Comparative Performance of Electrical Energy Efficiency Portfolios in Seven Northeast States

Stuart Slote, Optimal Energy, Inc.
Glenn Reed, Vermont Energy Investment Corporation
John Plunkett, Green Energy Economics Group, Inc.

ABSTRACT

This paper compares energy efficiency portfolio performance in seven Northeast states from 2001 through 2004. Meaningful comparisons between different states' performance are fraught with challenges. Differences in customer mix, climate, efficiency spending levels, program balance, program maturity, economic conditions, electricity rates and avoided electricity supply costs all account for variations in the electricity savings that portfolios achieve.

Two basic indices of efficiency portfolio performance are devised: *savings yield* (annual MWh energy saved per (real) dollar expended), and *savings depth* (annual energy savings divided into total annual retail sector electricity sales). We calculate one additional indicator, *spending depth*, to reflect the relative magnitudes of each state's portfolio funding compared to electricity sales.

We compare the indices separately for the residential and nonresidential sectors, at least roughly compensating for broad differences in customer mixes between states. Dividing savings into program spending and sector sales in the yield and depth indices accounts somewhat for differences in size between states. Confining the comparisons to portfolios in the Northeast helps limit the degree to which climactic differences account for different outcomes. Keeping a regional perspective also helps limit the potential influence of differences in efficiency technology cost-effectiveness due to major differences in avoided supply costs.

Neither indicator is very revealing by itself. High savings yield and low savings depth could be indicative of cream-skimming. Savings depth alone is also problematic. Program administrators could concentrate resources on achieving deep savings beyond the point of cost-effectiveness, resulting in uneconomically low portfolio yield. Accordingly, both indices should be considered together and over time.

Introduction

The Northeast states have made a significant, long-term commitment to pursue energy efficiency. All six New England states, New York and New Jersey have active and robust electricity efficiency programs. Further, gas efficiency efforts are also being pursued in Massachusetts, Rhode Island and New Hampshire. It is expected that this commitment to gas efficiency will grow over the next several years as policy makers increasingly turn their attention to additional efficiency opportunities.

This regional commitment to energy efficiency in the Northeast stretches back for nearly three decades in several states. However, the organizations providing efficiency services have both changed over time and vary by state. Program administrators in the Northeast include a mix of investor-owned utilities, efficiency utilities, municipal aggregation groups, electric co-ops, and state agencies. Table 1 summarizes the responsibilities for electricity efficiency program

administration in the eight Northeast states. Where there are multiple organizations in a state functioning under any single program administrator category, the number of such organizations is noted in parentheses.

Table 1. Electricity Efficiency Program Administrators in the Northeast

State	Program Administrator(s)
Connecticut	Investor-owned utilities (2); Co-op[2]
Maine	Public Utility Commission
Massachusetts	Investor-owned utilities (4); Municipal aggregation group[1]
New Hampshire	Investor-owned utilities (4); Co-op
New Jersey	Board of Public Utilities[3]
New York	State Authorities (2)
Rhode Island	Investor-owned utility
Vermont	Efficiency utility; Municipal utility

[1] Results for the Cape Light Compact are not included in the reported Massachusetts program data and indices
[2] Connecticut municipals plan to roll out their efficiency program offerings in mid-2006
[3] New Jersey investor-owned utilities (IOUs) continue to administer the state's electric and gas efficiency programs as a transition until the Board of Public Utilities awards contracts for the programs' administration. Program administration was competitively bid in 2005.

While there are multiple program administrators in New Hampshire, Massachusetts and Connecticut, a high degree of program coordination and similarity has evolved within each state. This convergence of program designs has been facilitated by regulatory and collaborative policies, and by the program administrators' recognition of the benefits of joint and coordinated program delivery. Only in New York and Vermont are there two fairly distinct approaches to program implementation within a single state. Therefore, we have reported the results of our analysis separately for the Long Island Power Authority (LIPA) and for the New York State Energy Research and Development Authority (NYSERDA). Results for Vermont exclude the Burlington Electric Department.

The analysis below provides a quantitative comparison of how these programs (excluding Rhode Island's, which are administered by an IOU that also delivers programs in Massachusetts and New Hampshire) performed over the 2001-2004 timeframe relative to one another, and how each program's performance has changed over time. These types of comparative analyses have been used to inform program design and funding level reviews and decisions in a number of jurisdictions including Connecticut, Maine and British Columbia.

Methodology

To perform this analysis we calculated three indices of program performance relative to either program budgets or to sales. These indices are:

- Spending Depth – annual efficiency expenditures per annual MWh energy sales. While spending can also be compared to annual dollar revenues, revenues will also vary due to differences in rates across states.
- Savings Yield – annual kWh energy savings per annual efficiency expenditures. This index is loosely correlated to the inverse of the cost of saved energy. However, the cost of

saved energy calculation considers a multi-year stream of savings based on the average measure life of the mix of measures installed in any program year. The savings yield calculation only considers first year savings.

