Historical Data Considerations of the Regional Greenhouse Gas Initiative and Implications for Going Forward
Environmental Energy Alliance of New York June 1, 2016

The Environmental Energy Alliance of New York (Alliance) appreciates the need for a RGGI program review, and the ongoing efforts to examine critical design elements of the program. RGGI has been successful in reducing emissions from the power sector, and the states are interested in broadening participation (particularly given the delays in implementing a national program). The Alliance has prepared the following to further these efforts. The purpose of this paper is to analyze the emission reductions that have occurred to date, determine if similar opportunities may exist going forward, and to highlight areas of concern that should be considered as RGGI goes through its programmatic review.

There are many New York initiatives and other programs under development, particularly Reforming the Energy Vision (REV) and the Clean Energy Standard (CES), that have significant implications to RGGI with respect to emissions reductions and energy costs. We encourage RGGI representatives to fully evaluate/model the emissions targets and costs before any final program changes are endorsed. Specifically for the CES, we support a model run absent the upstate nuclear facilities in the event the owners' current decision to close those facilities becomes fact. Consider also a sensitivity analysis that includes delayed implementation of the CES, because a less aggressive ramp rate for renewables than proposed will have emissions and generation impacts for RGGI particularly in the earlier years.

Among the many RGGI program design elements under discussion as part of the ongoing program review are the possible need to lower the cap and to eliminate the flexibility afforded to sources by the cost containment reserve (CCR). Regarding the emissions cap, we and others have studied what actions are responsible for the historical emissions reductions to date. If emissions reductions do not continue at a similar rate, then the availability of allowances could be an issue, particularly with respect to who holds the allowances and how that might affect price.

RGGI CO_2 emission reductions have indeed been greater than expected and it is instructive to review why the reductions occurred to determine if these reduction rates are likely to continue. In addition, the share of compliance entity to non-compliance entity banked allowances has historically put no pressure on allowance prices. However, the non-compliance entity share of the allowance bank has been increasing which could exert pressure on prices. The Congressional Research Service (CRS) report on RGGI[1] notes the lack of price pressures on allowances early in the program suggests the cap had little effect. It concludes that now that the cap has adjusted downward we are effectively operating under a new program.

In the following sections we summarize the observed emission reductions in the RGGI region and the New York only emission reductions. Following that is an analysis of the compliance entity to non-

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[1] Ramseur, Jonathan L., April 27, 2016: *The Regional Greenhouse Gas Initiative: Lessons Learned and Issues for Congress,* Congressional Research Service**, 7-5700, R41836, The Regional Greenhouse Gas Initiative: Lessons Learned and Issues for Congress.

compliance entity allowance holdings. Finally there is a summary of the results and implications that demonstrates that the history to date of RGGI should be no guide to the future.

RGGI Emission Reductions

The April 29 2016 RGGI stakeholder presentations included a reference to the Murray and Maniloff (2015)[2] paper that includes an estimate of RGGI program emission reductions. The presentation included the conclusion that "The analysis shows that after the introduction of RGGI in 2009 the region's emissions would have been 24 percent higher without the program, accounting for about half of the region's emissions reductions during that time". The presentation further suggested that "The other half is due to recession, complementary environmental programs and lowered natural gas prices." The results in this paper are based on an econometric modelling analysis.   This prediction can be considered the upper bound emission reductions owing to the RGGI program.

The Congressional Research Service (CRS) report describes the history of RGGI emissions and allowance allocations. The author notes that:

> Although actual emissions were ultimately well below the original emissions cap, the cap's existence attached a price to the regulated entities' CO_2 emissions. Because the cap level was above actual emissions, the allowance price acted like an emissions fee or carbon tax. Although the cap likely had limited *direct* impact on the region's power plant emissions, the revenues generated from the emission allowance sales likely had some impact on emission levels in the region.

However, there was no attempt to quantify the emissions impact.

Given this background provided by the CRS report, we used data from EPA's CAMD Data and Maps website to look at the changes in CO_2 emissions in the RGGI states by fuel type. This analysis does not attempt to reconcile differences between RGGI and all the other programs in this database. Annual data were downloaded for the years 2006-2015 for the RGGI states for all programs. Non-RRGI affected units are included and some of the included units report only six months of the year so this is not an exact analysis. Nonetheless, these data can give us an idea of how RGGI emissions were reduced.

For this analysis (Table 1) the 2006-2008 data were averaged to establish a pre-RGGI baseline and the total and fuel-type specific annual emissions were subtracted from the baseline to get the reductions during the RGGI program. For the facilities in this dataset in 2015 there has been a 41 million ton reduction from the 127 million ton baseline or a 32% reduction. Note that coal and residual oil emissions dropped 57 million tons from the baseline of 85 million tons or 67%. Natural gas emissions increased 15 million tons and other solids (mostly wood) increased1.3 million tons. Over the same time period gross loads and steam load declined 23% and 58%, respectively.

