Synapse
Energy Economics, Inc.

Energy Benefits Resulting from the Investment of 2010 RGGI Auction Revenues in Energy Efficiency

February 28, 2012

AUTHORS

Max Chang, David White, Patrick Knight, and Bruce Biewald

485 Massachusetts Ave.
Suite 2
Cambridge, MA 02139

617.661.3248
www.synapse-energy.com

Table of Contents

1. EXECUTIVE SUMMARY 1

2. INTRODUCTION AND BACKGROUND 3

3. STUDY APPROACH 4

4. AVOIDED COST CALCULATION RESULTS 5

A. ENERGY EFFICIENCY SAVINGS BASED ON RGGI FUNDING 5

B. AVOIDED ELECTRICITY COST BENEFITS OF RGGI-FUNDED EFFICIENCY PROGRAMS 6

5. CO_2 MITIGATION COST COMPARISONS 10

6. OTHER NON-ELECTRIC IMPACTS 12

7. SUMMARY OF OBSERVATIONS AND AREAS FOR FURTHER STUDY 13

APPENDIX I: AVOIDED COST METHOD, COMPONENTS AND ASSUMPTIONS 15

A. METHODOLOGY FOR ELECTRICITY AVOIDED COSTS 15

B. METHODOLOGY FOR OTHER FUELS 17

Avoided Cost of Natural Gas *17*

Other Fuels Methodology *18*

C. DEMAND REDUCTION INDUCED PRICE EFFECT (DRIPE) 21

APPENDIX II: DATA ON RGGI FUNDING OF EFFICIENCY PROGRAMS 22

A. STATE SPECIFIC DETAILS 22

Connecticut *22*

Delaware *22*

Maine *23*

Maryland *23*

Massachusetts *23*

New Hampshire *23*

New Jersey *23*

New York *24*

Rhode Island *24*

Vermont *24*

B. PARTICIPANT COSTS 24

Synapse Energy Economics wishes to thank The Regulatory Assistance Project for the support it provided in the development of this report, and all of our colleagues who have contributed ideas and feedback. In this updated report, we quantify at a high level the energy efficiency benefits of Regional Greenhouse Gas Initiative (RGGI) proceeds across the ten RGGI states. In compiling data for this report, we have relied upon publicly available data from energy efficiency programs in each state. We also contacted several individuals at state agencies, as well as energy efficiency program administrators, to provide clarification when needed. Responsibility for any errors and omissions in this report rests entirely with the authors, and not with The Regulatory Assistance Project.

1. Executive Summary

In October 2010, Synapse Energy Economics issued *Electricity Energy Efficiency Benefits of RGGI Proceeds: An Initial Analysis*, a study that analyzed the investment of Regional Greenhouse Gas Initiative (RGGI) auction proceeds for energy efficiency in 2009, and quantified the electricity savings benefits. This study found that, for every dollar of RGGI auction revenues that was invested in energy efficiency in 2009, participating states received $0.8 to $3.8 in **electric energy** benefits, with a weighted average benefit of $1.5.[1]

In this report, we have updated our study to analyze the investments of RGGI auction proceeds for energy efficiency in 2010. One major revision for this year's study is the quantification of other fuel savings benefits in addition to electric energy benefits. This results in a more comprehensive view of energy savings to participating states, expressed as total energy benefits. We have also revised our assumptions to reflect updated avoided costs, as well as reported savings.

Incorporating these changes and updates, we find in this update that, for every dollar of RGGI auction revenues that was invested in energy efficiency in 2010, participating states received $1.3 to $6.8 in **total energy** benefits, with a weighted average of $2.3.

Although RGGI revenues have decreased because RGGI allowances are trading at the floor prices of $1.89 per short ton, $133 million in RGGI revenue was invested or committed to energy efficiency programs in 2010.[2] Our analysis indicates that the $133 million of RGGI-funded energy efficiency programs will provide more than $304 million in lifetime avoided cost benefits for electricity and other fuels. In other words, the reduced energy consumption resulting from $133 million in energy efficiency measures will make it possible to avoid using $304 million worth of electricity and other fuels over the "life" of those measures. If other benefits were included in this analysis—such as market price effects, reduced consumption of water resources, and an avoided cost of carbon dioxide—the value would increase beyond $304 million.[3] Also not calculated are the economic benefits of energy efficiency spending in the local economy.

These RGGI-funded energy efficiency programs have also reduced carbon dioxide emissions at a lower cost than possible under a cap program that relied solely on a carbon dioxide price.[4] For RGGI states, the costs of reducing carbon emissions range from approximately -$5.27 to -$350

[1] In 2010$. Values in this report are in 2011$. The 2010 report is available at http://www.synapse-energy.com/Downloads/SynapseReport.2010-10.RAP.EE-Benefits-of-RGGI-Proceeds.10-027.pdf. See Exhibit 3 on page 13.

[2] States such as New Jersey and New York have used RGGI proceeds to meet budget shortfalls and to fund renewable energy projects. New Hampshire and Delaware include savings attributed to programs committed in 2010, but implemented in 2011.

[3] For example, Demand Reduction Induced Price Effects (DRIPE) lower the market prices for all customers when energy use is reduced. When including DRIPE impacts, the range of benefits increases to $1.4 to $8.7 for every dollar, with an average of $2.6 across the ten states. At the high end of the range, the benefit drops because the Vermont fuel efficiency program projects a slight increase in electricity consumption.

[4] While our analysis only examined the benefits associated with the reduction in CO_2, there are also other pollutants (such as nitrogen oxides, sulfur dioxide, ozone, particulates, and mercury) that are associated with fossil fuel based electricity generation that would be avoided through increased energy efficiency. Additionally, we did not examine reduced emissions associated with the fuel supply chain through the extraction, processing, and delivery of fossil fuels that could be avoided through increased energy efficiency.

per short ton of carbon dioxide (CO_2), with a weighted average cost of -$41.05 per ton.[5] A negative cost occurs because the program economic benefits are greater than the program costs. As a result, the CO_2 emission reductions from the energy efficiency programs are effectively free, or even a net benefit. In our previous report, we note that an analysis by PJM and others found that significant CO_2 reductions through fuel substitution in electric generation will only occur when carbon prices reach the neighborhood of $50/ton CO_2.[6] The fall in natural gas prices since 2009 has pushed the substitution point to $28/ton CO_2.[7]

In this update, we conduct a high-level quantification of fuel savings programs that were not analyzed as part of the 2010 paper. We emphasize that this report is not a comparative and detailed evaluation of the energy efficiency programs funded through RGGI in each state, but rather an attempt to use reasonably consistent assumptions and publicly available data to estimate electricity and other fuel savings benefits associated with energy efficiency programs across all ten states.

Our updated analysis finds that incorporating energy efficiency continues to be an integral component of the RGGI program, and results in CO_2 emissions reductions at a much lower cost to consumers than other approaches. These findings are significant and important in showing the benefits of energy efficiency spending through RGGI funding. Lessons from the RGGI program may be applied to the development of a federal cap-and-trade program. Investments of auction proceeds in energy efficiency programs continue to yield benefits that far exceed the initial investment.

[5] The mitigation cost range is based on our calculation incorporating: program costs, avoided cost of electricity and other fuels, and lifetime carbon dioxide savings as used within this analysis. Negative costs per ton occur when avoided cost of electricity benefits exceed program costs.

[6] Based on PJM; Potential Effects of Proposed Climate Change Policies on PJM's Energy Market; PJM Interconnection; January 23, 2009.

