annual Bills. In order to determine the average percent reduction on an average annual bill, the Division first calculated average annual bills for each rate class (using average annual usage values per participant, as provided by the Program Administrators). Two bills were then calculated for the purpose of comparison, an average annual bill per participant *with* the program, and a hypothetical average annual bill per participant *without* the program. The average annual bill per participant *without* the program was found by first adding actual kWh usage per participant to kWh savings per participant, based on the assumption that the usage savings would have been used were it not for the program in place. This number was then multiplied by the avoidable energy charge and added to the fixed (i.e., non-variable) charge for the year. The average annual bill per participant with the program was found by multiplying actual kWh usage per participant by the avoidable energy charge and adding that to the fixed charge for the year. The difference between the two was then considered average annual bill impact and the percent reduction was calculated.

Similar to the process for estimating the average and total annual bill savings, the Division aggregated the results of its analysis into the customer segments described above.

2. Demand Charge Bill Impact Analysis

The Division's analysis of the demand charge bill impact for participating customers involved the following steps:

- Estimating a weighted average demand charge for each distribution company. This required multiplying the total demand charge (i.e., charge per kW peak in a billing cycle) per rate class by the number of participants in that rate class, adding across all rate classes for each distribution company, and dividing by the total number of participants for each company.
- The total company weighted average demand charge was then aggregated by adding the company-weighted averages together and dividing by the total number of participants for all companies. The total weighted average demand charge was estimated to be $7.25 per KW.
- The total weighted average demand charge was multiplied by demand (KW) savings that accrued to C&I participants that were on a tariff with a demand charge. These average demand savings of 13,724 were based on summer/winter peak savings for all hours as reported by Program Administrators, and reflect average savings weighted over summer months (5), and winter months (7). Unlike last year, interruptible credit programs were only in place for residential customers, not C&I customers. Therefore, the C&I demand savings analysis does not reflect any savings from such programs. The Division's analysis assumed that individual customer peaks were coincident with system peak.
- The 13,724 in kW savings resulted in roughly $1.2 million in annual bill savings to participating customers, as shown in the table below.

	Total C&I kW Savings	Less Interruptible Credit Program kW Savings	kW Savings Weighted Over Summer/Winter Months
Summer Peak Savings	35,251	0	14,688
Winter Peak Savings	22,347	0	13,036
Avg. KW savings			13,724
Avg. $/KW monthly rate			7.25
Monthly Savings			$99,485
Annual Savings			**$1,193,815**

Appendix B: Wholesale Energy Clearing Price Impact Analysis

The Division's analysis of how ratepayer-funded energy efficiency programs can reduce wholesale energy market clearing prices involved two major steps. First, peak summer savings values provided by distribution companies were adjusted in order to aggregate them and extend them over a greater number of hours. Second, price impacts were calculated using ISO-NE day-ahead bidstack data. This second step involved the specific mechanics of pinning day-ahead bids to actual price and load measures, as described below.

The Division's analysis focused on two price impact scenarios:

- Summer months June-September of year 2002 due to 2002 program installations; and
- Summer months June-September of year 2002 due to 1998-2002 program installations.

For each of the above scenarios, the Division calculated average peak summer savings and price impacts using the methodologies described below.

A. Peak Savings Estimates

Massachusetts distribution companies estimate summer and winter peak demand reductions (peak savings) as a result of their energy efficiency programs. These estimates are coincident with system peak. As such, the values reported by the companies do not reflect peak load savings for every hour, but rather for a set of conditions intended to be representative of the time of the peak load. DOER integrated the peak savings data from the utilities by using the ISO-NE system load shape as reference.

B. Price Impact Calculations

There is substantial inherent uncertainty regarding which generator would have set the energy clearing price (ECP) on the margin if the system load had been higher (that is, without the state's efficiency programs). This is primarily due to the fact that some generators, after submitting their price bids on one day, may become unavailable to run on the next day, so that a different generating plant, having bid a different price, may actually be dispatched to meet load (thereby setting the ECP) in any particular hour.

For the price calculations, DOER examined the following variables for every hour of the period from June 1 through September 30, 2002:

- the actual ECP clearing price;
- the actual NE system load; and
- the "bid stack" of prices that increase for each "step" in generating capacity that could be brought on line to meet system load for that hour.