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[2] Murray, Brian C., Maniloff, Peter T., Why Have Greenhouse Emissions in RGGI States Declined? An Econometric Attribution to Economic, Energy Market, and Policy Factors, *Energy Economics* (2015), doi: 10.1016/j.eneco.2015.07.013

The RGGI "Investment of RGGI Proceeds Through 2013"[3] report states that "Over their lifetime, these RGGI investments are projected to save more than 48.7 million mmBtu of fossil fuels and 11.5 million MWh of electricity, avoiding the release of approximately 10 million short tons of carbon pollution". In 2013 RGGI CO_2 emissions were 89,115,811 tons of CO_2 so based on this RGGI report were it not for RGGI there would have been 10 million more tons of CO_2 emitted so total emissions would have been 99,115,811 tons so the difference from the baseline is 28,178,600 tons (Table 2). We calculated the percentage difference with and without the program to compare with results from the Murray and Maniloff paper. That calculation estimates that emissions would have only been 11% higher than without the program according to the RGGI estimate of investment impacts.

The lower bound for RGGI program CO_2 emissions reductions during this period can also be estimated. It can be argued that the coal and residual oil emissions were lower due solely to the changes in cost differences relative to natural gas and additional regulations and compliance pressure for NOx, Hg, and (in New York) opacity. This assumes that RGGI compliance is incorporated into the bid price and so was not a driver in facility decisions. Making those assumptions then means that the CO_2 reductions directly due to RGGI should be the savings of 48.7 million mmBtu of natural gas specifically and the natural gas emission factor for CO_2 should be used for CO_2 displacement. Table 3 lists this calculated value, 2,848,950 tons. This calculation shows that emissions would have been only 3% higher than without the program.

New York Emission Reductions
Table 4 provides CO_2 emission reductions for New York only. For the facilities in this dataset in 2015 there was a 13.5 million ton reduction (29%) from the 46.8 million ton baseline. Note that coal and residual oil emissions dropped 23.1 million tons (80%) from the baseline of 28.9 million tons Natural gas emissions increased 10.9 million tons. Over the same time period gross loads and steam load were 18% and 39% lower, respectively.

Because of our expertise in New York we can explicitly consider factors affecting particular facilities. Consider, for example, the coal-fired RG&E Russel station which operated from 2006-2008 (emitting ~ one million tons of CO2) and retired before 2009. Without investments in pollution control equipment for particulates, Hg and NOx the facility could not operate and meet emission compliance requirements. Therefore, none of the observed reductions should be ascribed to RGGI. At the other end of the spectrum for New York coal facilities is Huntley. This facility retired completely in early 2016 even though investments were made in pollution controls to meet the opacity, Hg and NOx limits. Despite those investments the facility closed as a result of operating costs, as coal is not currently competitive with gas. The erosion of load due to the recession and loss of manufacturing higher load requirements also played a factor. This is the same problem that is causing viability issues with the Upstate NY nuclear units. Given the range of factors affecting these coal units we can assume that New York coal retirements and operating reductions are more likely due to factors other than the RGGI program.

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[3] Investment of RGGI Proceeds Through 2013, Published April 2015 by RGGI Investment of RGGI Proceeds: Full Report.

Residual oil-fired units are similarly constrained by fuel price differential and, to a lesser extent, additional compliance requirements. However, it appears that capacity payments and the ability to co-fire natural gas at some facilities are sufficient to maintain the viability of New York's residual oil units because none of them have retired. Oil-fired unit emissions dropped 56% despite no loss of units. Importantly, in order to remain in compliance with minimum operating constraints imposed by the New York Independent System Operator, any significant lowering of emissions below a total of three million tons of year is unlikely.

The *2015 RGGI Operating Plan*[4] provides estimates of CO_2 emission reduction benefits of New York's RGGI investments.   This report notes that over the lifetime of these investments, there will be savings of more than 33.6 million mmBtu of fossil fuels avoiding the release of approximately 3.4 million short tons of CO_2. In 2014 NY CO_2 emissions were 34,692,213 tons of CO_2 so based on this report were it not for RGGI there would have been 3.4 million more tons of CO_2 emitted; total emissions would have been 37,445,220 tons so the difference from the baseline is 9,332,156 tons (Table 5). In order to compare with the claim from the Murray and Maniloff paper we need to calculate the percentage difference with and without the program. That calculation estimates that emissions would have only been 8% higher without the program according to the RGGI estimate of investment impacts.