[7] Based on AEO 2011 natural gas and coal prices.

2. Introduction and Background

As of November 2011, the Regional Greenhouse Gas Initiative (RGGI) has conducted 13 auctions, generating approximately $900 million in proceeds for the ten participating states.[8]

Since the publication of our October 2010 report, several updates and changes have occurred in the program, warranting an update to the report. Most visibly, reporting has improved across the RGGI states since our initial report. The improved reporting has allowed us to update information on savings for electricity and other fuels for the ten RGGI states. The improved reporting has also allowed us to incorporate results from programs initiated in 2009, and to include programs committed to in 2010 in this report. Methodologically, we have focused on reported RGGI spending.[9] This is a change from our last report, which included actual and planned budgets for the participating states.

The auction of RGGI allowances and use of auction proceeds for consumer benefit is still a signature component of the RGGI program, although each state implements this differently.[10] Some states, such as New Hampshire and New Jersey, fund greenhouse gas reduction programs through a grant process. Other states, such as Massachusetts, use their proceeds to augment ratepayer funded energy efficiency programs. Finally, Vermont uses its RGGI proceeds to fund fuel efficiency programs.

All of the programs have a number of benefits that can be viewed from a variety of perspectives. The first category of savings comes from the reduction in energy use. Production and consumption costs are reduced in direct proportion to the energy savings for both producers and consumers. For the end-user, the economic savings are based on the utility bills that they pay, whereas for the supplier the savings are based on the wholesale market prices. Another savings category comes from avoided infrastructure costs, such as the building of new power plants or transmission lines.[11] These costs are somewhat episodic and depend on the aggregate savings of the energy efficiency programs over years. Other benefits include the reductions in pollutant emissions associated with using less energy, and the ripple effects from consumer spending and business investments of energy savings resulting from the energy efficiency programs.[12]

---

[8] The ten RGGI states are Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. In 2010, New Jersey Governor Christie announced that New Jersey would not participate in RGGI starting in 2012.

[9] In Delaware this is an estimate, and in New Hampshire we have included funding committed to but not yet spent.

[10] Maryland, Maine, New Hampshire, Vermont, New York, New Jersey, and Delaware maintain RGGI-funded efficiency programs that are separate from utility ratepayer-funded efficiency programs. New Jersey uses RGGI proceeds to fund renewable energy projects including solar photovoltaics and combined heat and power technologies. New York uses some of its proceeds to fund solar PV projects. Other states such as Connecticut, Maryland, and Massachusetts also use RGGI proceeds to fund renewable energy projects, but these programs are separated from the energy efficiency programs and not included in this analysis.

[11] Depending on the technology and transmission addition and the location of the resource addition, these costs may be substantial. Avoided transmission and distribution benefits are not included in this analysis. See section 6 for additional discussion on this subject.

[12] For the New England states, the avoided cost values associated with energy efficiency are documented in the *Avoided Energy Supply Costs in New England: 2011 Report*. Other pollutants associated with fossil fuel based electricity generation include sulfur dioxides, nitrogen oxides, particulates, mercury, and ozone.

3. Study Approach

For this updated report, we compiled available data on spending on RGGI-funded energy efficiency programs in the ten RGGI states for 2010 based on information provided by individual states and information collected from the RGGI Inc. website, including additional hyperlinks to state-specific information in each of the ten participating states.[13]

For each state, we collected reported savings data (annual and lifetime) for the following avoided energy cost components:

- Electricity (MWh)
- Natural gas (MMBtu)
- Propane (MMBtu)
- Distillate fuel oil (MMBtu)
- Residual fuel oil (MMBtu)
- Carbon dioxide (short tons)

We collected energy efficiency program budgets along with reported RGGI proceeds to determine *pro rata* apportionment of savings to RGGI proceeds. Budget amounts reflect monies spent or committed to programs. We recognize that New York, New Jersey, Maryland, and New Hampshire have used RGGI proceeds to provide direct ratepayer relief or to meet budgetary shortfalls. These amounts have not been included in our analysis.

For calculations of avoided costs (see Appendix I), we relied on Synapse's *2011 Avoided Energy Supply Cost in New England* (AESC 2011) report for avoided cost value streams for the New England states.[14] For Delaware, Maryland, New Jersey, and New York, we estimated avoided cost values by adjusting the New England avoided cost values based on historical differentials to those four states consistent with the methodology from the 2010 analysis.[15]

In addition, we performed calculations for comparative and aggregation purposes of the abatement cost of carbon dioxide per-short-ton that incorporate the benefits of energy efficiency investments in the RGGI region.[16]

---

[13] Information regarding state programs is available at http://www.rggi.org/rggi_benefits/program_investments

[14] Hornby, R., Chernick, P., Swanson, C., White, D., Chang, M., Gifford, J., Hughes, N., Wilson, R., Wittenstein, M., and Biewald, B. Avoided Energy Supply Costs in New England: 2011 Report. August 11, 2011. Available at http://www.synapse-energy.com/Downloads/SynapseReport.2011-07.AESC.AESC-Study-2011.11-014.pdf. See Appendix I, Section A for additional discussion.

[15] We believe that this approach provides a reasonable approximation of avoided costs for the non-New England states without conducting a state-specific analysis of avoided costs, which would be beyond the scope of work for this report.

[16] See Section 5 for a more detailed discussion.

4. Avoided Cost Calculation Results

One of the signature features of the RGGI program is that many of the participating states use auction proceeds to fund a variety of energy efficiency programs. In order to quantify the benefits associated with this use of RGGI proceeds, we calculate what costs have been avoided due to expenditures on energy efficiency programs. Avoided cost calculations are a standard measure of the energy costs and benefits associated with retail customers' reduction of their annual energy use. To estimate the avoided costs we need two components: 1) the quantity of electricity or fuel saved, and 2) the value of electricity or fuel that will be avoided.

For this update, we focus on the benefits associated with the avoided cost of electricity and other fuels. Capacity, transmission, and distribution benefits are not examined or quantified in the context of this analysis.[17] However, these benefits are important and should be incorporated in a thorough economic analysis of individual programs.

A. Energy Efficiency Savings Based on RGGI Funding

For this analysis, we relied on available state-specific data. We note that New York uses some of its RGGI proceeds to fund solar photovoltaic (PV) systems, and New Jersey uses all of its proceeds to fund Combined Heat and Power (CHP) and solar PV projects.

Appendix I summarizes savings and avoided cost assumptions used in this analysis across the RGGI states. Appendix II provides specific details of adjustments that we used to approximate savings and/or RGGI funding.

The following Table summarizes available information on RGGI funding, *pro rata* energy, and *pro rata* CO_2 savings for energy efficiency programs utilizing and/or representing RGGI proceeds.[18] *Pro rata* values are based on RGGI proceeds relative to the program costs; in other words, the fraction of program costs funded by RGGI proceeds is applied to determine the amount of savings attributable to RGGI proceeds. Our analysis does not include participant costs, which would be required if evaluating the programs within a regulatory context. We present participant cost data in Appendix II.

[17] See Section 6 for a more detailed discussion. In addition, see Lazar, Jim., Xavier Baldwin. *Valuing the Contribution of Energy Efficiency to Avoided Marginal Line Losses and Reserve Requirements.* RAP. August 2011. The authors quantified the impact of energy efficiency on marginal line losses during system peak demand and the impact of energy efficiency in reducing generating reserves. The authors found that the capacity value from avoided line losses and reduced generation reserves attributable to energy efficiency investments that help reduce peak loads may be as valuable as the associated energy savings.

