Commonwealth of Massachusetts

Massachusetts Saving Electricity:

A Summary of the Performance of Electric Efficiency Programs Funded by Ratepayers Between 2003 and 2005

Executive Office of Energy and Environmental Affairs

Massachusetts Division of Energy Resources

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Highlights of 2003-2005 Ratepayer-Funded Electric Efficiency Programs

This report provides an overview of the performance of ratepayer-funded electric energy efficiency investments made during the years 2003 through 2005.

- Efficiency is the cheapest electricity resource and it became cheaper from 2003-2005. The cost to achieve energy savings dropped 15% over the three year period, from 3.8 cents to 3.2 cents per kWh. In comparison, the cost to produce electricity over the period *increased* by 61% to 8.9 cents per kWh.

- Each dollar invested in electric efficiency will create an estimated $2.84 in benefits over the life of the installed measures, the equivalent of a 184% return on investment.

- For an investment of $371 million in ratepayer funds over the three year period, the cumulative lifetime bill savings to all participating customers will amount to approximately $1.2 billion.

- For investments of $48 million over the three year period that improved the efficiency of low-income households, those households are projected to avoid some $140 million in electricity costs over the lifetime of the installed measures.

- A 216 MW reduction in demand for summer peak power produced $19.5 million in wholesale price savings by reducing the amount of wholesale power needed to meet overall demand during the most expensive hours of the year.

- Investments made in electric efficiency by these programs over the years 2003-2005 will reduce cumulative power plant emissions over their lifetime, including
    - More than 4,300 tons of nitrous oxides
    - More than 16,000 tons of sulfur dioxide; and
    - Almost 9 million tons of carbon dioxide

- More efficient lighting will contribute over 54% of the total electricity savings achieved over the life of these investments; 23% of the electricity savings will come from heating, ventilation and air conditioning improvements.

- Incentives for energy-efficient equipment typically provided about 60% of project costs, with participating customers paying the balance. In some special cases, such as small business programs, incentives contributed 80% of project costs, while for some municipal projects; incentives covered 100% of project costs.

- The lifetime economic impacts of the efficiency investments made during these three years will stimulate over 11,000 job years, increase personal Disposable Income by $650 million and will add almost $1.4 billion to the Gross State Product.

Introduction

Massachusetts' 1997 Electric Industry Restructuring Act established a System Benefit Charge (SBC) whereby customers of electric distribution companies pay a small charge to support energy efficiency programs. The programs, administered by the distribution utilities and a municipal aggregator (all referred to as Program Administrators), and overseen by the Division of Energy Resources (DOER), are available to residential, commercial, industrial and low-income sectors.[1] They restrain the annual growth in electricity use by approximately one third over what it would be otherwise. The programs also reduce peak demands for electricity in the summer and winter and lower the wholesale price paid for electricity during these periods to the benefit of all electricity consumers.

The Electric Energy Efficiency Programs Benefit Participants

During 2003-2005, customers in all sectors participated actively. Toward the end of the period, customer demand for energy efficiency services began to exceed program administrators' ability to meet the need. The System Benefits Charge, which was set at 2.5 mils ($0.0025) per kWh sold, amounting to an average of $124 million annually, has not been increased since 2001. The Massachusetts Legislature extended the SBC charge in 2005 for another seven years but did not increase the charge, so the total resources available to meet a growing need did not increase.

Customers who participated in the energy efficiency programs realized direct benefits in the forms of energy and demand savings, and savings on their electric bills. Because this period also saw steep increases in the *price* of fuels, particularly natural gas, these savings were not always readily apparent to customers but their bills would have been even higher if they had not participated. Table 1 shows the number of participants, total program costs, including participant costs, and annual and lifetime customer bill savings resulting from program participation.

Table 1
Participants and Annual Bill Savings, 2002-2005.

Program Summary 2003-2005				
Customer Class	**# Participants**	**Cost**	**Annual Bill Savings**	**Lifetime Bill Savings**
		(millions)		
Residential	1,520,391	$168	$35	$319
Low Income	420,525	$48	$12	$133
Small Commercial & Industrial	10,075	$49	$10	$132
Medium Commercial & Industrial	6,342	$96	$18	$258
Large Commercial & Industrial	1,913	$143	$25	$387
Total	**1,959,246**	**$504**	**$100**	**$1,229**

Note: Some customers participate in more than one program but are counted as a new participant each time.