The lower bound for RGGI-caused CO_2 emissions reductions during this period can also be estimated. We again assume the coal and residual oil emissions declined due solely to the changes in cost differences relative to natural gas and additional regulations and compliance pressure for NOx, Hg, and opacity. We also assume RGGI compliance is incorporated into the bid price and not a driver in facility decisions. Making those assumptions then means that the CO_2 reductions directly due to RGGI should be the savings of 33.6 million mmBtu of natural gas specifically and the natural gas emission factor for CO_2 should be used for CO_2 displacement. Table 6 lists this calculated value, 1,965,600 tons. This calculation shows that emissions would have been only 4% higher than without the program.

Allowance Bank Holdings
In cap and auction programs that distribute the allowances directly to compliance entities the allowance market consists primarily of surplus allowances from compliance entities that do not need them for compliance. In the RGGI auction scheme allowances are available to anyone willing to purchase them. In the worst case non-compliance entities could purchase all the allowances in the auctions then charge affected sources above market prices. That has not happened and is unlikely to happen in the future. Importantly we have no data to indicate what level of non-compliance entity holdings would adversely affect the market. Note, however that there are other factors in play that could change the historical ratio of compliance to non-compliance allowance holdings. We reviewed two RGGI market monitoring

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[4] New York's Regional Greenhouse Gas Initiative Investment Plan *2015 Operating Plan,* Prepared by: New York State Energy Research and Development Authority, Albany, NY, September 2015
http://www.nyserda.ny.gov/About/Regional-Greenhouse-Gas-Initiative/Auction-Proceeds

reports to determine if the compliance entity share of the total allowances is decreasing over time because compliance entities are using their allowances more quickly than non-compliance entities due to allowance surrenders for compliance.

There are two ways to determine the trend of compliance entity allowance holdings. The first is to use the market auction reports (https://www.rggi.org/market/market_monitor).   Table 7 summarizes market monitor data from reports since Auction 14. The last column, compliance entity allowance holdings, lists the percentage of allowances held by compliance entities. The Auction 14 market monitor report (12/9/2011) for the last auction of the first compliance period states: "Compliance entities and their affiliates will hold 97 percent of the allowances in circulation following the settlement of allowances sold in Auction 14." The most recent auction market monitor report (3/9/2016) states: "After settlement of allowances sold in Auction 31, 50 percent of the allowances in circulation will be held by firms that are believed to hold them for compliance purposes." Clearly the trend is to a smaller proportion of allowances for compliance entities. However, this approach does not quantify the number of allowances available to compliance entities.

The second way is to use the quarterly *Secondary Market Reports on the CO_2 Allowance Market* that lists the market monitor's assessment of the allowances in circulation at the end of the quarter and the number held by compliance-oriented entities. This report does not include a table of historical data and the information available has changed with time. In the first quarter of 2012 this report estimated that compliance-oriented entities held 98% of the allowances available but did not include an estimate of the total number of allowances in circulation. The first quarter of 2013 report is the first report that also included the allowances in circulation so we can estimate how many allowances are held by compliance entities. At that time there were 200 million allowances in circulation and 180 million were held by compliance entities. After this quarterly report the share of allowances held by compliance entities has been dropping. After the allowance reconciliation of the second compliance period at the end of 2014, the first quarter of 2015 indicated that the share of allowances held by compliance entities dropped to 62% and the number of allowances to 95 million.

One of the problems with trying to develop this trend report is that the categories may have changed. Nonetheless, the latest quarterly report makes our point. At the end of the first quarter of 2016 and after the 2015 Interim Control Period Compliance deadline and the sale of allowances in Auction 31 Compliance-oriented entities held approximately 79 million of the allowances in circulation (43 percent). This report also notes that approximately 95 million of the allowances in circulation (51 percent) are believed to be held for compliance purposes. Whichever value is appropriately used to compare to previous reports the percentage of compliance entity holdings is going down.

This analysis does confirm that the compliance entity share of the total allowances in circulation decreases over time. It is not clear how this report treated the interim compliance period adjustment but if you assume that they withdrew 50% of the 2015 emissions then compliance entities currently hold approximately 79 million allowances of the 186 million allowances in circulation. When the

remaining 50% of the allowances needed to cover the 84.8 million tons emitted in 2015 are subtracted from the compliance entity holdings they are left with only 37 million tons.

The intent of the control period interim adjustments was to draw down the allowance bank and coupled with the 2.5% reduction in annual allowances available, RGGI will have a constrained market. In 2015, the CO2 allowance budget was 88,725,000, but after the interim control period adjustments and various set-asides reduced allowances and the CCR added allowances the final total was 74,580,709 allowances. RGGI emissions were 84,818,235, a difference of 10,237,526 tons. This means that 12% of the 2015 emissions have to be covered by the allowance bank. The consequence of these adjustments is that the share of allowances owned by compliance entities is getting smaller faster because they are using their allowances to make up for the interim adjustment shortfall.