[18] Vermont's all fuels program includes 4,043 MMBtu's of annual net savings, or 71,426 MMBtu of lifetime net savings from efficiency measures targeting savings in wood that we not included in our analysis. Our analysis included electricity, fuel oil, propane, and natural gas measures,

Table 1. 2010 Planned or Actual Budget and Savings for RGGI Funded Energy Efficiency Programs[19]

State	Lifetime Electricity Savings (MWh)	Lifetime Natural Gas Savings (MMBtu)	Lifetime Distillate Fuel Oil Savings (MMBtu)	Lifetime Propane Savings (MMBtu)	Lifetime Residual Fuel Oil Savings (MMBtu)	Lifetime Non-electric Savings (MMBtu)	Pro Rata Lifetime CO2 Savings (short tons)
	a	b	c	d	e	f=sum(b:e)	g
Connecticut	254,703	281,571	284,004			565,575	166,036
Delaware	69,097	611,739				611,739	93,581
Maine	679,779	1,444,454	149,530		206,501	1,800,486	968,957
Maryland	394,875	1,604	1,465,110			1,466,714	331,305
Massachusetts	807,024	-95,818	297,870	30,704	-6,576	226,180	432,437
New Hampshire	253,500	950,000	235,773	118,473		1,304,246	199,920
New Jersey	185,182	3,395,900				3,395,900	1,903,720
New York	16,098	47,112	896,292	3,612		947,016	131,456
Rhode Island	136,599	316,802				316,802	97,688
Vermont	-1,818	3,602	295,684	245,717		545,003	40,082
Totals	**2,795,039**	**6,956,965**	**3,624,264**	**398,506**	**199,926**	**11,179,660**	**4,365,183**

Notes
Values may not sum due to rounding
Levelized avoided costs based on methodology described in Appendix I
Data based on state specific reported information detailed in Appendix II
Negative values for Vermont and Massachusetts indicate the program is anticipated to increase consumption
Pro Rata lifetime carbon dioxide savings for both electric and fossil fuel savings based on state reported savings and adjusted for RGGI proceeds

B. Avoided Electricity Cost Benefits of RGGI-Funded Efficiency Programs

As noted above, the calculations of the avoided electricity and fuel cost benefits for energy efficiency programs funded by RGGI are based on the avoided cost of electric energy and other fuels, which is detailed in Appendix I.[20] The Synapse AESC 2011 report provides projections of marginal energy supply costs that will be avoided due to reductions in the use of electricity, natural gas, and other fuels resulting from energy efficiency programs throughout New England. These

[19] The negative values for lifetime electricity, natural gas, and residual fuel savings for Massachusetts and Vermont reflect that energy efficiency measures will result in an increase in consumption of electricity or fuel. Specifically, Vermont's thermal efficiency program will result in increased usage of electricity of 1,818 MWh. For the Vermont program, the savings in other fuels outweigh the increase in electricity consumption.

[20] The values used in this analysis are a rough approximation of retail avoided energy cost without avoided transmission and distribution costs. This analysis does not represent specific analyses to determine specific retail electric costs across the ten states.

are the most readily available and generally accepted calculations of avoided costs in New England, and can be adapted for use in non-New England states in the RGGI region.[21]

For the non-New England states, we scaled those values based on the ratio of the near-term (2010) energy price in those states to the near-term energy price in New England.[22]

Using the state-specific avoided electricity supply costs, other fuel cost values, and the available estimates of lifetime energy savings, we estimate and aggregate the benefits of the electricity and other fuel use avoided through RGGI-funded energy efficiency in the ten RGGI states. Appendix II provides details of our calculation method. The aggregated benefits across fuels and electricity are summarized in the following Table.[23]

Table 2. Avoided Energy Benefits to RGGI Funding Ratio[24]

State	Avoided Cost of Electricity ($000's)	Avoided Cost of Natural Gas ($000's)	Avoided Cost of Fuel Oil ($000's)	Avoided Cost of Propane ($000's)	Avoided Cost of Fuel Oil #4 ($000's)	Total Energy Avoided Costs ($000's)	RGGI Funding Amount	Avoided Energy Benefits to RGGI Funding Ratio
	a	b	c	d	e	f=sum(a:e)	g	h=f÷g
Connecticut	$16,294	$2,429	$7,264			$25,988	$12,300	2.1
Delaware	$4,314	$5,186				$9,499	$3,793	2.5
Maine	$40,848	$12,127	$3,800		$4,126	$60,901	$11,448	5.3
Maryland	$28,948	$16	$37,229			$66,194	$21,464	3.1
Massachusetts	$55,516	-$786	$7,508	$1,118	-$131	$63,225	$26,311	2.4
New Hampshire	$15,702	$8,149	$5,931	$4,320		$34,102	$17,661	1.9
New Jersey	$14,464	$32,369				$46,833	$36,800	1.3
New York	$1,180	$408	$22,592	$132		$24,311	$14,900	1.6
Rhode Island	$8,213	$2,714				$10,927	$4,439	2.5
Vermont	-$130	$32	$7,591	$8,982		$16,475	$2,426	6.8
Total (weighted average)	**$185,350**	**$62,644**	**$91,916**	**$14,552**	**$3,995**	**$358,456**	**$151,542**	**2.4**

Notes
Values in 2011$
Participant costs not included
Values may not sum due to rounding
Negative values for Vermont and Massachusetts indicate the program is anticipated to increase consumption
Levelized avoided costs based on methodology described in Appendix I
Data based on state specific reported information detailed in Appendix II

[21] Energy efficiency program administrators (electric and natural gas) in all six New England states use the AESC studies to evaluate cost-effectiveness of their energy efficiency programs.
[22] Prices for PJM from Monthly Day-Ahead LMP Prices available at www.pjmenergy.com/markets/jsp/lmpmonthly.jsp. Prices for New York from NYISO monthly report data available at http://www.nyiso.com/public/webdocs/documents/studies_reports/monthly_reports/December_2009_Monthly_Report.pdf
[23] A more detailed treatment of calculating the benefits of avoided generation costs would aggregate and measure program level benefits to determine sector specific and statewide benefits. However, this analysis would have occurred during the screening process conducted in each state under varying rules.
[24] For a discussion of the negative values for Vermont and Massachusetts, see footnote 19.

The ratio of avoided electricity and avoided other fuel cost benefits to program costs for the RGGI states range from 1.3 to 6.8 of benefits for every dollar of *pro rata* program cost.[25][26]

If one were to include energy demand reduction induced price effects (DRIPE) in this analysis, then we would expect the benefits noted in Table 2 (above) to increase by roughly 25% for electric savings. Appendix I details the concept of energy DRIPE impacts associated with energy efficiency programs, as well as some of the difficulties in calculating specific values for each RGGI state. The following table shows the increased benefits if one were to include energy DRIPE.[27]

Table 3. Avoided Electricity Benefits and DRIPE Benefits Funding Ratio to RGGI Funding[28]