- Percent Savings Depth – annual MWh energy savings per annual retail sector MWh sales

We calculated these indices based on actual results reported for 2001 through 2004 when available. For several states, the first year of significant savings and/or program expenditures occurred after 2001.

We assembled spending and savings data, and calculated the corresponding indices, for Connecticut (2001-2004), Maine (2003-2004), Massachusetts (2001-2004), New Hampshire (available for 2003-2004), New Jersey (2001-2004), New York and Vermont (2001-2004). As noted above, the New York data were subdivided between the Long Island Power Authority (LIPA, 2001-2004), which separately administers its Clean Energy Initiative, and the New York State Energy Research and Development Authority (NYSERDA, 2002-2004).

A combination of deemed and ex ante savings, with some adjustments selected to ex post verified savings, and program expenditure data came from program administrator reporting. Sales, both revenues and MWh, came from the U.S. Energy Information Agency. In all cases data were developed separately for the residential and for the nonresidential sectors. This allowed us to better account for differences in the relative proportions of residential and nonresidential sector sizes and in the differences in measure mixes between the two sectors.

In several states, the development of sector level savings and spending data required aggregating more detailed program and budget information. In some cases activities were not clearly identified as being sector-specific. Where this occurred we either spoke to program staff or did a proportional allocation based on known sector-level savings or expenditures.

While we believe that the spending and savings data, and resulting indices, are comparable both over time and across states, a few caveats should be noted. Savings estimation and evaluation methodologies vary among states, and in New York, within the state. Treatment of program attribution, spillover and other market effects is not handled consistently within the region. Also, some states make a distinction between actual and committed expenditures. While commitments may be made for larger retrofit and new construction projects, particularly in the nonresidential sector, the actual expenditures for these projects may be made in a subsequent year. It is not clear if all of the states in the region handle this project accounting distinction in a consistent manner.[1]

Results

Tables 2 and 3 provide the calculated indices by year and by state and/or program administrator, as well as the annual program spending, savings and energy sales. We discuss the residential and nonresidential results separately.

[1] See, for example the NEEP protocols.

Table 2. Residential Performance Indices

Energy Efficiency Portfolio Performance Comparison								
Residential		**Spending Depth (4) / (5)**	**Savings Yield (6) / (4)**	**Savings Depth (6) / (5)**		**Data**		
State	**Year**	**(1) $ Spent (2005$) per Retail Sector MWh Sales**	**(2) Annual kWh Savings per $ Spent (2005$)**	**(3) Annual MWh Savings per Retail Sector MWh Sales**		**(4) Spending ($ millions)**	**(5) Retail Sector Sales (MWh)**	**(6) Annual MWh Savings**
Connecticut	2004	$1.4	5.1	0.65%		$16.4	12,366,484	80,617
	2003	$1.2	1.9	0.20%		$14.4	12,331,116	25,000
	2002	$1.7	4.3	0.62%		$18.3	11,772,238	72,460
	2001	$2.0	5.1	0.81%		$20.2	11,446,846	92,550
Maine	2004	$0.4	4.0	0.13%		$1.5	NAV	5,580
	2003	$0.1	4.6	0.04%		$0.4	4,359,020	1,918
	2002	-	-	-		NAV	NAV	NAV
	2001	-	-	-		NAP	NAV	NAP
Massachusetts	2004	$3.3	4.3	1.29%		$51.7	16,430,880	211,781
	2003	$2.3	2.8	0.55%		$34.6	16,114,567	88,913
	2002	$1.8	2.3	0.36%		$25.9	15,522,546	55,241
	2001	$2.2	2.5	0.45%		$30.1	15,159,987	68,291
New Hampshire	2004	$1.7	2.3	0.35%		$6.9	4,218,015	14,896
	2003	$1.7	2.2	0.32%		$6.5	4,129,405	13,344
	2002	-	-	-		NAV	NAV	NAV
	2001	-	-	-		NAP	NAV	NAP
New Jersey	2004	$1.5	3.5	0.46%		$37.4	26,947,140	124,369
	2003	$1.5	2.6	0.33%		$36.7	26,384,718	88,230
	2002	$1.1	1.0	0.09%		$26.8	26,598,261	24,161
	2001	$1.0	1.1	0.09%		$23.0	24,783,958	22,882
Long Island Power Authority (LIPA)	2004	$2.0	2.8	0.51%		$16.1	9,182,520	43,312
	2003	$2.7	2.7	0.64%		$21.8	8,489,702	54,742
	2002	$2.8	2.3	0.54%		$21.6	8,489,702	46,102
	2001	$2.4	2.7	0.52%		$17.3	8,143,069	42,574
New York State Energy Research and Development Authority (NYSERDA)	2004	$1.4	1.9	0.24%		$44.8	33,582,007	80,900
	2003	$0.7	3.3	0.19%		$20.3	33,260,213	62,700
	2002	$0.6	3.5	0.17%		$17.9	33,305,596	57,800
	2001	-	-	-		NAV	NAV	NAV
Vermont	2004	$3.6	4.3	1.44%		$7.0	2,016,715	29,026
	2003	$3.4	3.3	0.99%		$6.1	1,917,142	18,969
	2002	$3.2	3.8	1.02%		$5.7	1,955,203	19,991
	2001	$2.7	4.4	0.99%		$4.7	1,919,617	18,917