Summary

Emission History
Our analysis shows that the region's CO_2 emissions would have been somewhere between 24 percent and 3 percent higher without the RGGI program. The Alliance believes that in New York the impact of RGGI is much closer to the bottom of the range than the top.

Importantly, regardless of which estimate is correct, there is no question that the future will be different. The CO_2 emission history for RGGI and New York both indicate that the future reductions will be more difficult than in the past. As the CRS report[5] notes:

> The revised cap took effect in January 2014. RGGI's new, more-binding cap may have vastly different effects than its predecessor. It is uncertain how this new development may impact electricity use and prices in the RGGI region and, in turn, the perception and support for the program.

The fuel price differential between lower carbon emitting natural gas and coal or residual oil was the primary driver of emission reductions. Most of those reductions have already been made so this naturally cost-effective emission reduction method will not be available in the future. Note that facility energy efficiency programs could reduce CO_2 emissions but because fuel costs have always been a primary driver of production costs it is unlikely that many more cost-effective efficiencies are available.

As a result, future reductions will have to be driven by RGGI investments. RGGI Inc. indicates that those investments were responsible for "approximately 10 million tons of reductions" over five years or two millions tons of reductions per year of investments. NYSERDA claims investments have resulted in avoiding the release of approximately 3.4 million tons of CO_2 over six years or 567,000 tons per year. For the RGGI states a 2.5% reduction per year requires lowering CO_2 emissions by 2,157,739 tons per year

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[5] Ramseur, Jonathan L., April 27, 2016: *The Regional Greenhouse Gas Initiative: Lessons Learned and Issues for Congress,* Congressional Research Service**,** 7-5700, R41836, The Regional Greenhouse Gas Initiative: Lessons Learned and Issues for Congress.

from the 2015 emission level and in New York a 2.5% reduction per year requires lowering CO_2 emissions by 831,132 tons per year from 2015 levels.

Compliance Entity Share of Available Allowances

The electric generating unit industry concern with non-compliance entity holdings is the possibility of market control. For the most part EGUs only purchase what they need when they will need it with only a small margin (typically 5%) for compliance. In the event that auction allowances are insufficient to provide what they need based on projected emissions they will have to go to the secondary market to get the allowances needed for compliance.

It does not require any collusion at all for the non-compliance entities to realize that simply by holding their existing allowances that eventually the compliance entities are going to have to approach them for allowances or alter their generation plans. As a result, the cost containment reserve becomes a critical tool to prevent market manipulation. Even with the addition of the CCR allowances the compliance entity share of the total allowance bank is going down by around ten million tons per year. These data suggest that the future success of RGGI may be more dependent on flexibility mechanisms such as the CCR.

Table 1: RGGI State CO$_2$ Emission Reductions

RGGI States, Annual Totals, All Program Units: CO$_2$ Mass, Gross Load and Steam Load by Primary Fuel Type

Year	Total	CO$_2$ Mass (Short Tons) Coal	Other Solid	Residual Oil	Other Oil	Natural Gas	Other Gas	Load (MWh)	Steam (1000 lb)
2006	128,402,332	74,482,225	445,565	12,977,610	1,984,279	38,288,295	224,357	178,593,586	98,661,029
2007	133,903,150	75,223,761	1,001,373	14,177,045	2,480,820	40,871,862	148,289	188,533,942	95,382,948
2008	119,577,750	67,977,062	1,428,256	9,709,910	2,104,278	38,215,109	143,136	166,139,460	92,777,237
2009	108,487,823	57,324,247	1,164,165	6,879,835	1,834,159	41,141,370	144,047	147,434,248	69,305,382
2010	118,444,437	59,736,642	1,054,168	8,385,012	1,557,561	47,691,093	19,961	161,111,800	62,316,413
2011	104,844,759	43,871,136	855,087	5,175,109	1,504,451	52,381,671	1,057,306	154,295,324	47,356,683
2012	95,595,473	29,096,542	1,105,357	6,575,331	1,905,569	56,069,189	843,485	152,426,369	43,017,645
2013	89,115,811	31,759,050	1,171,191	4,915,312	1,599,335	49,499,432	171,491	138,186,304	43,737,027
2014	89,553,622	31,060,039	2,039,574	4,858,765	1,394,087	49,980,173	220,984	136,051,149	41,706,830
2015	86,309,540	23,279,018	2,253,858	4,972,163	1,335,180	54,283,220	186,101	136,088,543	40,053,785