[1] Prior to 1997 Massachusetts electric utilities provided energy efficiency programs beginning in the late 1980's under regulatory orders set by the DTE (formerly DPU) and a stakeholder settlement process.

Energy Efficiency Investments Lower Wholesale Power Supply Costs for All Customers

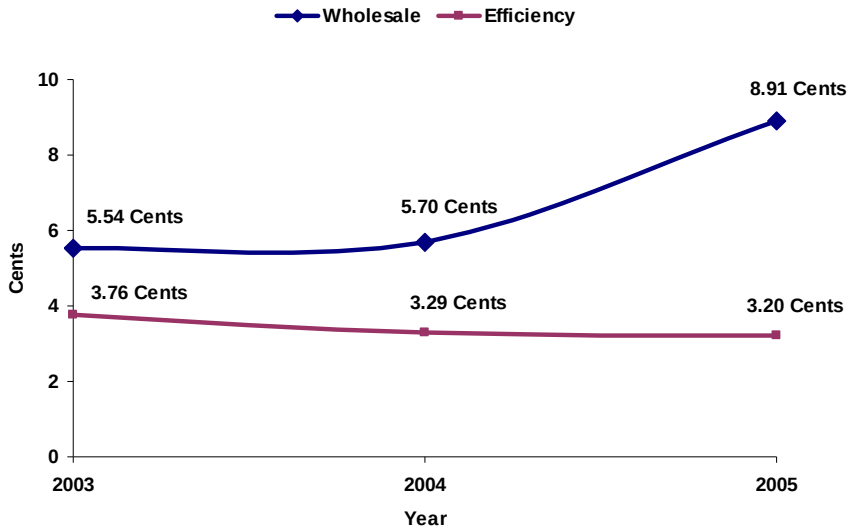
Load reductions help decrease wholesale energy costs by helping to avoid higher energy wholesale clearing prices. DOER estimates that the cumulative benefit of the annual energy and demand savings achieved by the programs from 2003-2005 produced $19.5 million savings at the wholesale level. The determination was made through a review of wholesale bid prices recorded by ISO New England. Because the energy efficiency programs put measures such as efficient air conditioning in place, the wholesale marketplace did not have to purchase an additional 60 MW at the system peaks. As demand increases on the summer peaks, each additional increment of electricity is significantly more expensive and the *entire* wholesale market pays a higher price.

The Cost to Conserve Energy is 64% Less Than the Cost to Produce Electricity

From 2003 through 2005, the cost of energy efficiency activities decreased by 15% from $0.0376 to $0.032 per kilowatt-hour. In comparison, the wholesale cost of electricity increased by 61% from $0.054 MW to $8.91, as shown in Chart 1. In 2005, the cost to conserve energy was 64% less than the cost to produce electricity

Electric efficiency productivity increased, especially for residential and commercial fluorescent lighting, leading to a lower cost for electric efficiency activities. Marketing of compact fluorescent bulbs became more effective by decreasing the wholesale costs of fluorescent bulbs through upstream subsidies to retailers, distributors and manufacturers. Also, a more efficient commercial lighting product, the Super T-8, was introduced.

Chart 1
Costs of Electricity Generation and Energy Efficiency
2003 - 2005



Ten Years of the SBC Have Saved 41,000 Gigawatt Hours of Electricity

The 1997 Electric Utility Restructuring Act for the first time codified a mandatory charge to all consumers of electricity delivered through investor-owned electric utilities. Known as the System Benefit Charge, (SBC), each utility collects a fixed amount for every kilowatt hour delivered to customers in all sectors. The SBC charge was set at 3 mils ($0.003), on a declining rate. In 2002 the charge was fixed at 2.5 mils for five years and extended at the same rate for another seven years in 2005. Table 2 below, shows the amounts expended in the programs, and energy and demand savings achieved since 1997. The costs include customer shares of the costs of measure installations. In 2005, program collections and expenditures amounted to $123 million. Customers contributed another $41 million, a typical total cost share.

Over their lifetime, the measures installed by these programs since 1997 will avoid the consumption of more than 40,000 giga-watt hours (GWh) of electricity and help avoid the need for more than 7,200 mega-watts (MW) of electric power plants.