State	Avoided Cost of Electricity ($000's)	DRIPE Benefit Estimate (000's)	Total Energy Avoided Costs ($000's)	Energy Avoided Costs with DRIPE ($000's)	RGGI Funding Amount	Energy Benefits (with DRIPE) to RGGI Funding
	a	b=a*0.25	c	d=b+c	e	f=d÷e
Connecticut	$16,294	$4,074	$25,988	$30,062	$12,300	2.4
Delaware	$4,314	$1,078	$9,499	$10,578	$3,793	2.8
Maine	$40,848	$10,212	$60,901	$71,113	$11,448	6.2
Maryland	$28,948	$7,237	$66,194	$73,431	$21,464	3.4
Massachusetts	$55,516	$13,879	$63,225	$77,104	$26,311	2.9
New Hampshire	$15,702	$3,926	$34,102	$38,028	$17,661	2.2
New Jersey	$14,464	$3,616	$46,833	$50,449	$36,800	1.4
New York	$1,180	$295	$24,311	$24,606	$14,900	1.7
Rhode Island	$8,213	$2,053	$10,927	$12,980	$4,439	2.9
Vermont	-$130	-$32	$16,475	$16,442	$2,426	6.8
Total (weighted average)	**$185,350**	**$46,337**	**$358,456**	**$404,794**	**$151,542**	**2.7**

Notes
Values in 2011$
Values may not sum due to rounding
Values from Column C taken from Exhibit 2
Levelized avoided cost based on methodology described in Appendix I
Data based on state specific reported information detailed in Appendix II

[25] These cost benefit ratios are an approximation. State-specific program cost benefit ratios may differ based on specific regulatory requirements in each jurisdiction. For example, participant costs are not included in all filings, so it would be difficult to obtain all the necessary inputs to evaluate program cost-effective across all ten states in a manner consistent with standard cost-effectiveness tests. We have included available participant cost data in Appendix II.

[26] Including Vermont's lifetime benefits attributable to avoided wood costs would increase Vermont's total energy avoided cost by approximately $646,000. This would increase Vermont's lifetime ratio to 7.0 instead of 6.6.

[27] Intrastate DRIPE benefits only. Capacity DRIPE benefits are not included in this analysis.

[28] Vermont's negative avoided cost of electricity reflects the value of increased consumption of electricity as a result of its thermal energy efficiency program.

As shown in Tables 2 and 3, the states with the lowest "energy benefits to RGGI funding" ratios are New Jersey, New York, and New Hampshire; this can be explained in part by the fact that these states use their RGGI proceeds to fund programs that reduce CO_2 emissions in ways that may produce fewer avoided electricity cost benefits than other states, according to our high-level analysis. For example, New Jersey has invested its RGGI proceeds to award grants for CHP and solar PV projects across the state. New Hampshire awards grants to a variety of greenhouse gas mitigation projects. New York uses some of its proceeds (~9%) to fund job training programs that are difficult to measure using the metrics of this analysis.

Similarly, while Vermont has the highest "energy benefits to RGGI funding" ratio in Tables 2 and 3, note that it also has the lowest value in column A (avoided cost of electricity). This is because Vermont uses its RGGI proceeds to fund a fossil-fuel efficiency program that has incidental avoided electricity supply benefits, and for some measures results in *increased* electric energy consumption. For example, improving thermal efficiencies through measures such as air sealing and/or increased insulation will result in less consumption in heating fuel usage, but may also result in reduced air exchanges that require the need to increase mechanical ventilation. This will translate to fuel savings, but an increase in electricity consumption. . In our report last year, we noted that these types of programs would not be considered "traditional" energy efficiency programs. In this updated study, we attempt to quantify the total energy benefits of these programs, which results in Vermont's much improved ratio of 6.8 (total energy benefits), versus 3.0 (only electric energy benefits) in the 2010 study.

While this revision represents an improvement over the 2010 study, we recognize that our high-level analysis does not capture substantial non-electric benefits or co-benefits associated with these energy efficiency programs, which should be quantified within the context of a regulatory proceeding.[29] A more detailed discussion of these non-electric benefits/co-benefits is found in Section 6 below.

Similarly, while our high-level analysis clearly shows that the avoided-cost-of-energy benefits associated with these programs is significant, measuring the impacts of the disbursement of RGGI proceeds within each state, individually, requires a more in-depth, state-by-state analysis, which is beyond the scope of this paper.

[29] A more detailed discussion of non-electric impacts is described in Section 6.

5. CO_2 Mitigation Cost Comparisons

The RGGI program, with its integration of efficiency investments, allows states to lower the cost of reducing CO_2 emissions since efficiency offers lower carbon mitigation costs compared to other emission-reduction approaches. Thus, another way to evaluate the investment of RGGI auction proceeds in energy efficiency programs is to calculate the effective CO_2 mitigation cost associated with those investments.

The per-ton abatement costs from RGGI funding range from $11.81 to $113.35/ton CO_2. However, this simple calculation understates the efficacy of energy efficiency at reducing CO_2 emissions, because it ignores the fact that energy efficiency investments also *avoid* costs (e.g., power plant operation and capital costs), in addition to reducing CO_2 emissions. Incorporating these avoided-cost benefits (what energy efficiency *saves* electricity consumers) and factoring in participant costs (what energy efficiency *costs* electricity consumers) allows for an estimation of *net* costs per ton of CO_2 reduction achieved through energy efficiency.[30]

Using our data from the RGGI-funded programs, we calculate the net costs of CO_2 mitigation in Table 4, below. This table includes two levels of calculation in determining net costs of CO_2 mitigation through energy efficiency. The first calculation estimates the net costs when one considers only the avoided *electricity* costs (column e). The second calculation estimates the net cost when one considers avoided *total energy* costs (column h). As we noted earlier, this analysis does not consider participant costs, since that data is not available for every state. In Appendix II, we provide Table 4 restated to include participant costs for the four states (Maine, Massachusetts, Rhode Island, and Vermont) that report participant cost information.

[30] Including participant costs into the calculation provide a better approximation of "all-in" costs associated with energy efficiency programs. Including participant costs have the impact of increasing net costs. For some states, participant cost data is available, in other states this data was not available.

Table 4. Net CO_2 Mitigation Costs of RGGI-Funded Energy Efficiency Programs

State	Lifetime CO2 Savings (tons)	RGGI Funding Amount ($000's)	Total Electricity Avoided Costs ($000's)	Net RGGI Cost of Programs ($000's)	Net Cost of CO2 Reductions (Electricity) ($/tons)	Total Energy Avoided Costs ($000's)	Net RGGI Cost of Programs ($000's)	Net Cost of CO2 Reductions (Energy) ($/tons)
	a	b	c	d=b-c	e=d÷a	f	g=b-f	h=g÷a
Connecticut	166,036	$12,300	$16,294	-$3,994	-$24.06	$25,988	-$13,688	-$82.44
Delaware	93,581	$3,793	$4,314	-$521	-$5.57	$9,499	-$5,707	-$60.98
Maine	968,957	$11,448	$40,848	-$29,400	-$30.34	$60,901	-$49,453	-$51.04
Maryland	331,305	$21,464	$28,948	-$7,484	-$22.59	$66,194	-$44,729	-$135.01
Massachusetts	432,437	$26,311	$55,516	-$29,205	-$67.54	$63,225	-$36,914	-$85.36
New Hampshire	199,920	$17,661	$15,702	$1,959	$9.80	$34,102	-$16,441	-$82.24
New Jersey	1,903,720	$36,800	$14,464	$22,336	$11.73	$46,833	-$10,033	-$5.27
New York	131,456	$14,900	$1,180	$13,720	$104.37	$24,311	-$9,411	-$71.59
Rhode Island	97,688	$4,439	$8,213	-$3,774	-$38.64	$10,927	-$6,488	-$66.41
Vermont	40,082	$2,426	-$130	$2,555	$63.76	$16,475	-$14,049	-$350.52
Total (weighted average)	**4,365,183**	**$151,542**	**$185,350**	**-$33,808**	**-$7.74**	**$358,456**	**-$206,914**	**-$47.40**

Notes
Values in 2011$
Values may not sum due to rounding
Levelized avoided cost based on methodology described in Appendix I
Data based on state specific reported information detailed in Appendix II

When including just the value of avoided cost of *electricity*, the net costs range from $104.37/ton CO_2 to -$67.54/ton. When the *total* avoided energy costs are taken into account, CO_2 reductions through energy efficiency actually have a negative net cost (because the avoided costs are significantly greater than the program costs). The New York value of $104/ton reflects programs such as the Green NY that have uncertain or no CO_2 savings, but certain costs. For all ten states, the net cost range when factoring other fuels is from -$-5.27/ton to -$350/ton CO_2 based on publicly available data. New Jersey's -$5.27/ton reflects its emphasis on supply-side projects such as CHP and solar rather than energy efficiency. On the other end of the spectrum, Vermont's value of -$350/ton reflects the program emphasis on other fuels, especially home heating oil, which has a higher CO_2 content compared to natural gas and propane.