RGGI States, Annual Totals, All Program Units: Parameter Changes from 2006-2008 Baseline

Year	Total	CO$_2$ Mass (Short Tons) Coal	Other Solid	Residual Oil	Other Oil	Natural Gas	Other Gas	Load (MWh)	Steam (1000 lb)
Base	127,294,411	72,561,016	958,398	12,288,188	2,189,792	39,125,089	171,927	177,755,662	95,607,071
2009	-18,806,587	-15,236,769	205,767	-5,408,353	-355,633	2,016,281	-27,880	-30,321,414	-26,301,690
2010	-8,849,974	-12,824,374	95,770	-3,903,177	-632,231	8,566,004	-151,966	-16,643,863	-33,290,658
2011	-22,449,651	-28,689,880	-103,311	-7,113,080	-685,341	13,256,583	885,378	-23,460,338	-48,250,389
2012	-31,698,937	-43,464,474	146,959	-5,712,857	-284,223	16,944,100	671,558	-25,329,293	-52,589,427
2013	-38,178,600	-40,801,966	212,793	-7,372,877	-590,458	10,374,344	-436	-39,569,358	-51,870,044
2014	-37,740,789	-41,500,977	1,081,176	-7,429,423	-795,705	10,855,084	49,056	-41,704,513	-53,900,241
2015	-40,984,871	-49,281,998	1,295,460	-7,316,025	-854,612	15,158,131	14,174	-41,667,120	-55,553,286

RGGI States, Annual Totals, All Program Units: CO$_2$ % Changes from 2006-2008 Baseline

Year	Total	Coal	Other Solid	Residual Oil	Other Oil	Natural Gas	Other Gas	Load	Steam
2009	-15%	-21%	21%	-44%	-16%	5%	-16%	-17%	-28%
2010	-7%	-18%	10%	-32%	-29%	22%	-88%	-9%	-35%
2011	-18%	-40%	-11%	-58%	-31%	34%	515%	-13%	-50%
2012	-25%	-60%	15%	-46%	-13%	43%	391%	-14%	-55%
2013	-30%	-56%	22%	-60%	-27%	27%	0%	-22%	-54%
2014	-30%	-57%	113%	-60%	-36%	28%	29%	-23%	-56%
2015	-32%	-68%	135%	-60%	-39%	39%	8%	-23%	-58%

Table 2: Estimates of CO$_2$ Emissions with and without RGGI Using RGGI Emission rate

Year		Total	CO$_2$ Mass (Short Tons)						Load	Steam
			Coal	Other Solid	Residual Oil	Other Oil	Natural Gas	Other Gas	(MWh)	(1000 lb)
	Baseline	127,294,411	72,561,016	958,398	12,288,188	2,189,792	39,125,089	171,927	177,755,662	95,607,071
2013	w/RGGI	89,115,811	31,759,050	1,171,191	4,915,312	1,599,335	49,499,432	171,491	138,186,304	43,737,027
2013	RGGI Delta						10,000,000		11,500,000	
2013	w/o RGGI	99,115,811	31,759,050	1,171,191	4,915,312	1,599,335	59,499,432	171,491	149,686,304	43,737,027
2013	Delta	-28,178,600	-40,801,966	212,793	-7,372,877	-590,458	20,374,344	-436	-28,069,358	-51,870,044
2015	w/RGGI	86,309,540	23,279,018	2,253,858	4,972,163	1,335,180	54,283,220	186,101	136,088,543	40,053,785
Rate	RGGI Rate						2,000,000		2,300,000	
2015	RGGI Delta						14,000,000		16,100,000	
2015	w/o RGGI	100,309,540	23,279,018	2,253,858	4,972,163	1,335,180	68,283,220	186,101	152,188,543	40,053,785
2015	Delta	-26,984,871	-49,281,998	1,295,460	-7,316,025	-854,612	29,158,131	14,174	-25,567,120	-55,553,286

RGGI states that "Over their lifetime, these RGGI investments are projected to save more than 48.7 million mmBtu of fossil fuels and 11.5 million MWh of electricity, avoiding the release of approximately 10 million short tons of carbon pollution". The baseline data are the average of 2006-2008. The 2013 RGGI delta row lists that data and the w/o RGGI row incorporates those values in the totals. In order to estimate 2015 values it was assumed that additional reductions in 2014 and 2015 would equal the rate of reductions achieved by RGGI in the first five years of the program. The delta row is the change from the baseline.