Table 2
Electric Efficiency Programs Since 1997

Expenditures, Energy and Demand Savings 1997-2005

Year	Expenditure*	Energy (MWH x 1,000)		Demand MW Summer)	
	(Millions)	Annual	Lifetime	Annual	Lifetime
1997	$109	257	3,682	45	645
1998	$114	304	4,017	67	891
1999	$142	318	4,580	63	908
2000	$164	331	5,066	53	804
2001	$173	330	4,882	62	922
2002	$141	232	3,428	48	709
2003	$166	318	4,421	56	745
2004	$174	442	5,279	67	859
2005	$164	455	5,124	58	755
Totals	**$1,346**	**2,987**	**40,479**	**520**	**7,238**

Note: Lifetime savings refer to the savings achieved by measures installed each year over the measure's lifetime. Electric efficiency measures average 13 year lifespan.

* Expenditures include SBC funds plus participant measure cost share.

Energy Efficiency Investments Also Produce Economic Benefits and Create Jobs

The effect of the rate-payer funded efficiency programs on three economic indicators are shown in Figure 3. The cumulative lifetime economic impacts of energy efficiency investments in 2003-2005 will create an estimated 11,000 job years, contributing more than $1.3 billion to the gross state product and $650 million in disposable income. Job creation happens in jobs directly

created in the energy efficiency industry due to investments in energy efficiency measures, where Massachusetts is a major factor nationally. These short-term jobs represent about 30% of the job total and last the length of time needed for the production and installation of the energy efficiency measures. There are also beneficial economic impacts due to reduced electricity costs to consumers and businesses that last over the lifetime of the measures. Consumers have more funds to spend and businesses have lower operating costs, which helps their competitiveness and allows them to expand their hiring. Economic impacts from energy efficiency spending are more local than monies spent on traditional generation, because dollars spent on energy fuels are almost all imported from other states and regions.

Table 3
Economic Impacts over the Lifetime of Efficiency Measures Installed 2003-2005

Key Results	Life- Time Cumulative				
	2003	2004	2005	Average	Grand Total
Gross State product (Million of 2005$)	391	483	470	551	1,356
Total Employment (# of Employee Years)	3,166	4,075	3,952	4,374	11,278
Disposable Income (Million of 2005$)	185	233	226	255	650

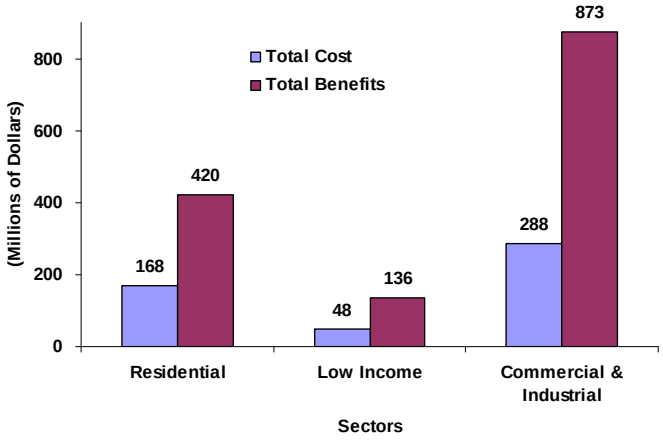
The Electric Efficiency Programs Produce a Variety of Benefits

All energy efficiency programs are screened for cost-effectiveness before and after implementation[2]. Before implementation, planned costs and benefits are evaluated based on historical results and programs are modified to maximize their cost-effectiveness. Following the completion of each year's programs, Program Administrators issue annual reports comparing the planned costs and benefits to actual results, incorporating the results of independent, third-party evaluations done in that year.

The installation of various efficient end-use technologies, such as lighting, refrigeration and motors contribute to these savings to different degrees. For example, residential and commercial air conditioning measures reduce demand on summer peak days in addition to saving energy. Residential lighting reduces peak demands in January and February, when the natural gas used for electricity generation may be in short supply. Residential customers who heat with oil are served by the Residential Conservation Services program and may receive assistance with adding insulation or replacing inefficient oil heating systems, providing non-electric energy savings.

[2] A cost-effective program is one whose lifetime benefits exceed the program costs, using the Total Resource Cost (TRC) test as the evaluation standard. TRC resources examined include: electric energy, electric demand; postponement of upgrades to transmission and distribution; and non-electric resources such as water and heating oil.