These calculations illustrate that energy efficiency investments can achieve carbon reductions at much lower cost than other abatement options, such as carbon capture and sequestration.

6. Other Non-Electric Impacts

This updated report attempts to quantify energy benefits of RGGI-funded energy efficiency investments in the form of fuel savings for heating fuels such as natural gas, oil, wood, propane, and other sources.

Most electric efficiency measures also deliver non-electric impacts. These are impacts that are attributable to energy efficiency but not directly related to the direct cost of electricity or other fuels. For example, measures that save on air conditioning costs in the summer months, such as insulation and air sealing, also reduce heating costs in the winter. Other examples of non-electric benefits include measures that reduce water consumption by way of high efficiency appliances, or reduce maintenance costs through the use of high-efficiency lighting. These benefits are significant, but are not captured in our analysis. [31]

Using RGGI allowance proceeds to fund energy efficiency also provides economic benefits through job creation in the efficiency industry, and electricity cost savings as consumers and businesses spend less on their electricity bills. A recent study conducted by the Analysis Group analyzed the economic impact of *all* of the proceeds from first three years of the RGGI program across the participating states.[32] That analysis found that the $912 million of RGGI proceeds resulted in net economic benefit of $1.6 billion for the ten RGGI participating states.[33]

[31] TetraTech recently completed an extensive study for Massachusetts Program Administrators quantifying non-electric impacts specific to Massachusetts. Tetra Tech. Massachusetts Program Administrators: Massachusetts Special and Cross Sector Studies Area, Residential and Low-income Non Energy Impacts (NEI) Evaluation. August 15, 2011.

[32] Hibbard, P., Tierney, S., Okie, A., Darling, P. "*The Economic Impacts of the Regional Greenhouse Gas Initiative on Ten Northeast and Mid-Atlantic State Review of the Use of RGGI Auction Proceeds from the First Three-Year Compliance Period."* November 15, 2011. Available at http://www.analysisgroup.com/rggi.aspx. Accessed December 12, 2011.

[33] The assumptions and methodologies are different between the two reports, so a direct comparison between the two reports is not possible. However the general conclusions between this report and the Analysis Group report are similar.

7. Summary of Observations and Areas for Further Study

Using readily available data, this updated study was conducted to estimate the avoided-electricity and avoided-other-fuel benefits of using RGGI auction proceeds to support 2010 energy efficiency programs across the ten RGGI states. In states that have supplemented ratepayer-funded energy efficiency programs with RGGI funding, we continue to find that these RGGI-funded programs provide significant benefits associated with reductions in annual electricity consumption. In states where RGGI proceeds have been used to fund fuel efficiency and/or greenhouse gas reduction programs, the ratio of avoided fuel cost benefits to program costs is also pronounced and significant.

For 2010, the $133.3 million of RGGI funds that was invested or committed to energy efficiency programs will provide more than $304.3 million in lifetime avoided energy cost benefits.

If a federal cap-and-trade program is implemented, we hope that the positive lessons from the RGGI program will be applied nationally. A cap-and-trade program that simply relies on a price signal and market effects to achieve emissions reductions is likely to have higher overall costs than one that incorporates energy efficiency investments as an integral program component.

On the other hand, the combination of a cap-and-trade program and complementary measures such as energy efficiency that uses the auction proceeds to augment funding of energy efficiency programs can achieve carbon reductions at a much lower cost than just price signals alone.[34] As we note for RGGI states with electric energy efficiency programs, the costs of reducing carbon emissions range from approximately negative $53 to negative $100 per (short) ton of CO_2, with a weighted average cost of negative $73 per ton, indicating that the benefits of the efficiency investments far exceed initial costs.[35]

This report also offers a broad-brush estimate of the net costs of achieving carbon reductions through energy efficiency investments. We find that energy efficiency programs offer an opportunity for carbon reductions at negative costs ranging from approximately -$5.27 to -$350/ton CO_2 for energy efficiency across the ten RGGI states.

In developing this report, we found that the improved reporting of available data across the ten RGGI states allows for better assessment of the RGGI programs. As the RGGI program undergoes a comprehensive review in 2012, we hope that improvements to the program will enable coordination and resource sharing among states to promote development of best practices.

We reiterate that transparency of data is crucial; more than $900 million has been raised by RGGI auctions since 2008, which is far from trivial. Continuing to improve the reporting of this data will further assist stakeholders in understanding the benefits associated with RGGI-funded programs,

---

[34] Chang, White, Johnston, Biewald; *Electricity Energy Efficiency Benefits of RGGI Proceeds: An Initial Analysis;* Synapse Energy Economics; October 5, 2010. http://www.synapse-energy.com/Downloads/SynapseReport.2010-10.RAP.EE-Benefits-of-RGGI-Proceeds.10-027.pdf

[35] Idem.

both within and across states. This will only enhance RGGI's usefulness as a foundation for the development of a cost-effective federal carbon cap-and-reduction program that incorporates allowance auctions and investment of proceeds for the public benefit.

Appendix I: Avoided Cost Method, Components and Assumptions

Avoided costs are defined in the EPA's National Action Plan for Energy Efficiency (NAPEE Report) as "costs that would have been spent if the energy efficiency savings measure had not been put in place."[36] The following summarizes our methodology for the avoided costs for electricity used in this analysis.

A. Methodology for Electricity Avoided Costs

Electricity avoided costs are generally divided into energy and capacity. Energy avoided costs generally account for market prices of energy, fuel costs, and natural gas prices. Capacity avoided costs generally account for avoided infrastructure investments, such as new generation plants, and transmission and distribution lines.[37]

A detailed listing of these components is summarized in the following Table, taken from the NAPEE Report.[38]

Table 5. Energy and Capacity Components in Avoided Costs from NAPEE Report

Electricity Energy Efficiency	
Energy Savings	**Capacity Savings**
Market purchases or fuel and operation and maintenance costs	Capacity purchases or generator construction
System losses	System losses (peak load)
Ancillary services related to energy	Transmission facilities
Energy market price reductions	Distribution facilities
Co-benefits in water, natural gas, fuel oil, etc.	Ancillary services related to capacity
Air emissions	Capacity market price reductions
Hedging costs	Land use
Natural Gas Energy Efficiency	
Energy Savings	**Capacity Savings**
Market purchases at city gate	Extraction facilities
Losses	Pipelines
Air emissions	Cold weather action/pressurization activities
Market price reductions	Storage facilities
Co-benefits in water, natural gas, fuel oil, etc.	LNG terminals
Hedging costs	

Note: More detail on each of these components can be found in Chapter 3 of the Action Plan's *Guide to Resource Planning with Energy Efficiency* (National Action Plan for Energy Efficiency, 2007b).