Notes:

1. NAV = Information Not Available; NAP = Not Applicable (No Program)
2. 2001, 2002, 2003 and 2004 sector sales as reported by US EIA
3. Maine sales are from Bangor Hydro (2003), Central Maine Power (2004) and Maine Public Service (2002); in addition, all others are assumed to be 5% of these sales
4. U.S. Bureau of Labor and Statistics Consumer Price Index Inflation Calculator used to calculate present worth in 2005$
5. Connecticut programs were suspended for part of 2003
6. New Hampshire annual savings = lifetime savings / assumed average 15 year measure life
7. Vermont data excludes Burlington Electric Department

Table 3. Nonresidential Performance Indices

Energy Efficiency Portfolio Performance Comparison								
Nonresidential		**Spending Depth (4) / (5)**	**Savings Yield (6) / (4)**	**Savings Depth (6) / (5)**		**Data**		
State	**Year**	**(1) $ Spent (2005$) per Retail Sector MWh Sales**	**(2) Annual kWh Savings per $ Spent (2005$)**	**(3) Annual MWh Savings per Retail Sector MWh Sales**		**(4) Spending ($ millions)**	**(5) Retail Sector Sales (MWh)**	**(6) Annual MWh Savings**
Connecticut	2004	$1.5	5.7	0.76%		$23.4	16,779,631	127,385
	2003	$1.2	6.1	0.63%		$18.6	16,756,800	105,700
	2002	$1.7	5.1	0.73%		$26.2	16,622,278	122,036
	2001	$1.7	5.5	0.76%		$26.1	16,867,301	128,200
Efficiency Maine	2004	$0.3	6.4	0.17%		$2.0	NAV	12,338
	2003	$0.1	8.5	0.05%		$0.5	7,462,290	3,909
	2002	-	-	-		NAV	NAV	NAV
	2001	-	-	-		NAP	NAV	NAP
Massachusetts	2004	$3.4	3.2	1.10%		$68.6	19,173,983	210,152
	2003	$2.9	4.7	1.18%		$56.2	21,030,110	247,488
	2002	$3.4	3.5	1.02%		$63.4	20,247,516	205,856
	2001	$3.4	5.2	1.44%		$60.5	19,728,983	284,286
New Hampshire	2004	$1.3	5.7	0.65%		$7.6	6,457,719	41,879
	2003	$1.2	6.7	0.70%		$6.9	6,241,509	43,412
	2002	-	-	-		NAV	NAV	NAV
	2001	-	-	-		NAP	NAV	NAP
New Jersey	2004	$0.7	7.8	0.50%		$27.2	32,295,198	204,144
	2003	$0.7	7.6	0.48%		$27.6	41,105,248	197,347
	2002	$0.9	4.5	0.32%		$35.4	45,129,424	144,635
	2001	$0.3	2.9	0.07%		$11.8	43,671,352	30,943
Long Island Power Authority (LIPA)	2004	$0.8	3.7	0.27%		$7.2	9,666,377	25,828
	2003	$0.9	2.8	0.22%		$7.9	9,593,209	20,884
	2002	$0.9	4.0	0.31%		$7.5	9,026,264	27,542
	2001	$0.9	3.0	0.22%		$7.3	9,002,154	19,510
New York State Energy Research and Development Authority (NYSERDA)	2004	$1.3	9.0	1.21%		$52.5	37,897,275	456,900
	2003	$0.6	12.3	0.69%		$24.7	41,500,182	284,500
	2002	$0.6	10.1	0.49%		$25.8	48,471,686	239,100
	2001	-	-	-		NAV	NAV	NAV
Efficiency Vermont	2004	$1.6	6.0	0.86%		$4.9	3,294,004	28,410
	2003	$1.9	5.7	0.93%		$5.4	3,069,837	28,453
	2002	$1.6	4.6	0.63%		$4.9	3,291,679	20,630
	2001	$1.3	5.5	0.56%		$3.8	3,293,986	18,572

Notes:

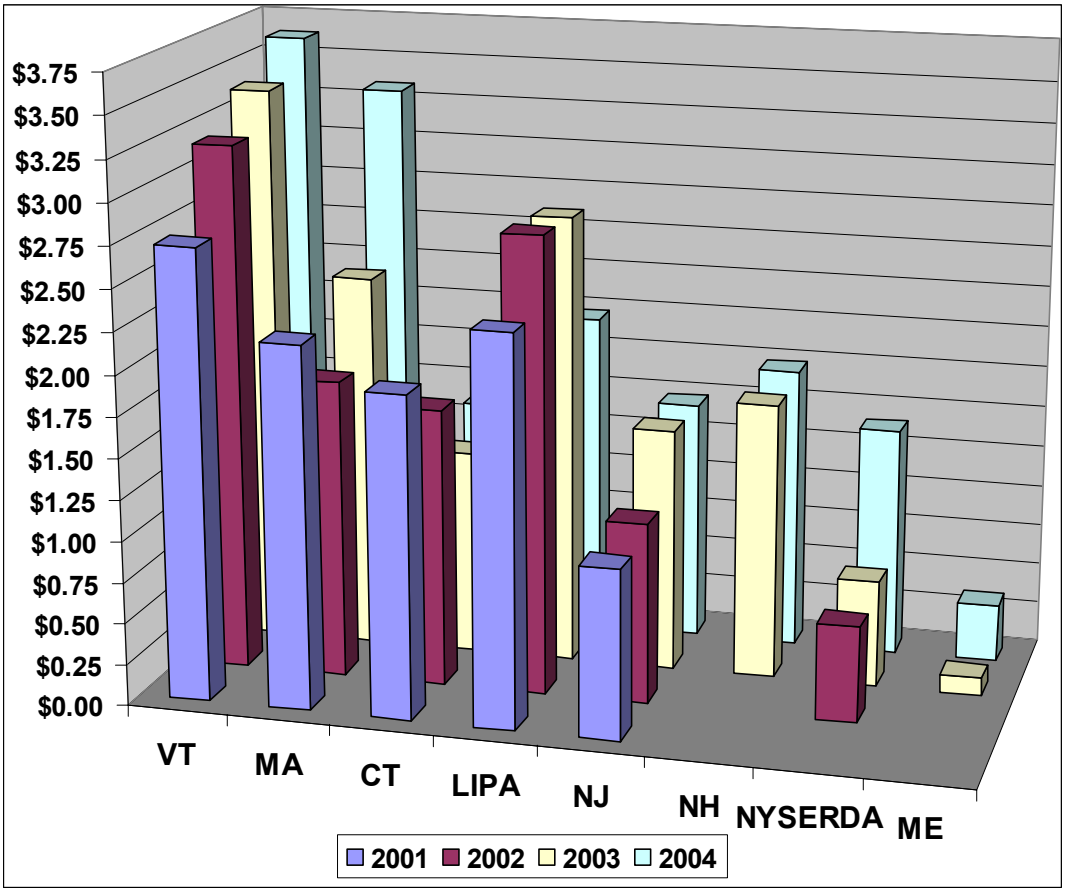
1. NAV = Information Not Available; NAP = Not Applicable (No Program)
2. 2001, 2002, 2003 and 2004 sector sales as reported by US EIA
3. Maine sales are from Bangor Hydro (2003), Central Maine Power (2004) and Maine Public Service (2002); in addition, all others are assumed to be 5% of these sales
4. U.S. Bureau of Labor and Statistics Consumer Price Index Inflation Calculator used to calculate present worth in 2005$
5. Connecticut programs were suspended for part of 2003
6. 2003 Connecticut savings are for United Illuminating only
7. New Hampshire annual savings = lifetime savings / assumed average 15 year measure life
8. Vermont data excludes Burlington Electric Department

Residential Sector Findings

Residential program spending levels as illustrated in Figure 1 exhibit large difference across the eight states/programs examined. In 2004, residential funding levels in the region varied by a factor of ten, with Vermont spending ($3.6/MWh sales) at one end of the range and Maine ($0.3/MWh sales) at the other. These spending differences are largely attributable to regulatory determination of program funding, though year to year differences within states or program are also affected by prior year program commitments and under- or over-expenditures in any given year.

Spending levels have also generally increased over time in the 2001 to 2004 timeframe, though none of the state or program level changes over this timeframe are as dramatic as the inter-state differences. Most noticeable are the increases in program funding in Maine and NYSERDA. These changes may be largely attributable to early program ramp-up.or a variety of other reasons.[2]