Chart 2: Total Resource Costs & Benefits by Sector



All Ratepayer-funded Energy Efficiency Programs in 2003-2005 were Cost Effective

Accounting for both ratepayer funds and participant costs, the cumulative program benefits ($1,430 million) are greater than program costs ($504 million) by 2.84 to 1 across all sectors. The chart to the right depicts the benefits and costs by sector. Although all programs are cost effective, the range of the benefit to cost ratios varies among the different sectors and program strategies. For example, the 2003 Residential Retrofit Program for Multi-Family Buildings ratio is 1.12 to 1; by contrast, the 2005 Residential Lighting Program is 4.91 to 1.

Energy Efficiency Activities Produce Several Different types of Savings

Chart 3 shows the percent savings by types of benefits in each customer sector. Table 4 shows the three-year cumulative monetary value of these benefits. Direct electricity saving benefits come from these programs as a result of avoided energy use or energy generation reductions, postponement of power plant construction, and avoidance of upgrades transmission and distribution poles & wires. Non-electric benefits include resource savings such as, reductions in fossil fuel, water and sewer costs. These non-electric resource savings are realized through reduced operation and maintenance costs resulting from the installation of new equipment. In the Low Income sector, some of these non-electric resource benefits include lower mortgage default rates due to bill savings and lower expenses, such as the costs avoided by not having to move to a new home.

Chart 3: 2003 - 2005 Percentage Savings Value by Resource Savings Category

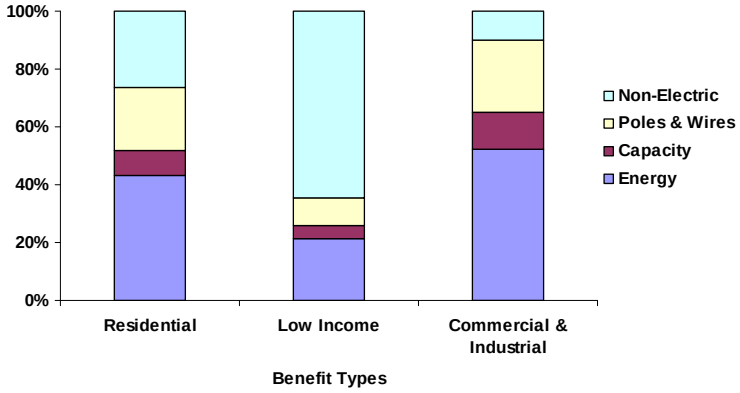


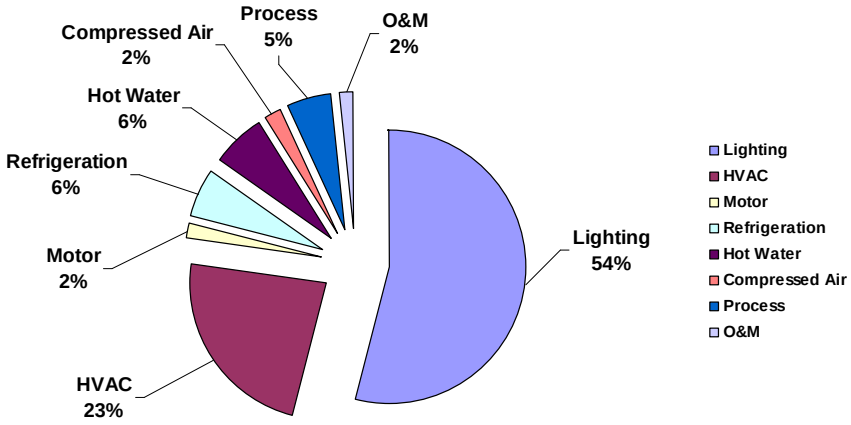
Table 4

2003 - 2005 Benefit Values ($-Millions)			
Resource Category	**Residential**	**Low Income**	**Commercial & Industrial**
Non-Electric	$111	$88	$86
Poles & Wires	$92	$13	$220
Capacity	$37	$6	$111
Energy	$181	$29	$457

Energy Efficient Lighting Produces More than Half of the Energy Savings

Chart 4 breaks out the end use technologies employed in the energy efficiency programs and their percent contribution to program benefits. Lighting as well as heating, ventilation & air conditioning (HVAC) provide 78% of the benefits. Refrigeration, hot water and industrial processes, each contribute about 5%. The balance is from motors, compressed air and operation & maintenance at about 2% respectively.

Chart 4: Percent Benefits by End Use



Lifetime Bill Savings Exceed $300 Million for Residential Customers. Other customers had comparable savings.

DOER divides electric customers into five classes. The Residential Class encompasses all residential customers except those who qualify for the low-income discount rate, or are ineligible for the discount rate, but are at or below 60% of median income. These exceptions are classified as Low Income Customers.