[36] EPA, "Understanding Cost-Effectiveness" p. 4-1.
[37] EPA, "Understanding Cost-Effectiveness" p. ES-2.
[38] EPA, "Understanding Cost-Effectiveness" p. 4-2.

Regulators generally factor in these avoided costs when evaluating energy efficiency programs. However, there are differences between which and how avoided costs are calculated within the ten RGGI states. In the six New England states, the Avoided Energy Supply Component Study Group has sponsored the bi-annual calculation of avoided costs associated with energy efficiency. Thus, for this analysis, Synapse relied upon estimates published in the 2011 AESC study for the New England states.[39]

Our analysis incorporated the following assumptions and caveats:

- 2011 energy prices are based on historic prices from ISO data.
- For our avoided electricity supply value, we used the avoided cost of electricity from the 2011 AESC report for the six New England states.
- Avoided cost values included a wholesale risk premium of 9% for New England states and 11.1% for Vermont as required by the Vermont Public Service Board. With this premium, the values are closer to an energy supply cost for consumers.
- This analysis does not include transmission and distribution losses, since that information is generally utility specific.
- For New York, New Jersey, Maryland, and Delaware, Synapse used existing published day-ahead price estimates from PJM and adjusted based on a regression of levelized prices from the six New England states.[40]Understandably, the PJM market has more coal on the margin than the New England market, where natural gas is generally the marginal resource. In addition, the potential development of offshore renewable resources in Delaware, New Jersey, and Massachusetts within the next 11 years may affect avoided costs. However, for the purposes of this analysis, our approach is—premised on the belief that the regional energy markets will follow similar macro-trends—to model behavior from New England data in the near term, and not to examine factors influencing avoided costs specific to each of the RGGI states.
- Discount rate is based on the AESC 2011 study discount rate of 2.46%, and is applied to all states.[41]Because the avoided cost of electricity changes gradually during the time period, the calculation of the levelized costs will be fairly insensitive to changes in the discount rate. For example, changing the discount rate from 2.46% to 5% results in a decrease in the avoided electricity benefits of 0.4% to 0.9% across the states.

[39]Hornby et al. Avoided Energy Supply Costs in New England: 2009 Report. October 23, 2009, page 6-52. Available at http://www.synapse-energy.com/Downloads/SynapseReport.2009-10.AESC.AESC-Study-2009.09-020-Appendices.pdf

[40]Day-ahead price estimates from PJM market at http://www.pjmenergy.com/markets/energy-market/day-ahead.html.

[41]Discount rates will vary based on regulatory requirements. We did not attempt to identify discount rates that would be used during the screening process for individual energy efficiency programs.

B. Methodology for Other Fuels

The following summarizes our methodology for the avoided costs for other fuels (natural gas, propane, and fuel oils) used in this analysis.

Avoided Cost of Natural Gas

For the New England states, we used avoided natural gas costs from the AESC 2011 study. The levelized values are based upon the weighted average measure life of programs to determine the levelization period for each state.[42]

For Delaware, Maryland, New York, and New Jersey we used the following methodology to approximate avoided natural gas costs.

First, we calculated monthly historical price differentials between Henry Hub, citygate, and end-use natural gas prices for the four states. We annualized the average monthly ratios for the period between 2001 through 2011 for each of the four states to determine a price differential ratio that would be applied to the AESC 2011 forecast of Henry Hub prices to approximate future citygate and end-use prices.[43] In order to estimate the avoidable retail margin component associated with natural gas efficiency, we used the AESC 2011 fraction of avoidable margins taken from a survey of New England natural gas local distribution companies (LDCs).[44] For residential end-uses the margin is 21%, and for commercial/ industrial end-uses the margin is 28%. The avoidable margin was then applied to the difference between citygate and end-use prices for both residential and commercial/ industrial end-use price forecasts to determine forecasted avoidable retail margins.[45]The resulting levelized avoided natural gas costs are shown in the following Table for the ten RGGI states.[46]

[42]Weighted for savings.

[43]We also calculated price differentials for the period between 2007and 2011, but did not see a material difference in price estimates.

[44]A survey of avoidable retail margins from LDCs in Delaware, Maryland, New Jersey, and New York would provide more state-specific data, but is currently beyond the scope of this paper.

[45] Although natural gas prices differ by end-use sector, programs across the ten states did not materially impact the use of a single avoided natural gas avoided cost versus sector specific avoided natural gas costs.

[46] Massachusetts values for avoided natural gas costs are negative because the electric energy efficiency programs resulted in increased natural gas consumption. Because the Massachusetts natural gas efficiency programs are not funded with RGGI proceeds, there is no corresponding offset in natural gas savings from natural gas efficiency programs.

Table 6. Avoided Natural Gas Summary

State	Annual Natural Gas Savings (MMBtu)	Lifetime Natural Gas Savings (MMBtu)	Calculated Program Life (years)	Levelized Avoided Cost of Natural Gas ($/MMBtu)	Avoided Cost of Natural Gas (000's)
	a	b	c=b÷a	d	e=b*d
Connecticut	17,652	281,571	16.0	$8.63	$2,429
Delaware	41,168	611,739	14.9	$8.48	$5,186
Maine	96,297	1,444,454	15.0	$8.40	$12,127
Maryland	107	1,604	15.0	$10.10	$16
Massachusetts	-8,093	-95,818	11.8	$8.20	($786)
New Hampshire	53,423	950,000	17.8	$8.58	$8,149
New Jersey	140,416	3,395,900	24.2	$9.53	$32,369
New York	3,926	47,112	12.0	$8.65	$408
Rhode Island	20,594	316,802	15.4	$8.57	$2,714
Vermont	209	3,602	17.2	$8.81	$32
Total	312,276	6,006,965	19.2		$54,495

Notes
Values may not sum due to rounding
Massachusetts programs result in increased natural gas usage.
Levelized avoided cost based on methodology described in Appendix I
Data based on state specific reported information detailed in Appendix II

Other Fuels Methodology

For avoided Fuel Oil #2, Fuel Oil #4, and propane, we used avoided costs from the AESC 2011 study for all ten RGGI states. We examined historical price differentials between the Mid-Atlantic and New England states for heating oil to determine if we needed to calculate separate Mid-Atlantic avoided fuel oil costs. We observed only minor differences between fuel oil prices across the two regions, which were not significant enough to warrant further calculations. Because programs differ across the ten states, not all states funded programs that would result in savings in other fuels. As a result, other fuel categories are blank for a number of states. The following Tables summarize our findings on the value of avoided costs for other fuels.