These data are available from ISO-NE at:

http://www.iso-ne.com/historical_bid_data/,
http://www.iso-ne.com/forecasted_vs_actual/,
http://www.iso-ne.com/historical_market_data/energy_spot_market/.

The input to the price impact model was a series of estimates of the additional load in each hour that the New England system would have had to serve absent the energy efficiency programs.

The model calculated the price differential that would have resulted in each hour from that additional load. The price differential generated by the model is actually the difference between the closest bid price below the actual clearing price and the price of the bid needed to cover the additional load.[27] The results of the Division's analysis are as follows:

Scenario 1: Summer 2002 Impact Due to 2002 Measure Installations

Over all peak hours of the summer of 2002, the energy efficiency measures installed under the utility efficiency programs reduced the load an average of 48 MW. Without the 48 MW reduction, additional generating units would have been needed to meet the system load. The average "ECP" would have been **$0.59/MWh** higher without the energy efficiency programs. This difference from the price bid submitted by the generating unit that was, on average, 48 MW lower in the "bid stack," appears small. However, given that this price impact is reflected in every peak hour of the summer 2002, these data indicate a potential **$5,969,225** in savings accrued to spot market buyers, and ultimately, their customers.

Scenario 2: Summer 2002 Impact Due to 1998-2002 Measure Installations

The analysis of the cumulative impact of four years of installations is similar to Scenario 2 above in that it is performed over all summer peak hours during year 2002. The three years savings were approximated at 263 MW of flat savings.

Without the cumulative four-year impact of 263 MW, the average "ECP" would have been **$1.83/MWh** higher in every peak hour of summer 2002. These data indicate a potential **$19,394,352** in savings to the buyers in the spot market over the summer of 2002.

C. Bid-Stack Methodology

The use of the ISO-NE day-ahead bid-stack data is relatively straightforward. However, how the day-ahead bid-stack is pinned to reality requires some explanation to better understand the mechanics of the Division's above analyses.

ISO-NE provides a list of MW amounts and bid prices. Bids for the same dollar amount are combined and these combined bids are ranked from lowest to highest. The result is a set of

[27] The specifics of the bidstack methodology are discussed later in this Appendix.

variable size stairs rising from left to right as load and price increase. As stated before, the day-ahead bid stack does not exactly represent the actual real-time supply curve. The actual load and price points available on an hourly basis from ISO-NE do not land on the day-ahead stack for that hour. The stack must be shifted left or right so that actual load and price coincide with the stack.

Because actual prices are rounded to the nearest cent and bids are made in round dollars, a right-left shift will always coincide with the vertical part of the stair. However, in terms of the bid stack this is not a point that represents a realistic price-load combination. A price between two bids indicates that the more expensive generation has not yet been activated. The solution is to drop to the nearest stair (load-price combination) below the actual price.

Because the analysis is based on a relative shift of load it is also important to consider where on the stair (multiple MWs of load bid at the same price) the actual load should be pinned. Simply dropping to the stair below from the initial meeting point on the vertical is problematic. The analysis compares this point to a point to the right representing the assumption of greater load without energy efficiency savings. If the starting point is always the last MW of load available on the lower stair then even a single MW of savings will have a minimum one dollar price differential in every hour. A more conservative approach shifts the bid stack so that actual load coincides with the midpoint of that first stair below. Under this assumption there will only be a price change if the stair is less than twice as wide as the assumed load savings. This maintains the very real potential that a small decrement of load will in fact have no impact on prices.

Appendix C: Job Impact Analysis – REMI Model Overview and Assumptions

The Division used REMI Economic and Demographic Forecasting and Simulation Model (REMI-EDFS) to determine the economic impact of ratepayer-funded energy efficiency programs over time in the state of Massachusetts. REMI-EDFS model, calibrated for the for the state of Massachusetts, is used in this study to represent the economic impacts over time resulting from 2002 spending on energy efficiency programs (i.e. over 140 million dollars).

The model integrates the key aspects of three economic modeling tools: (1) Input-Output (I-O) models; (2) Computer General Equilibrium (CGE) models; and (3) Econometrics models. In general, it is able to forecast over 2000 output variables for the years 2002 to 2035 using a historical database that spans the years with a complete history or forecast for all of these variables for the period 1969 to 2000. For this report, the Division examined employment, output and income over the forecast horizon through the year 2015, the lifetime of the energy efficiency measures installed in 2002. Employment, as measured by number of employee-years; output or gross regional product (GRP), which provides an overall measure of economic production in the Commonwealth; and disposable income, which is the income (after taxes) that results from this increased economic activity.