DOER aggregates the Commercial & Industrial (C&I) class according to monthly electricity consumption. Small C&I customers use less than 3,000 kWh/month; Medium C&I use more than 3,000 kWh/month but less than 120,000 kWh/month. Large C&I customers use more than 120,000 kWh/month.

Chart 5: 2003 - 2005 Lifetime Bill Savings by Customer Class

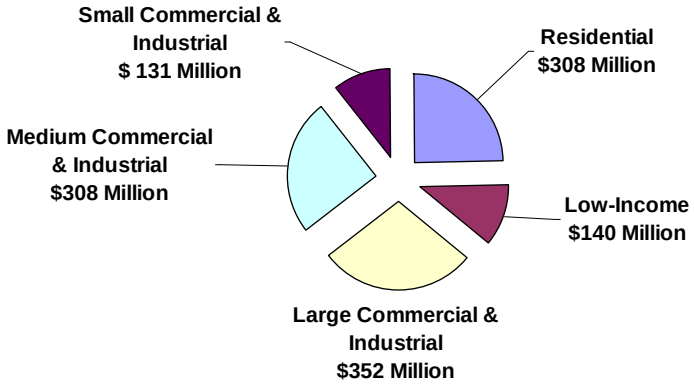


Chart 5 above, shows the lifetime bill savings for 2003-2005 energy efficiency investments by class. Electric efficiency installations during 2003-2005 are expected to save a participating residential customer $170 over the 13 year average life of the measures

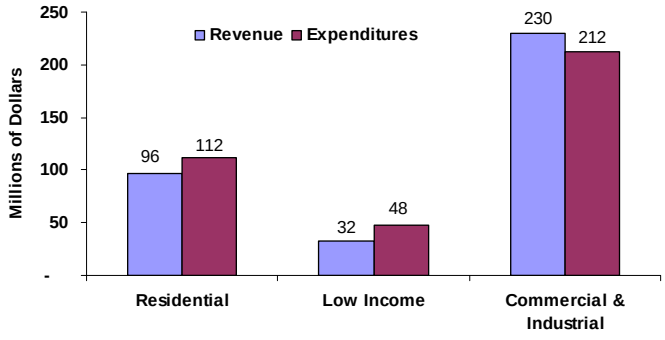
Revenue and Expenditures

This section describes the types of expenditures Program Administrators and program participants incurred. Program Administrators incur costs for planning, implementation, evaluation, education, administration and research, as detailed below. Program participants are required to contribute a portion of the cost of services they receive, low income customers excepted.

Energy Efficiency Funds Are Equitably Allocated Across Customer Sectors

DOER ensures that spending of ratepayer funds is equitably allocated among customer sectors. The guideline is a dollar paid in from a customer class results in a dollar expended for that customer class. Expenditures for low income customers are adjusted upward to meet customer need but not downward. Chart 6 shows that each sector's revenue and expenditure for the years 2003-2005 was overall equitably allocated with slight

Chart 6:
2003 - 2005 Revenue and Expenditures by Customer Sector

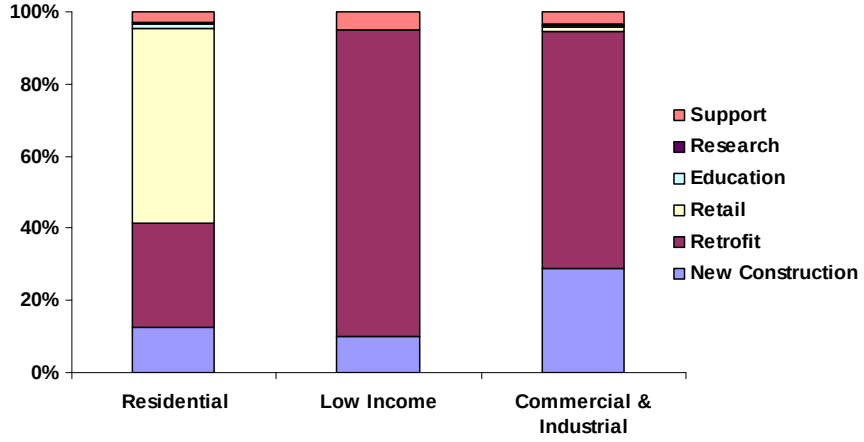


imbalances. Imbalances are adjusted annually, as needed. The revenue-expenditure imbalance between the Residential sector and the Commercial & Industrial (C&I) sector during this time is a correction from overspending in C&I in the first 5-years of program funding. Overall spending at $372 million exceeded revenue of $358 million by $13.3 million dollars or 3.7% due to program demand. This imbalance will be reconciled in future years by affected Program Administrators.