Table 7. Avoided Fuel Oil #2 Summary

State	Annual Fuel Oil Savings (MMBtu)	Lifetime Fuel Oil Savings (MMBtu)	Calculated Program Life (years)	Levelized Avoided Cost of Fuel Oil ($/MMBtu)	Avoided Cost of Fuel Oil ($000's)
	a	b	c=b÷a	D	e=(b*d)
Connecticut	16,232	284,004	17.5	$25.58	$7,264
Delaware					
Maine	9,969	149,530	15.0	$25.41	$3,800
Maryland	97,674	1,465,110	15.0	$25.41	$37,229
Massachusetts	25,158	297,870	11.8	$25.21	$7,508
New Hampshire	21,213	235,773	11.1	$25.16	$5,931
New Jersey					
New York	74,691	896,292	12.0	$25.21	$22,592
Rhode Island					
Vermont	16,096	295,684	18.4	$25.67	$7,591
Total	239,820	3,388,491	14.1		85,985

Notes
Values may not sum due to rounding
Levelized avoided cost based on methodology described in Appendix I
Data based on state specific reported information detailed in Appendix II

Table 8. Avoided Propane Summary

State	Annual Propane Savings (MMBtu)	Lifetime Propane Savings (MMBtu)	Calculated Program Life (years)	Levelized Avoided Cost of Propane ($/MMBtu)	Avoided Cost of Propane ($000's)
	a	b	c=b÷a	D	e=b*d
Connecticut					
Delaware					
Maine					
Maryland					
Massachusetts	2,593	30,704	11.8	$36.41	$1,118
New Hampshire	10,805	118,473	11.0	$36.47	$4,320
New Jersey					
New York	301	3,612	12.0	$36.41	$132
Rhode Island					
Vermont	12,103	245,717	20.3	$36.56	$8,982
Total	14,997	280,033	18.7		$10,232

Notes
Values may not sum due to rounding
Levelized avoided cost based on methodology described in Appendix I
Data based on state specific reported information detailed in Appendix II

Table 9. Avoided Fuel Oil #4 Summary

State	Annual Fuel Oil Savings (MMBtu)	Lifetime Fuel Oil Savings (MMBtu)	Calculated Program Life (years)	Levelized Avoided Cost of Fuel Oil ($/MMBtu)	Avoided Cost of Fuel Oil ($000's)
	a	b	c=b÷a	D	e=b*d
Connecticut					
Delaware					
Maine	13,767	206,501	11.8	$19.98	$4,126
Maryland					
Massachusetts	-555	-6,576	11.8	$19.98	($131)
New Hampshire					
New Jersey					
New York					
Rhode Island					
Vermont					
Total	13,211	199,926	15.1		$3,995

Notes
Values may not sum due to rounding
Massachusetts programs result in increased fuel oil usage
Levelized avoided cost based on methodology described in Appendix I
Data based on state specific reported information detailed in Appendix II

C. Demand Reduction Induced Price Effect (DRIPE)

Energy efficiency programs provide market price benefits that affect everyone, whether they are a program participant or not. The basic concept behind these benefits is that energy market prices increase with demand, so that a reduction in demand reduces the market price. Or, in other words, as demand for electricity decreases due to energy efficiency, electricity prices should decrease since higher-cost generators are no longer needed. Some markets are global in extent; consequently, a regional demand reduction will have a negligible impact on prices. However, for some energy resources, especially electricity and perhaps to some extent natural gas, a modest demand reduction will appreciably reduce the market price. This can be seen clearly, for instance, if one looks at trends in hourly electricity demand and the wholesale market electricity price.

Such overall effects in both the energy and capacity markets are generally known as price suppression effects, or Demand-Reduction-Induced Price Effects (DRIPE). The 2011 AESC study discusses these in some detail in Chapter 6, and we will only briefly summarize those findings here. DRIPE effects are very small when expressed as a fraction of the market price, but are significant in terms of total cost impact. The effects will dissipate over time, but the length of the timeframe depends on a variety of factors, including the overall growth in demand and the associated addition and retirement of resources.

In Table 6-34 of the 2011 AESC report the energy DRIPE is presented as a multiple of the energy price in-state and for the remainder of New England.[47] For example, in Massachusetts the annual on-peak factor is 0.69. This means that, for energy savings in Massachusetts, there is a DRIPE effect equivalent to 69 percent of full market price. Thus the customer reducing their load will reap the direct savings, and all other Massachusetts customers will receive an equivalent savings as a side effect. The equivalent coefficient for the customers in the other New England states is 0.71, so their savings will be about the same as Massachusetts's. Coefficients for off-peak periods are higher for intrastate and lower for the rest of the region. Overall, the annual coefficients by state and period range from 0.09 to 1.15. For our present purposes, we use an average coefficient of 0.50 for this effect.

Also, since the effects are likely to dissipate over the life of the measure savings, we further halve this effect to 0.25. We expect the dissipation of this price effect to occur, since over some period of time suppliers of electricity will respond to the new market demand for electricity, thereby reaching some new equilibrium for the price of electricity. How long this dissipation effect lasts is open to debate; nevertheless, we suggest that DRIPE savings add an additional 25% to the direct energy savings associated with energy efficiency programs.

[47] Hornby et al. Avoided Energy Supply Costs in New England: 2009 Report. October 23, 2009, page 6-52. Available at http://www.synapse-energy.com/Downloads/SynapseReport.2009-10.AESC.AESC-Study-2009.09-020-Appendices.pdf

Appendix II: Data on RGGI Funding of Efficiency Programs

In preparing this updated report, we found that the availability of information on RGGI-funded energy efficiency programs has improved since our last report.[48] In Delaware, Maryland, New Jersey, New York, Maine, and New Hampshire, there is a distinction between programs funded through RGGI and other ratepayer-funded programs. As in the previous report, we did not attempt to evaluate or codify reporting requirements across states; we simply tried to collect available and consistent information where possible.

A. State Specific Details

State specific details on data sources are presented below.

Connecticut

Connecticut program and savings information was taken from the Connecticut Energy Efficiency Fund 2010 Program report.[49]

Delaware

Our estimate for Delaware savings and benefit reflect planned spending for 2011 and ramp-up of programs in 2010. Savings data specific to 2010 were not available, reflecting the ramp of Delaware's energy efficiency programs.

Delaware uses its RGGI proceeds to fund energy efficiency programs through the Sustainable Energy Utility (SEU). Approximately 65% of the Delaware RGGI proceeds fund the SEU.[50]We extrapolated annualized electricity and fuel savings based on cumulative values through June 30, 2011 from SEU press release. We cross referenced calculated annualized savings for SEU programs with planned SEU savings presented in the Delmarva Light and Power Company 2010 Integrated Resource Plan.[51] Estimated RGGI-funded amounts were based on annualized amounts from SEU financial statements through May 31, 2011.[52]

---

[48]As a reminder, we note that, in many cases, the RGGI-funded energy efficiency programs are distinct from ratepayer-funded programs, where information is more readily available.

[49]Energy Conservation Management Board. Year 2009 Programs and Operations. March 1, 2010. Available at http://www.ctsavesenergy.org/files/Final%202009%20Legislative%20Report%202.19.10.pdf.

[50]Delaware Division of Energy and Climate. State of Delaware Energy Efficiency Resource Standards Workgroup Report. June 2011. Available at http://www.dnrec.delaware.gov/energy/information/Documents/EERS/Final%20EERS%20Workgroup%20Report.pdf.

[51]Delmarva Power and Light Company. 2010 Integrated Resource Plan. Filed December 1, 2010.

[52]Sustainable Energy Utility, Inc. Financial Statements and Accountants' Compilation Report. May 31, 2011. Available at http://www.energizedelaware.org/sustainable-energy-utility/oversight-board/reports/financial-reports.

Maine

Maine program and savings information was taken from the Efficiency Maine 2010 Annual RGGI Program report to the Maine State Legislature.[53] We collected additional program information from Efficiency Maine's 2010 Annual Report.[54]Detailed information on Maine's large C&1 program funding provided by Efficiency Maine.