Figure 1. Residential Spending Depth



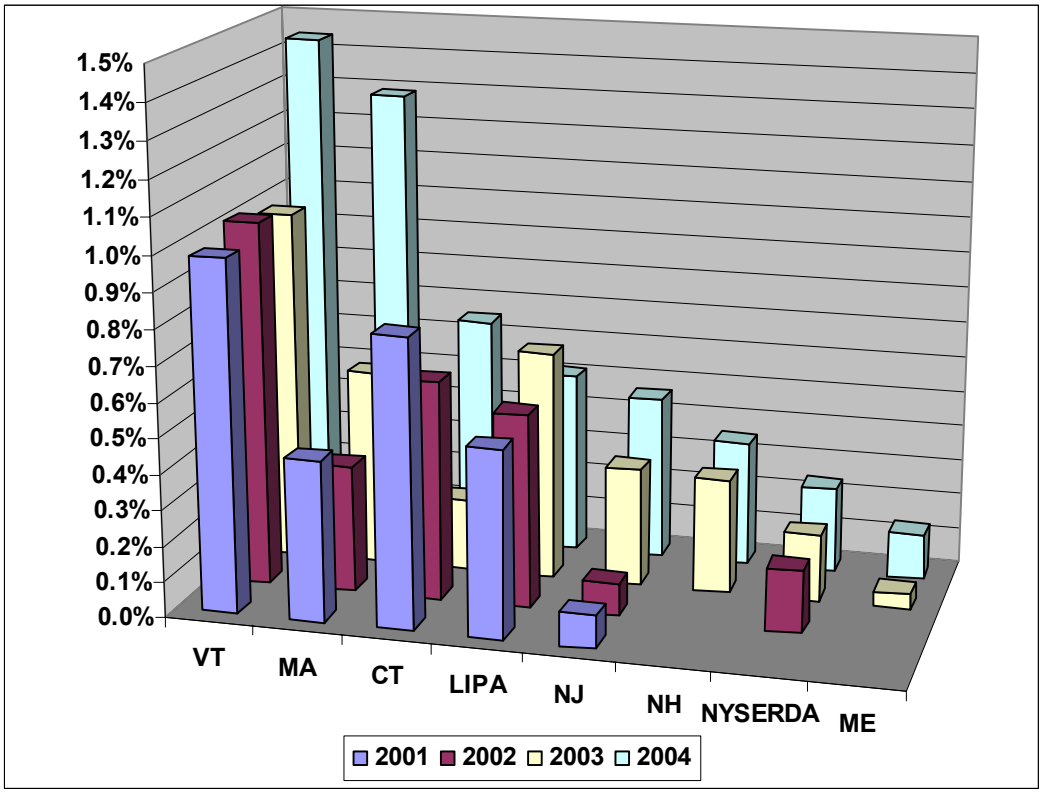
Source: Programs Results

[2] Past funders happiness with past results may lead to much higher budgets, if the State coffers are in good shape. Or if there is a perceived emergency situation of supply, you may see an all-out effort to garner savings--as California did in 2001.

A comparison of Figures 1 and 2 shows that spending depth and savings depth roughly track each other in the residential sector in the Northeast; large expenditures generate large overall savings. In 2004, savings depth ranged from 1.4 percent in Vermont to 0.2 percent in Maine. In comparison, the efficiency in which these savings are attained, as measured by the savings yield indices (Figure 3), varies much less across states or programs. Residential savings yields in 2004 varied from 5.1 kWh/$ (Connecticut) to 1.9 kWh/$ (NYSERDA). Maine, with the lowest spending depth achieved a savings yield of 4.0kWh/$ in 2004 comparable to, or greater than, most of the other states or programs in the region.

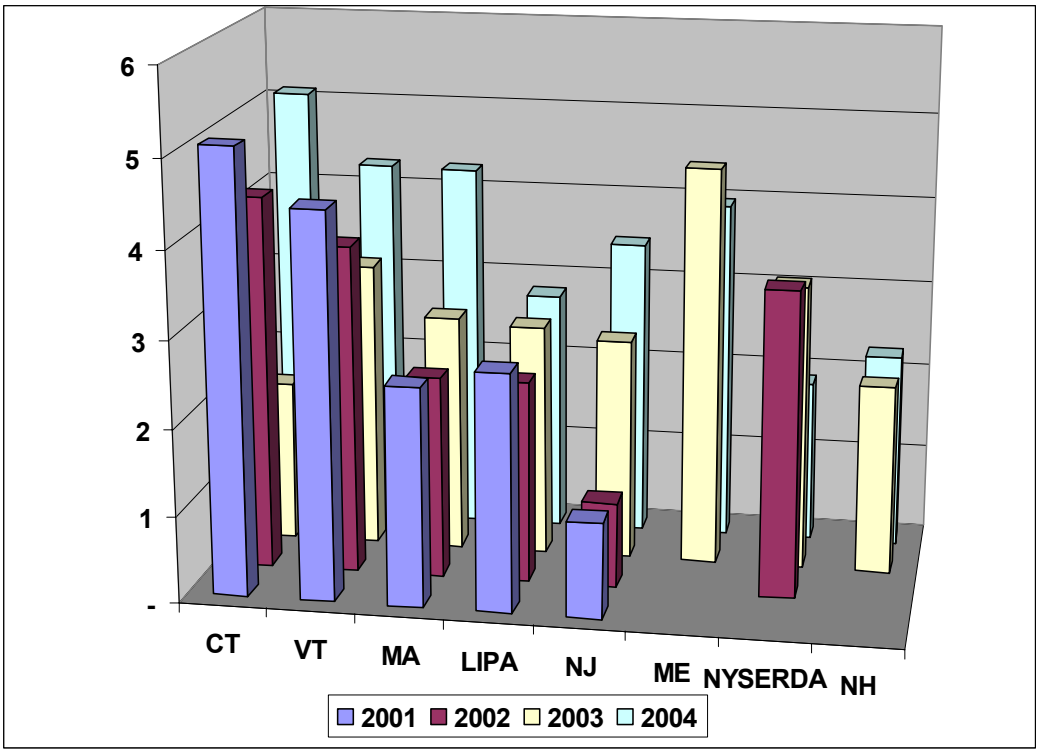
Maine's high savings yield can be explained in large part due to its incomplete residential portfolio. The vast majority of Maine's residential program expenditures support the sales of ENERGY STAR® CFLs and fixtures. All of the other states listed have appliance and residential new construction programs, and several have extensive retrofit programs, which all tend to generate savings at a higher cost per kWh than do lighting programs. However, even in Vermont, Massachusetts, and Connecticut, which have the highest savings yields, the largest percentage of residential sector program savings come from their lighting programs. NYSERDA, with the lowest residential sector savings yield, provides more limited support for its residential lighting programs and a much higher proportion of funding for its Home Performance with ENERGY STAR® residential whole house retrofit program. NYSERDA's decision to pursue comprehensive savings opportunities through its Home Performance efforts is reflected in its low residential sector savings yield.