1. Overall Methodology. The REMI model first calculates a baseline forecast for the state of Massachusetts using historical data and the most likely scenario for future economic conditions. The analysis then incorporates any changes related to the energy-efficiency into the model –via policy variables- to produce an alternative forecast (or simulation). This part of the analysis relied on Bill of Goods (BOG) data. The BOG data were developed by the Goodman Group, Ltd., and were desegregated into energy efficiency expenditures to industry-specific expenditures. The alternative simulation results are then subtracted from the baseline forecast to produce the net impact of policy changes.

2. Steps. The REMI model for energy efficiency program involves the following steps:

a. The Division ran a control forecast and examined the results for employment, output, and income.

b. Based upon 2002 energy efficiency expenditure data (including investments using ratepayer funds and participants costs), the Division established the amount by which each policy variable should be changed. This involved use of BOG data to allocate energy efficiency expenditures to the relevant industries of the Massachusetts economy. As described below, changes in these industries' demand were input as policy variables to REMI.

c. The Division input the bill savings that resulted from the energy efficiency investments and changed the relevant variables in REMI.

d. The Division reran the model. A complete alternative forecast was created based on the policy variable changes.

e. The Division interpreted the impact of policy change by analyzing the differences between the alternative and the control forecast.

3. Policy Variables. The following policy variables were used to model expenditures on energy efficiency products and services:

a. Increased demand for mining. This variable includes spending on windows, insulation, solar water heating, and lamps, lighting fixtures, HVAC controls, heating & cooling equipment, refrigeration, and motors.

b. Increased demand for rubber industry products/services. This variable includes spending on plastic products.

c. Increased demand for stone, clay, & glass industry products/services. This variable includes spending on mineral products.

d. Increased demand for machinery and computers equipment industry products/services. This variable includes spending metal working, special industry, and general industry.

e. Increased demand for railroad, trucking, air transportation, public utilities transportation, and other transportation industry products/services.

f. Increased demand for wholesale trade services.

g. Increased demand for professional and business services.

The following two variables were used for the bill savings analysis.

h. Decreased electricity costs. This variable includes saving on fuel costs for the commercial and the industrial sector over the lifetime of the energy efficiency program activities.

i. Increased demand for consumption expenditures. This variable includes spending on consumer reallocation of bill savings to products/services over the lifetime of the energy efficiency program activities.

Results. The Table below shows the results of the Division's REMI simulation. The employment impact is further broken down by industry sector.

Key Result	2002
Gross State Product (million of 2000$)	159
Disposable Income (million of 2002$)	79
Total Employment (number of employees)	2,093
Number of Jobs created by Sector	
Agriculture	19
Mining	4
Construction	183
Durable Goods	270
Non-Durable Goods	59
Transportation	63
Finance, Insurance, and Real Estate	104
Wholesale	133

Retail	335
Services	897
State & Local Government	24

Interpretation of Results. 2002 energy efficiency program activities generated 2,093 net new jobs in Massachusetts in 2002, contributing $159 million to the gross state product (GSP). In addition, $79 million in disposable personal income was gained from these jobs, concentrating in construction, retail trade and durable goods. The impacts of 2002 ratepayer-funded energy efficiency activities in Massachusetts's economy occur over time. As expected, the greatest impact is in the first year. Subsequent impacts (over fifteen year period) are lower as the increased demand from energy efficiency products, and the increased saving from fuel cost along with the increased in consumption expenditures are met. It is important to note that employment figures represent employee-years. Thus, future job impacts due to 2002 expenditures is not additional, "permanent" jobs created, but rather are jobs that remain in future years that were originally created in 2002. However, due to bill savings throughout the lifetime of the measures, we enjoy stable job creation throughout the entire life of the measures. In a sense, these can be considered "permanent" or long-term jobs.

The largest employment sector is services and durable goods- a result due to the nature of energy efficiency products and local economy. The $ 159 million in GSP provides an overall measure of economic production in the Commonwealth due to 2002 energy efficiency expenditures. Finally, as a result of 2002 activities, the Division estimates that the $ 79 million in disposable income was created that results from this increased economic activities. Lastly, as with employment, the GSP and disposable income figures decline over time.