Maryland

For Maryland, we collected budget and saving information from the Maryland Strategic Energy Investment Fund (SEIF) 2009/2010 Accomplishment report.[55]

Massachusetts

Massachusetts data was taken from electric program administrator funded programs that received RGGI proceeds.[56]Program savings were taken from 1) the 2010 Report of the Massachusetts Energy Efficiency Advisory Council for 2010 savings data for electric and gas programs, and 2) annual reports filed by Massachusetts program administrators.[57]

New Hampshire

New Hampshire uses its proceeds to fund projects through a Request for Proposal (RFP) process administered through the New Hampshire Public Utilities Commission in its Greenhouse Gas Emissions Reduction Fund (GHGERF). CO_2 savings were taken from the 2010 evaluation report.[58]

New Jersey

In February 2010, Governor Christie used $65 million from New Jersey's RGGI proceeds to meet budget shortfalls within the state.[59] As a result, New Jersey's use of its RGGI proceeds has been limited to the New Jersey Clean Energy Solutions Capital Investment Loan/Grant Program (CESCI) administered through the New Jersey Economic Development Authority.[60]New Jersey has allocated funding for ten clean energy projects (seven solar photovoltaic projects and three combined heat and power projects) for a combined total of $36.8 million.

---

[53]Efficiency Maine. Regional Greenhouse Gas Initiative Annual Report. Available at http://www.rggi.org/docs/2011_DEP_Efficiency_Maine_Annual_RGGI_Report.pdf.
[54]Efficiency Maine.2010 Annual Report. Available at http://www.efficiencymaine.com/docs/reports/EMO16444_AnnualReport_2010.pdf.
[55]Information available at http://energy.maryland.gov/documents/FY09andFY10SEIFAccomplishmentsbook.pdf.
[56]http://www.mass.gov/?pageID=eoeeasubtopic&L=3&L0=Home&L1=Energy,+Utilities+%26+Clean+Technologies&L2=Energy+Efficiency&sid=Eoeea.
http://www.mass.gov/?pageID=eoeeamodulechunk&L=3&L0=Home&L1=Air,+Water+%26+Climate+Change&L2=Climate+Change&sid=Eoeea&b=terminalcontent&f=doer_rggi_rggi-auction-proceeds&csid=Eoeea.
[57]Efficiency as Our First Fuel: Strategic Investments in Massachusetts' Energy Future. Available at: http://www.mass.gov/Eoeea/docs/doer/Energy_Efficiency/eeac-2010-report-ee-advisory-council.pdf.
[58]Clean Energy Solutions New England. "The New Hampshire Greenhouse Gas Emission Reduction Fund Year 1 (July 2009-June 2010) Evaluation." University of New Hampshire. Available at: http://www.carbonsolutionsne.org/resources/reports/pdf/GHGERF_Year1_Report_Final.pdf.
[59]http://www.newjerseynewsroom.com/science-updates/christie-cutting-65-million-for-global-warming-prevention.
[60]http://www.rggi.org/rggi_benefits/program_investments/New_Jersey.

New York

In our analysis, we have taken the New York Operating Plan budget from April 2011 as the basis of our savings for New York.[61]In our 2010 report, we use the 2009 planned budget that included proceeds that were eventually diverted to the Con Edison Smart Grid Program and Deficit Reduction Plan Transfer.[62]

Our analysis includes the $14.9 million spent by New York; it does not include the $121.8 million of contract commitments reported by NYSERDA.

Rhode Island

Data for Rhode Island are based upon National Grid's 2010 Demand Side Management program report, since their energy efficiency programs serve virtually all of the state and also receive RGGI funding.[63]Under the Rhode Island Office of Energy Resources rules, National Grid is expected to receive at least 60% of RGGI funding.[64]

Vermont

Vermont allocates RGGI proceeds to fund expanded fuel efficiency programs for low-income residential customers.[65] In 2010 these programs were administered by Efficiency Vermont.[66]

B. Participant Costs

In evaluating the benefits of RGGI funded energy efficiency programs, we have focused on program costs as reported by individual states. Generally, these costs exclude participant costs and include program incentives in the program costs. Evaluating energy efficiency programs using the Total Resource or Societal Test requires the inclusion of participant costs. For programs that include such information we have provided the following summary Table.

[61]NYSERDA. Operating Plan for Investments in New York under the CO2 Budget Trading Program and the CO2 Allowance Auction Program. April 16, 2009.
http://www.nyserda.org/RGGI/Files/Final%202009-2011%20RGGI%20Operating%20Plan.pdf

[62] The two diversions amounted to $97.7 million.

[63]In 2010$. Values in this report are in 2011$. The 2010 report is available at http://www.synapse-energy.com/Downloads/SynapseReport.2010-10.RAP.EE-Benefits-of-RGGI-Proceeds.10-027.pdf

[64]2009 Plan for the Allocation and Distribution of Regional Greenhouse Gas Initiative Auction Proceeds, State of Rhode Island and Providence Plantations Office of Energy Resources. Dated September 30, 2009.
http://sos.ri.gov/documents/archives/regdocs/released/pdf/OER/5617.pdf

[65]http://www.rggi.org/states/program_investments/Vermont

[66]In 2010, Efficiency Vermont will administer 100% of the funding for fuel efficiency programs.

Table 10. Program Cost and Participant Cost

State	Total Program Cost (000's)	Total Participant Cost (000's)	RGGI Funding Portion of Program Costs
Connecticut	$162,241	Not Available	8%
Delaware	$9,678	Not Available	39%
Maine	$16,988	$18,965	67%
Maryland	$21,464	Not Available	100%
Massachusetts	$235,885	$78,178	11%
New Hampshire	$17,661	Not Available	100%
New Jersey	$36,800	Not Available	100%
New York	$14,900	Not Available	100%
Rhode Island	$30,249	$12,895	15%
Vermont	$2,425	$3,288	100%

Notes
Delaware based on Synapse estimate
Maine uses $5.5 million of RGGI proceeds to fund industrial grants that are not part of Efficiency Maine's ratepayer funded programs.

Table 11. Net CO_2 Mitigation Costs of RGGI-Funded Energy Efficiency Programs Including Available Participant Cost Data

State	Lifetime CO2 Savings (tons)	Net RGGI Cost of Programs ($000's)	Net Cost of CO2 Reductions (Energy) ($/tons)	Participant Costs ($000's)	Total Cost of CO2 Reductions (Energy) ($/tons)
	a	b	c=b÷a	d	e=(b+d)/a
Connecticut	166,036	-$13,688	-$82.44	NA	
Delaware	93,581	-$5,707	-$60.98	NA	
Maine	968,957	-$49,453	-$51.04	$18,965	**-$31.47**
Maryland	331,305	-$44,729	-$135.01	NA	
Massachusetts	432,437	-$36,914	-$85.36	$78,178	**$95.42**
New Hampshire	199,920	-$16,441	-$82.24	NA	
New Jersey	1,903,720	-$10,033	-$5.27	NA	
New York	131,456	-$9,411	-$71.59	NA	
Rhode Island	97,688	-$6,488	-$66.41	$12,895	**$65.59**
Vermont	40,082	-$14,049	-$350.52	$3,288	**-$268.48**
Total (weighted average)	**4,365,183**	**-$206,914**	**-$47.40**		

Notes
Values in 2011$, and detailed calculations shown in Table 4
Values may not sum due to rounding
Levelized avoided cost based on methodology described in Appendix I
Data based on state specific reported information detailed in Appendix II; Participant cost data not reported for most states