Figure 2. Residential Savings Depth



Source: Programs Results

Figure 3. Residential Savings Yield

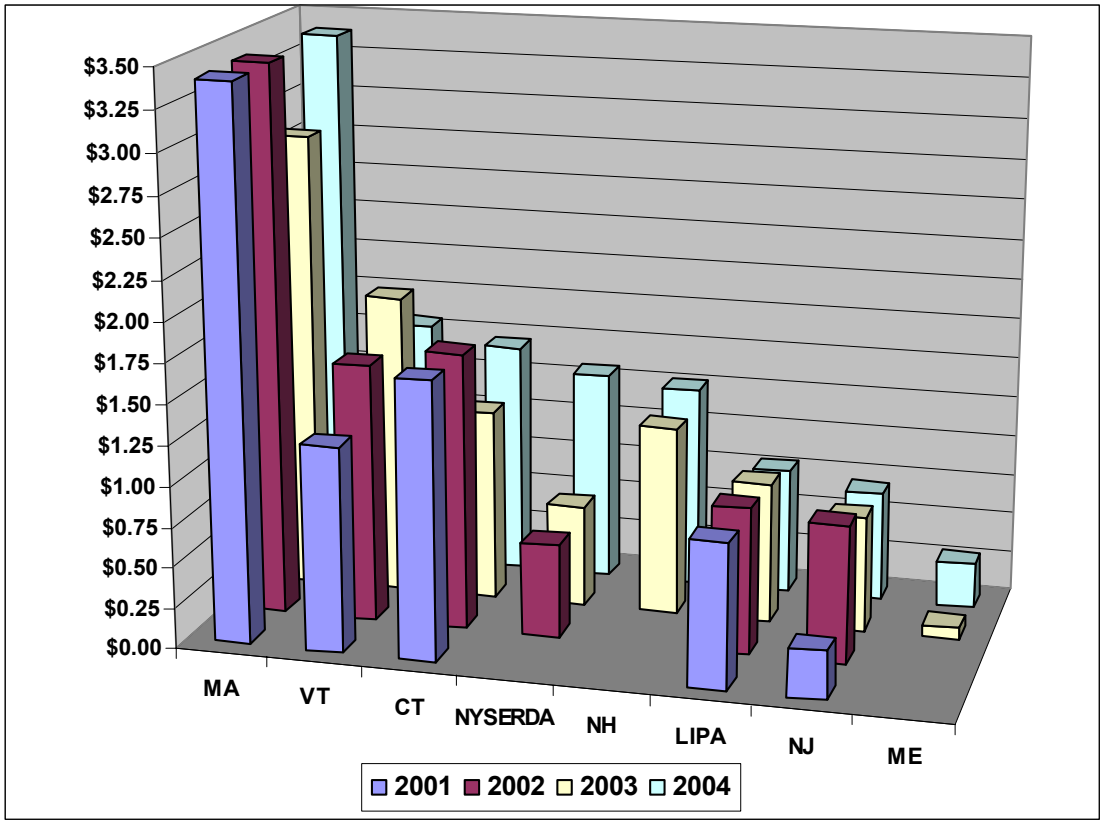


Source: Programs Results

Nonresidential Sector Findings

With the exception of Massachusetts, 2004 nonresidential spending depth is less than that for the residential sector. Nonresidential spending depth varied in 2004 from $3.4/MWh to $0.3/MWh. Again, there are significant variations across the states and programs, though there is less variation in spending levels over time. Spending within a state/program is more constant over the 2001-2004 timeframe than it is in the residential sector. The higher Massachusetts nonresidential sector spending depth may be a result of fairly stringent sector-level funding requirements in that state. All system benefits charges collected from customers within a given sector must be spent within the sector. In Massachusetts, no cross-sector program spending subsidization is allowed.