Table 3: Estimates of CO$_2$ Emissions with and without RGGI Using Natural Gas Emission Factor for CO$_2$ Reductions

Year		Total	CO$_2$ Mass (Short Tons)						Load	Steam
			Coal	Other Solid	Residual Oil	Other Oil	Natural Gas	Other Gas	(MWh)	(1000 lb)
2013	w/RGGI	89,115,811	31,759,050	1,171,191	4,915,312	1,599,335	49,499,432	171,491	138,186,304	43,737,027
2013	RGGI Delta						2,848,950		11,500,000	
2013	w/o RGGI	91,964,761	31,759,050	1,171,191	4,915,312	1,599,335	52,348,382	171,491	149,686,304	43,737,027
2013	Delta	-35,329,650	-40,801,966	212,793	-7,372,877	-590,458	13,223,294	-436	-28,069,358	-51,870,044
2015	w/RGGI	86,309,540	23,279,018	2,253,858	4,972,163	1,335,180	54,283,220	186,101	136,088,543	40,053,785
Rate	RGGI Rate						569,790		2,300,000	
2015	RGGI Delta						3,988,530		16,100,000	
2015	w/o RGGI	90,298,070	23,279,018	2,253,858	4,972,163	1,335,180	58,271,750	186,101	152,188,543	40,053,785
2015	Delta	-36,996,341	-49,281,998	1,295,460	-7,316,025	-854,612	19,146,661	14,174	-25,567,120	-55,553,286

These estimates are the same as Table 2 except that it is assumed that all the RGGI induced reduction in load affects only natural gas emissions because the coal and residual oil price differential with natural gas and other environmental regulations caused the fuel switches away from those fuels instead of RGGI. The EIA CO$_2$ emission factor for natural gas of 117 lbs CO$_2$ per mmBtu was used with the 48.7 million mmBtu RGGI reduction estimate. The delta row is the change from the baseline which is the same as Table 2.

Table 4: New York State Only CO$_2$ Emission Reductions

Year	CO2	CO$_2$ tons per primary fuel type				Load (MWh)	Steam Load (1000 lb)
		Coal	Residual Oil	Other Oil	Natural Gas		
2006	47,912,271	22,183,541	8,709,203	1,649,917	15,369,610	74,112,212	50,139,655
2007	49,575,411	21,630,223	8,748,343	1,921,077	17,021,092	77,850,741	48,344,919
2008	42,844,448	18,679,355	6,652,123	1,686,932	15,381,567	65,374,328	45,681,285
2009	38,295,368	13,637,433	5,104,878	1,370,850	17,973,806	57,738,755	34,460,702
2010	42,563,848	14,950,792	6,233,220	576,286	20,714,884	64,883,058	36,569,316
2011	37,445,417	10,394,280	3,880,581	306,381	22,864,174	61,275,085	30,031,312
2012	35,800,053	5,030,164	3,625,339	437,716	26,520,219	64,017,117	26,911,472
2013	33,991,141	5,129,951	3,392,926	199,768	24,679,151	59,063,066	29,257,671
2014	34,692,213	4,655,020	3,039,643	124,538	26,197,561	60,104,983	29,293,688
2015	33,245,276	2,229,725	3,524,698	108,193	26,809,082	59,369,103	29,490,634

Year	CO2	CO$_2$ tons per primary fuel type				Load (MWh)	Steam Load (1000 lb)
		Coal	Residual Oil	Other Oil	Natural Gas		
Base	46,777,377	20,831,040	8,036,556	1,752,642	15,924,090	72,445,760	48,055,286
2009	-8,482,009	-7,193,606	-2,931,678	-381,792	2,049,716	-14,707,005	-13,594,584
2010	-4,213,528	-5,880,247	-1,803,336	-1,176,356	4,790,794	-7,562,702	-11,485,971
2011	-9,331,960	-10,436,759	-4,155,975	-1,446,261	6,940,084	-11,170,676	-18,023,974
2012	-10,977,324	-15,800,876	-4,411,218	-1,314,926	10,596,130	-8,428,643	-21,143,815
2013	-12,786,235	-15,701,089	-4,643,631	-1,552,874	8,755,061	-13,382,695	-18,797,615
2014	-12,085,163	-16,176,019	-4,996,913	-1,628,104	10,273,471	-12,340,777	-18,761,598
2015	-13,532,101	-18,601,315	-4,511,858	-1,644,449	10,884,992	-13,076,657	-18,564,652

Year	CO2	Coal	Residual Oil	Other Oil	Natural Gas	Load	Steam Load
2009	-18%	-35%	-36%	-22%	13%	-20%	-28%
2010	-9%	-28%	-22%	-67%	30%	-10%	-24%
2011	-20%	-50%	-52%	-83%	44%	-15%	-38%
2012	-23%	-76%	-55%	-75%	67%	-12%	-44%
2013	-27%	-75%	-58%	-89%	55%	-18%	-39%
2014	-26%	-78%	-62%	-93%	65%	-17%	-39%
2015	-29%	-89%	-56%	-94%	68%	-18%	-39%