Expenditures by Energy Efficiency Strategies Vary by Sectors

The electric efficiency programs focus on short-term objectives, such as replacing inefficient equipment with efficient equipment, and long-term objectives, educating elementary school children about the advantages of an energy-efficient lifestyle. The portfolio of electric efficiency strategies provides a comprehensive and integrated campaign to improve the efficiency of buildings in the Commonwealth. Chart 7 depicts the percent of expenditures by program strategy. The strategies are classified into two broad categories – Productive and Supportive. Productive strategy measures are New Construction (including major renovations, often described as "Lost Opportunity Programs"), Retrofit and Retail. Over 95% of the ratepayer funds expended are for productive strategies which generate direct savings. Internalized costs such as the costs of providing technical services to customers are included. Supportive strategies encompass program support, research and education.

Chart 7:
2003 -2005 Percentage of Expenditures by Strategies



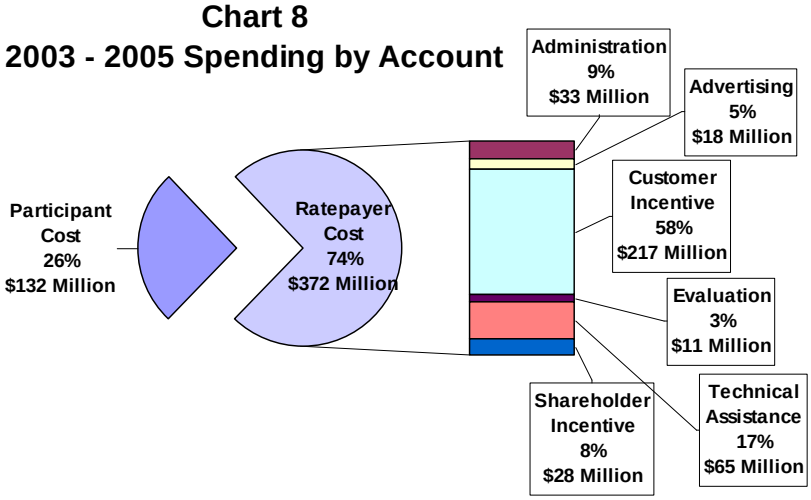
The emphasis on different energy strategies and their expenditures varies by sector. The Residential sector's primary focus is the "Retail" sector whereby customers are encouraged to buy ENERGY STAR® lights and appliances. Low Income sector strategies are concentrated on "Retrofit" measures which assist residents of existing buildings lower their energy bills. Finally, the programs that serve the Commercial & Industrial sector have a larger percentage of investments in "New Construction" and major renovation.

Customer Incentives Account for 58% of Ratepayer Funds Spent

DOER tracks all monies spent on energy efficiency by allocating energy efficiency funding into two major categories, Ratepayer Cost and Participant Cost. In 2003-2005, $372 million of Ratepayers funds were spent on energy efficiency activities. Program participants spent an

additional $132 million of their own money, listed in Chart 8. Overall, participants pay 26% of program costs but this varies considerably by customer class and project type, Low Income customers pay nothing. In the Commercial Retrofit program customers paid 40% of the project cost. In Commercial new construction customers typically pay 25-50 % of the increment between 'standard' and 'energy-efficient' equipment. Incentives in all programs where participants pay some part of the cost are examined and adjusted each year; sometimes incentives are adjusted within a year in response to higher or lower than expected demand for the program

Chart 8
2003 - 2005 Spending by Account



Ratepayer Cost is subdivided into six accounts. "Customer Incentive" stands for the funds paid directly to or on behalf of customers to install energy efficiency improvements. This account embodies 58% of ratepayer expenditures. "Technical Assistance" encompasses efforts to motivate customers to purchase energy efficient product as well as training to use energy efficiently The "Administration Account" includes the cost to the distribution company for planning and administering the programs. . "Advertising" covers expenditures for mass media, newspapers, bill boards, radio and television. "Shareholder Incentive" account denotes the incentives awarded to the four investor-owned local distribution companies for achieving or exceeding their energy efficiency performance goals. The spending ceiling for this account is just under 9% but from 2003 to 2005 only 7.8% of ratepayer money funded this account. "Evaluations", 3%, includes assembling data to report on energy efficiency activities and analytical reports produced by third party contractors used to adjust savings in subsequent years.