Tables C-1 to C-3 show the data in greater detail for all years in the planning horizon. Table C-1 shows the data discussed above, while Tables C-2 and C-3 show the investment and bill savings impacts, respectively. Summing Tables C-2 and C-3 yields, approximately[28], the values found in Table C-1.

[28] Totals may not add up due to (1) rounding impacts, and (2) the interactions of the bill savings and investment spending on economic impacts.

TABLE C-1: 2002 EEDSM Expenditures & Bill Savings

Expenditues & Bill Savings	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Key Results															
Gross State product (Million of 2002$)	159	13	16	16	17	18	19	20	21	22	22	23	23	24	24
Total Employment (# of Employee)	2,093	198	219	218	220	223	228	230	232	234	236	234	232	232	227
Disposable Income (Million of 2002$)	79	12	14	14	14	14	14	14	15	15	15	16	16	16	16
	Number of Jobs Created by sector														
Agriculture	19	2	3	3	3	3	3	3	4	4	4	4	4	4	4
Mining	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	183	10	12	11	10	10	10	10	9	9	9	9	9	9	8
Durable Goods	270	5	6	7	8	8	9	9	10	10	11	11	11	11	11
Non-Durable Goods	59	7	8	8	9	9	9	9	9	10	10	10	10	10	10
Transportation	63	5	6	6	6	6	66	6	6	6	6	6	6	6	6
Finance, Insurance, & Real Estate	104	11	13	14	14	15	15	16	16	16	17	17	17	17	17
Wholesale	133	8	8	8	8	8	8	8	8	8	8	8	7	7	7
Retail	335	64	67	67	66	66	66	66	65	64	64	62	61	59	58
Services	897	61	69	69	69	72	74	75	76	78	78	79	78	79	78
State & Local Government	24	23	22	23	23	24	24	25	25	26	26	27	27	27	26

TABLE C-2: 2002 EEDSM Expenditures Economic Impacts

Expenditures	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Key Results															
Gross State product (Million of 2002$)	140	(6)	(5)	(5)	(3)	(3)	(2)	(2)	(2)	(1)	(1)	(0)	(0)	(0)	0
Total Employment (# of Employee)	1,777	(98)	(75)	(73)	(64)	(53)	(40)	(29)	(20)	(12)	(5)	0	3	6	8
Disposable Income (Million of 2002$)	64	(2)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(0)	(0)	0	0	0	0
Number of Jobs Created by sector															
Agriculture	14	(1)	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	153	(15)	(12)	(11)	(9)	(8)	(6)	(5)	(4)	(3)	(2)	(2)	(1)	(1)	(1)
Durable Goods	255	(9)	(7)	(7)	(6)	(5)	(4)	(3)	-2	-1	0	0	0	0	0
Non-Durable Goods	48	(3)	(3)	(3)	(2)	(2)	(1)	0	0	0	0	0	0	0	0
Transportation	53	(3)	(3)	(2)	(2)	(2)	(1)	(1)	0	0	0	0	0	0	0
Finance, Insurance, & Real Estate	81	(10)	(7)	(6)	(5)	(4)	(3)	(2)	(1)	0	0	0	0	0	0
Wholesale	119	(5)	(4)	(4)	(4)	(3)	(2)	(2)	(1)	(1)	0	0	0	0	0
Retail	248	(18)	(14)	(14)	(12)	(10)	(7)	(5)	(4)	(3)	(1)	0	0	0	0
Services	780	(47)	(37)	(35)	(30)	(25)	(19)	(14)	(10)	(7)	(4)	0	0	0	0
State & Local Government	20	15	12	10	8	7	6	5	5	4	4	4	3	3	3

TABLE C-3: 2002 EEDSM Bill Savings Economic Impacts

Bill Savings	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Key Results															
Gross State product (Million of 2002$)	19	19	20	21	21	22	22	22	23	23	23	23	23	23	23
Total Employment (# of Employee)	315	294	294	288	282	274	267	258	251	246	239	234	228	226	221
Disposable Income (Million of 2002$)	14	14	15	15	15	15	15	15	15	15	15	15	15	15	15
	Number of Jobs Created by sector														
Agriculture	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Mining	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction	30	25	24	22	20	18	17	15	14	13	12	11	11	10	9
Durable Goods	14	14	14	14	14	13	13	12	12	12	11	11	11	11	10
Non-Durable Goods	11	11	11	11	11	11	11	11	10	10	10	10	10	10	10
Transportation	10	9	9	8	8	8	8	7	7	7	7	7	6	6	6
Finance, Insurance, & Real Estate	23	21	21	20	20	19	18	18	17	17	17	17	16	16	16
Wholesale	14	13	13	12	12	11	11	10	9	9	9	8	8	7	7
Retail	87	82	81	80	78	76	74	71	70	67	65	63	61	59	57
Services	118	107	106	103	100	96	93	89	86	84	81	79	77	76	74
State & Local Government	4	8	10	13	15	17	19	20	21	22	23	24	24	24	25