Table 5: Estimates of CO$_2$ Emissions with and without RGGI Using NYSERDA Emission rate

| Year | Scenario | CO2 | CO$_2$ tons per primary fuel type | | | | Load | Steam Load | Heat Input |
			Coal	Residual Oil	Other Oil	Natural Gas			
	Baseline	47,912,271	22,183,541	8,709,203	1,649,917	15,369,610	74,112,212	50,139,655	715,342,694
2014	w/RGGI	34,692,213	4,655,020	3,039,643	124,538	26,197,561	60,104,983	29,293,688	559,289,034
2014	RGGI Delta					3,428,459			33,600,000
2014	w/o RGGI	37,445,220	4,655,020	3,039,643	124,538	29,626,020	60,104,983	29,293,688	592,889,034
2014	Delta	-9,332,156	-16,176,019	-4,996,913	-1,628,104	13,701,930	-12,340,777	-18,761,598	-122,453,661

The NYSERDA 2015 Operating Plan notes that investments are anticipated to reduce CO$_2$ emissions more than 3.4 million tons and achieve nearly 33.6 million mmBtu in energy savings. The baseline data are the average of 2006-2008. The RGGI Delta row lists those values and the w/o RGGI row incorporates those values. The delta row is the change from the baseline.

Table 6: Estimates of CO$_2$ Emissions with and without RGGI Using Natural Gas Emission Factor

| Year | Scenario | CO2 | CO$_2$ tons per primary fuel type | | | | Load | Steam Load | Heat Input |
			Coal	Residual Oil	Other Oil	Natural Gas			
2014	w/RGGI	34,692,213	4,655,020	3,039,643	124,538	26,197,561	60,104,983	29,293,688	559,289,034
2014	RGGI Delta					1,965,600			33,600,000
2014	w/o RGGI	35,982,361	4,655,020	3,039,643	124,538	28,163,161	60,104,983	29,293,688	592,889,034
2014	Delta	-10,795,015	-16,176,019	-4,996,913	-1,628,104	12,239,071	-12,340,777	-18,761,598	-122,453,661

These estimates are the same as Table 5 except that it is assumed that all the RGGI induced reduction in load affects only natural gas emissions because the coal and residual oil price differential with natural gas and other environmental regulations caused the fuel switches away from those fuels instead of RGGI. The EIA CO$_2$ emission factor for natural gas of 117 lbs CO$_2$ per mmBtu was used with the 33.6 million mmBtu RGGI reduction estimate.

Table 7: Summary of Market Monitoring Reports Auctions 14-31.

Auction	Date	Number Bidders	Ratio of Bids to Supply	Allowance Prices			Compliance Entities			
				Clearing	Minimum	Maximum	Share Purchased	Share of Bids	Purchased to Date	Allowances Holdings
14	12/9/2011	38	0.63	$ 1.89	$ 1.89	$ 5.00	99%	99%	86%	97%
15	3/14/2012	20	0.62	$ 1.93	$ 1.93	$ 5.36	62%	99%	87%	90%
16	6/6/2012	24	0.57	$ 1.93	$ 1.93	$ 6.14	95%	95%	87%	90%
17	9/5/2012	22	0.65	$ 1.93	$ 1.93	$ 6.51	100%	100%	88%	92%
18	12/5/2012	29	0.53	$ 1.93	$ 1.93	$ 5.14	100%	100%	88%	94%
19	3/13/2013	43	2.2	$ 2.80	$ 1.98	$ 5.03	69%	72%	88%	90%
20	6/5/2013	47	2.1	$ 3.21	$ 1.98	$ 5.55	68%	80%	86%	86%
21	9/4/2013	42	2.0	$ 2.67	$ 1.98	$ 12.85	53%	54%	84%	82%
22	12/4/2013	49	2.7	$ 3.00	$ 1.98	$ 12.00	43%	53%	81%	77%
23	3/7/2014	45	3.1	$ 4.00	$ 2.00	$ 11.85	45%	65%	78%	74%
24	6/4/2014	43	2.9	$ 5.02	$ 2.00	$ 19.27	55%	72%	78%	77%
25	9/5/2014	43	2.5	$ 4.88	$ 2.00	$ 7.35	66%	80%	78%	80%
26	12/5/2014	50	2.5	$ 5.21	$ 2.00	$ 12.20	88%	71%	78%	81%
27	3/13/2015	45	2.8	$ 5.41	$ 2.05	$ 12.50	100%	66%	78%	62%
28	6/5/2015	48	3.1	$ 5.50	$ 2.05	$ 12.50	68%	39%	77%	55%
29	9/11/2015	51	3.4	$ 6.02	$ 2.05	$ 10.00	74%	40%	77%	55%
30	12/4/2015	51	3.0	$ 7.50	$ 2.05	$ 10.01	80%	34%	77%	55%
31	3/9/2016	46	3.5	$ 5.25	$ 2.10	$ 10.46	67%	41%	77%	50%