The majority of the funds pay for customer incentives and competitively procured services, such as contractors who conduct energy audits and install measures in customers homes or businesses on behalf of the Program Administrators. On average distribution companies keep 17% of the funds collected from ratepayers for efficiency

Finally "Participant Costs" are project costs paid directly by customers or sources other than the ratepayer funds in order to install energy efficiency improvements. These amounts are determined on a categorical basis with some programs or projects requiring a large customer contribution (such as Commercial Lighting) while others require a low contribution (such as Small Commercial Direct Installation.

Energy Efficiency Programs Improve Air Quality and Reduce Greenhouse Gases

Lowering electricity demand through energy efficiency activities reduces the need for electricity production from fossil fuels and avoids air polluting emissions. Nitrous oxides (NO_x), sulfur dioxide (SO_2) and carbon dioxide (CO_2) are harmful byproducts from burning fossil fuels. NO_x and SO_2 have adverse health, ecological and property effects, while CO_2 is the major contributor to global warming. DOER estimates that over the lifetime of energy efficiency measures installed in 2003-2005, measures will lower emissions of these pollutants as shown in Table 5.

Table 5

2003-2005 Lifetime Environmental Benefits	
Emission	**Tons avoided**
Carbon Dioxide (CO_2)	8,897,960
Nitrous Oxides (NO_x)	4,360
Sulfur Dioxide (SO_x)	16,391

Policy Issues

The electric energy efficiency programs authorized under the 1997 Electric Utility Restructuring Act provide savings to program participants, restrain the annual growth in total electricity consumed and provide other environmental and energy-related benefits.

The years 2003-2005 saw several trends which place increasing strains on the ability of energy efficiency programs to continue to provide the same level of effective services to Massachusetts consumers. As the cost of generation increased from 5.54 cents to 8.91 cents, the demand for program services increased dramatically across the spectrum. In particular, demand from C/I customers increased, as the effects of rising energy costs on total operating costs increased their desire to control energy costs through efficiency. At the same time, Program Administrators became more productive, delivering electric efficiency for 15% less in 2005 than it cost in 2003. Nevertheless, the financial resources available to for efficiency investments remained fixed at 2.5mils/kWh sold, so even increased efficiency in delivering energy efficiency could not offset the increasing need for efficiency programs. At least one Program Administrator has experienced a small drop in total electricity sales, further reducing the available efficiency funds in that territory.

The implementation of the wholesale Forward Capacity Market is expected to provide modest new revenues for capacity savings, in the range of adding 5-10% (of current SBC funds) per year in new revenue. But the current electric efficiency programs are only partly oriented toward the capacity savings valued by the Forward Capacity Market. Traditional electric efficiency programs and the programs that will be needed to meet Regional Greenhouse Gas Initiative (RGGI) goals (expected to be available beginning in 2009) are oriented to energy savings. There will be a need to construct a balance of programs to address the energy and capacity savings

needed to meet each of the varying electricity goals, including restraining overall electric load growth in the years ahead.

Conclusion

The electric energy efficiency programs operated by Massachusetts Investor-Owned electric utilities and the Cape Light Compact municipal aggregator continued to be highly effective and highly cost-efficient through the 2003-2005 period. The collaborative efforts of DOER, Program Administrators and Non-Utility Parties involved in the planning, implementation and evaluation of the electric energy efficiency programs were successful in continuing to deliver high quality programs, increasing their efficiency, as reflected by the 15% reduction in the cost of electric energy saved.

Massachusetts has been a leader in electric efficiency for more than 20 years. Since 1997 alone, the programs have produced almost 3,000 GWh in annual savings. With all the work that has been done and the savings realized, one might ask whether there are still efficiency gains to be achieved that would be cost-effective. In 2001, DOER commissioned a study that examined that question and estimated the remaining achievable potential annual savings to be almost 10,000GWh in annual savings, more than three times the savings achieved in the last ten years. Significant technology improvements since 2001 (such as in commercial lighting, compact fluorescent bulbs and light emitting diode lighting) have increased this still remaining potential by at least 20% that Substantial opportunities remain for energy efficiency since it continues to be the cheapest electric resource in the Commonwealth.

Acknowledgement

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