Figure 4. Nonresidential Spending Depth



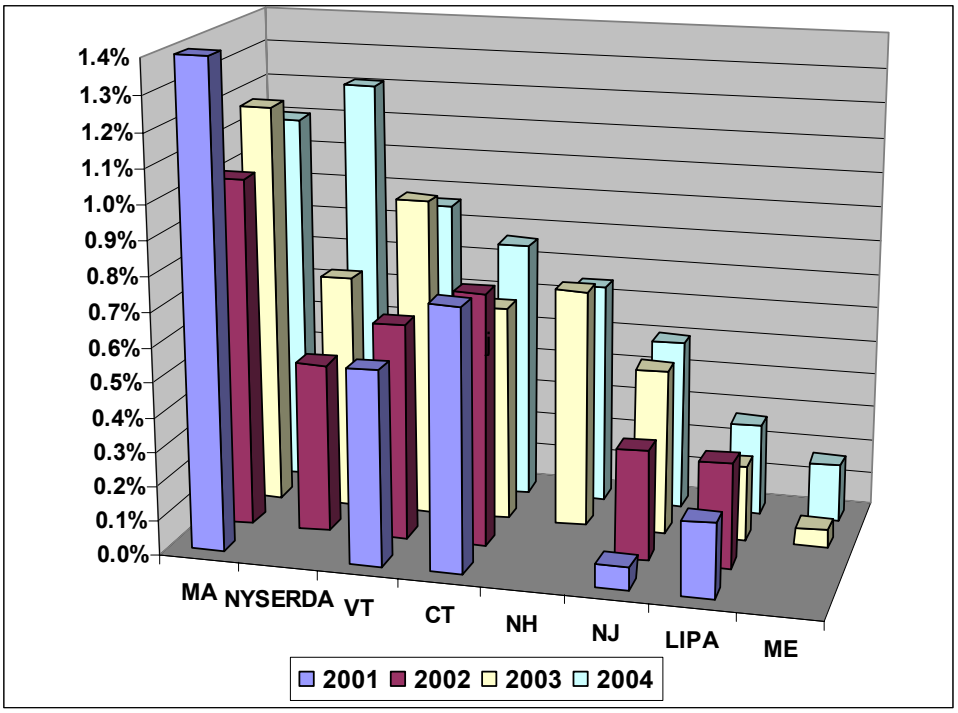
Source: See Programs Results

As with the residential sector, non residential spending and savings depth (Figure 5) generally tracked each other, with a few notable exceptions. In 2004 NYSERDA attained the highest savings depth (1.21%) in the region, though its spending depth ($1.3/MWh) was less than half of that of Massachusetts ($3.4/MWh).

NYSERDA also had the highest nonresidential savings yield (9.0 kWh/$ - Figure 6) in the region in 2004, while Massachusetts had the lowest (3.2 kWh/$). NYSERDA's apparent nonresidential sector program success may be due to the high number of large commercial and industrial (C&I) projects in the state. Similarly, New Jersey's savings yield (7.8 kWh/$) was second only to NYSERDA's. In fact, the three states with the highest proportion of large industrial load – New York, New Jersey and Maine (6.4 kWh/$) – have the highest savings yield. Massachusetts lower savings depth and yield may be a reflection of the maturity of the Massachusetts C&I programs. While there have been variations in program activity and funding levels within the state over the past three decades, Massachusetts program administrators have achieved a high level of program participation among their nonresidential customers compared to other Northeast states. Low savings yields in Massachusetts may reflect past program success. More recent program efforts in Massachusetts may be achieving "deeper" savings among prior program participants at a higher cost per saved MWh.

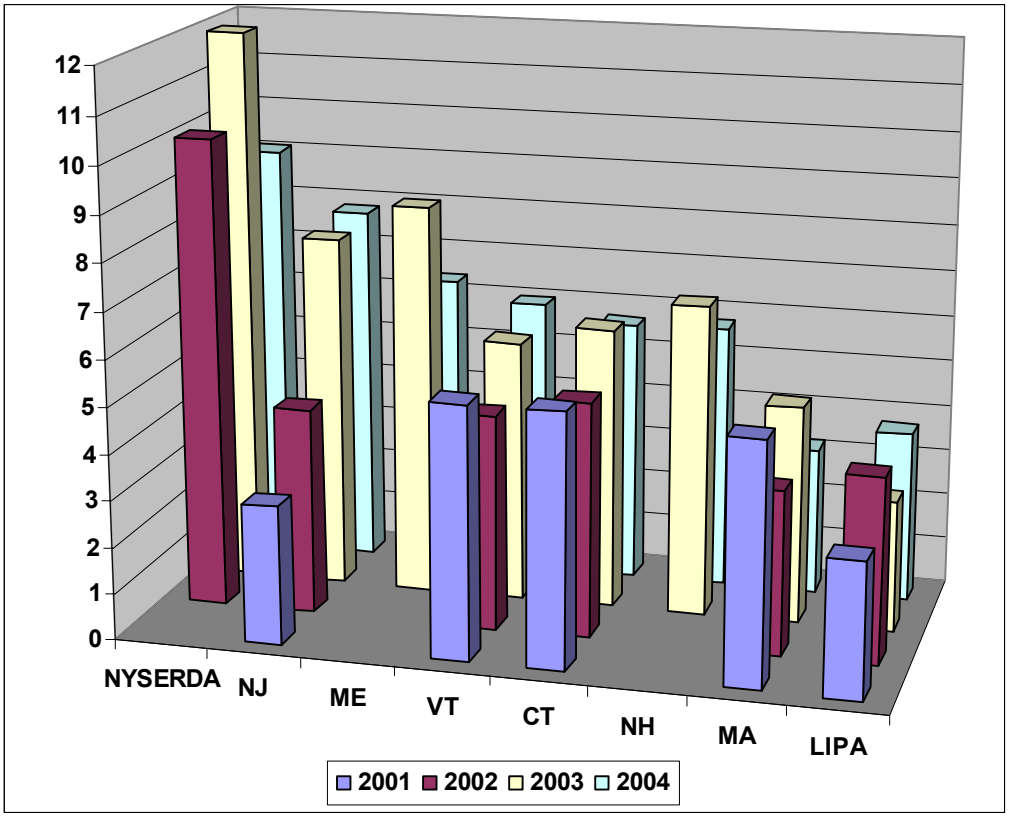
In most states/programs, nonresidential savings yields also did not vary much over time. Only in New Jersey and NYSERDA was there a steady trend towards increasing savings yield from 2001/2002 to 2004.