Table 8: Summary of Secondary Market Monitor Quarterly Reports

Quarter	Year	Allowances in Circulation Million Allowances	Compliance-Oriented Entities Million Allowances	%
1	2012			98
2	2012			90
3	2012			92
4	2012			94
1	2013	200	180	90
2	2013	239	206	86
3	2013	278	228	82
4	2013	319	255	80
1	2014	344	255	74
2	2014	364	280	77
3	2014	385	308	80
4	2014	403	326	81
1	2015	154	95	62
2	2015	169	116	69
3	2015	202	130	64
4	2015	213	136	64
1	2016	186	79	43

Attachment 1: RGGI Expected Reductions Due to Program Investments

New York's Regional Greenhouse Gas Initiative Investment Plan *2015 Operating Plan,* Prepared by:
New York State Energy Research and Development Authority, Albany, NY, September 2015
http://www.nyserda.ny.gov/About/Regional-Greenhouse-Gas-Initiative/Auction-Proceeds

Investments of RGGI proceeds into the programs listed in this Operating Plan are anticipated to result in more than 3.4 million tons of CO_2e emission reductions over the expected lifetime of the measures and practices; the equivalent of removing nearly 31,000 cars off the road each year over the lifetime of those measures.6 Specifically, the expected lifetime emission reductions would total more than 0.9 million tons of CO_2e from electricity energy efficiency savings and solar electric generation and more than 2.5 million tons of CO_2e from other fuel savings. These expected lifetime emission reductions are associated with the displacement of nearly 4.3 million barrels of crude oil.

NYSERDA Table of CO_2 emission reductions by fuel type. I cannot find the table with these numbers so that I could use the information in the analysis.

CO_2 tons	Fuel Type
58,361	Other fuels
231,212	Residual
140,779	Electric energy efficiency
435,020	Natural gas
1,800,454	Distillate oil
762,633	Renewable electric generation
3,428,459	Total

Executive Summary – Investment of RGGI Proceeds Through 2013
Investment of RGGI Proceeds Through 2013, Published April 2015 by RGGI Investment of RGGI Proceeds: Full Report.

The investment of proceeds from the Regional Greenhouse Gas Initiative (RGGI) has powered an investment of over $1 billion in the energy future of the New England and Mid-Atlantic states. This report reviews the benefits of programs funded through 2013 by RGGI proceeds, which have reduced harmful carbon dioxide (CO_2) pollution while spurring local economic growth and job creation.

Over their lifetime, these RGGI investments are projected to save more than 48.7 million mmBTU of fossil fuels and 11.5 million MWh of electricity, avoiding the release of approximately 10 million short tons of carbon pollution. As a whole, the RGGI states have reduced power sector CO_2 pollution over 40 percent since 2005, while their economies have grown 8 percent, adjusted for inflation.

RGGI programs also save consumers money and help support businesses. The investment of RGGI proceeds through 2013 is projected to return more than $2.9 billion in lifetime energy bill savings to more than 3.7 million participating households and 17,800 businesses.

RGGI states have individual discretion as to how they invest RGGI proceeds. The investments fall into four major categories:

- **Energy efficiency** makes up 57 percent of 2013 investments and 62 percent of cumulative investments. Programs funded by these investments are expected to return more than $2.3 billion in lifetime energy bill savings to 1.2 million participating households and 17,550 businesses in the region.
- **Clean and renewable energy** makes up 13 percent of 2013 investments and 8 percent of cumulative investments. RGGI investments in these technologies are expected to return more than $240 million in lifetime energy bill savings to 7,000 participating households and 250 businesses in the region.
- **Direct bill assistance** makes up 9 percent of 2013 investments and 15 percent of cumulative investments. Direct bill assistance programs have returned more than $140 million in bill savings to more than 2.4 million participating households.
- **Greenhouse gas abatement** makes up 15 percent of 2013 investments and 9 percent of cumulative investments. RGGI investments in greenhouse gas (GHG) abatement are expected to avoid the release of 310,000 short tons of harmful CO_2 pollution into the atmosphere.
- These investments, in concert with the broader energy policies in each RGGI state, have enabled the region to continue to set a national example in reducing harmful GHG pollution and improving energy efficiency.