Appendix D: Air Emission Reduction Analysis

The Energy 2020 model was used to analyze the emission reduction impacts of the energy efficiency programs. The Energy 2020 model is an integrated energy model that contains detailed demand and supply sector simulations, including macroeconomic interactions as supplied by the REMI model (see Appendix C). The model is maintained by Systematic Solutions, Inc., and has been used extensively by over 50 utilities and states/provinces in both deregulated and transitioning environments. More recently, Energy 2020 has been used to examine the regional impacts of proposed Kyoto initiatives at the national level.

1. Results of Energy 2020 Analysis

The Division's 2002 analysis of emission reductions used the Energy 2020 model to examine the impacts of energy efficiency programs on the price to generate electricity, which in turn impacts the decisions about the dispatch, building of capacity, and exports and imports of electricity to other regions. The model focuses on how energy efficiency programs reduce electricity demand, which in turn leads to a reduction in the overall price for electricity. This reduction in price can be quite dramatic when energy efficiency programs reduce peak demand. A reduction in price, while positive, can also produce disincentives for more expensive (and cleaner) plants, such as new combined cycle gas plants, to be dispatched or built. This occurs because reductions in price lead to reductions in revenues (current and anticipated), which results in reduced investment and dispatch in more expensive technologies.

The results of the model showed that a displacement of plants (according to fuel type) occurred in the following fashion in 2002 due to the energy efficiency program related energy savings of 241 million kWh: 52% gas/oil steam, followed by 11% gas/oil turbines, 29% gas/oil combined cycle, and 8% coal steam.[29] The associated emission reductions in 2001 were 135 tons of nitrogen oxides (NO_X), 394 tons of sulfur dioxides (SO_2), and 161,205 tons of carbon dioxide (CO_2). As expected, natural gas combined cycle plants were displaced at higher rates in 2002, given the expansion of these plant types and the relatively low price of natural gas during that year.

The Division also estimated the emission reductions over the lifetime of measures installed in 2001, or over the period 2001-2015. Total savings over this period were estimated to be 4,571 million kWh, which over the long-term will reduce emissions as follows: 1,889 tons of NO_X, 5,516 tons of SO_2, and 2,256,869 tons of CO_2. This analysis assumes no retirement of plants over the period 2000-2015, and the addition of 7,200 MW of new combined cycle gas/oil units (dual and single fuel, primarily gas with oil back up) that are anticipated to come on line before 2002.[30]

2. Key Model Characteristics/Assumptions

The major assumption underlying the Energy 2020 model work is to use historical data (up to 1998) for model calibration. This is important given the recent dramatic changes in the energy

[29] Totals do not add to 100% due to rounding and displacement other plant types (< 1%).
[30] See ISO 2002 Regional Transmission Expansion Plan.

environment since then, such as the higher oil and gas prices. This database essentially describes the "assumptions" underlying the model. However, the model's results are not completely traceable to these assumptions given the complexity of the internal system interactions.

In order to somewhat simulate recent changes (and include an important assumption that has major impacts on results), the Division ran the model in a higher-gas environment than was previously expected using the existing historic data. Additional corrections, such as knowledge of particular generation expansions not forecasted in the model are also possible and will be included in future analyses.

A second important assumption applied in the Division's analysis was the use of deregulated decision-making in terms of dispatch and capacity addition. Dispatch and generation decisions are made using the following technologies: oil/gas combustion turbine, oil/gas combined cycle, oil/gas steam turbine, coal steam turbine, advanced coal, nuclear, baseload hydro, peaking hydro, renewables, baseload purchase power contracts, baseload spot market, intermediate purchase power contracts, intermediate spot market, peaking purchase power contracts, peaking spot market, and emergency purchases.