Figure 5. Nonresidential Savings Depth



Source: See Programs Results

Figure 6. Nonresidential Savings Yield



Source: See Programs Results

Findings

Comparisons of the three calculated indices across the eight states/programs in the Northeast lead to the following observations:

- Spending and savings depth track one another fairly closely in the residential sector, somewhat less so in the nonresidential sector. Higher spending typically generates greater savings in the residential sector. In the nonresidential sector this correlation is weaker due to larger differences in nonresidential savings yields.
- Savings yield variation in the residential sector appears to be influenced by the level of residential lighting program activity. As lighting programs typically generate savings at a low cost per kWh, those residential program portfolios with substantial lighting program activity tend to have higher savings yields.
- Variation in the nonresidential savings yield is highest in those states with the largest industrial loads. Conversely, the low nonresidential savings yield observed in Massachusetts may be the result of high participation rates and the need to dig "deeper" to attain further cost-effective savings.
- Savings yield in the nonresidential sector appears to vary inversely between states with investment and savings depth. For example, Connecticut and Vermont both achieved comparable savings yields with similar spending depths, whereas Massachusetts achieves relatively lower yield at significantly greater spending depth. This inverse relationship between yield and depth is also suggested to a lesser extent within some of the states, but not others.

Conclusions

Annual electricity savings yield per dollar of efficiency program expenditures is a useful indicator of efficiency portfolio performance at the sector level. Historical data on residential and nonresidential efficiency program spending and savings allow one to estimate a range of annual electricity savings that could be achieved with a given level of portfolio spending.

As would be expected, savings depth is closely correlated with the resulting spending depth, measured as a percentage of sector-level electricity sales. As with yield, the data allow one to project a range of expected savings depth for given levels of efficiency portfolio spending.

The data are far less conclusive on the correlation between spending depth on the one hand and savings yield on the other, both between utilities and within service areas over time. One would expect the law of diminishing returns to produce lower yields as spending and savings deepen.

Because of the wide divergence in spending depth, drawing definitive conclusions on variations in savings yield between jurisdictions are problematic. Comparisons may be helpful in focusing critical attention on wide divergences in savings yield or depth from comparable spending depths. For example, NYSERDA's nonresidential savings yield is much higher than would be expected compared to the much lower yields achieved in other states with considerably higher spending depth. Conversely, LIPA's nonresidential savings yield is more typical of Massachusetts, where spending depth is roughly three times as high.

Finally, these historical indicators of efficiency yield and depth are most useful in predicting ranges of savings that one could expect to achieve under varying funding levels. Such

projections may be particularly helpful in setting expectations for neighboring or nearby states with either little or no sustained funding in energy efficiency investment (e.g., states in the mid-Atlantic region of the U.S.).

References

Chernick, Paul, September 9, 2005. *Before the British Columbia Utilities Commission, British Columbia Hydro and Power Authority), 2005 Resource Expenditure and Acquisition Plan) Project No. 3698388, Direct Testimony of Paul Chernick, Resource Insight, Inc.* Arlington, MA. British Columbia Sustainable Energy Association and Sierra Club of Canada British Columbia Chapter.

Northeast Energy Efficiency Partnerships, Inc., January 2006. *The Need for and Approaches to Developing Common Protocols to Measure, Verify and Report Energy Efficiency Savings in the Northeast, Final Report,* Lexington, MA. Northeast Energy Efficiency Partnerships, Inc.

Optimal Energy, Inc. and Vermont Energy Investment Corporation, October 28, 2005. *Comments by the Maine Office of Public Advocate On Efficiency Maine's 2006-2008 Program Plan,* Bristol, VT, Maine Office of Public Advocate.

Optimal Energy, Inc. and Vermont Energy Investment Corporation, Draft April 2006. *Efficiency Long Island Strategic Plan,* Bristol, VT. Long Island Power Authority.

Optimal Energy, Inc., Vermont Energy Investment Corporation, and PAH Associates, October 31, 2003. *Review of Connecticut's Conservation and Load Management Administrator Performance, Plans and Incentives, DPUC Docket No. 03-01-01, Final Report,* Bristol, VT. Connecticut Office of Consumer Counsel.