Caiazza Comments on Third Program Review October 2023

Summary
I am most concerned about two components of the Third Program Review. There is a proposal to change the compliance period from a three-year period to annual and there are several possible allowance allocation trajectories. These comments urge caution for these proposals.

There is significant upcoming RGGI compliance uncertainty because of expected changes to the relationship between allowance availability, allowance holdings by different entities, and expected emissions. Compliance flexibility would help address these changes so switching to annual compliance is inappropriate at this time.

Fuel switching from coal and residual oil to natural gas is the primary cause of historical emission reductions but the opportunities for these fuel switching reductions are diminishing. Future reductions will depend on displacement of RGGI affected sources by wind and solar. IPM is finding that "Federal incentives for clean energy have the potential to rapidly transform the RGGI region generation mix" but recent developments suggest that this may be overly optimistic. The RGGI States should model a scenario where the renewable implementation is delayed, allowance prices increase, and the Cost Containment Reserve is employed.

The September 26 meeting observed that "Modeling shows how current state decarbonization and renewable requirements can significantly reduce emissions". There is an aspect of the Third Program Review modeling process that has not been available previously for other modeling efforts. There are two independent projections of the electricity system resources necessary to meet a zero-emission target by 2040. Comparison of those projections with the Integrated Planning Model (IPM) projections enables verification previously unavailable. Importantly, there are significant differences that suggest that it would be appropriate to reconcile the results publicly before the Third Program Review is finalized.

The IPM analysis methodology description claims affected sources "over-comply". Affected sources purchase allowances to enable compliance for current and possibly the next three-year compliance period. Because they buy allowances for near-term compliance requirements, RGGI sources do not "over-comply". It is not clear how this fundamental IPM presumption affects the results so this uncertainty should be considered before the final program review decisions are made.

Introduction
I submitted initial comment recommendations on the third program review and followed up with supplemental comments in October 2021. Those comments addressed my concerns about a "binding" allowance cap, a possible emissions trajectory to zero by 2035, and market monitoring. Since then, the observed emissions and allowances data reinforce my concerns. In the comments I submitted last April I recommended that RGGI address these issues during this program review.

I have included an addendum that describes relevant RGGI results to date. There are four key points that should be kept in mind when reading these comments Since the beginning of the program most emissions reductions have been the result of fuel switching from coal and residual oil to natural gas. In the nine states that have been in RGGI since its inception most of the coal and residual oil fuel switching opportunities have been exhausted so future emission reductions will rely on the displacement of RGGI source generation by wind and solar generation. Unfortunately, RGGI investments have not been particularly effective reducing CO2 emissions. RGGI investments are only directly responsible for 6.7% of the total observed annual reductions over the baseline to 2021 timeframe. Finally, the sum of the RGGI investments divided by the annual avoided CO2 emission reductions is $927 per ton reduced. This suggests that future auction revenue investments will have to be more effective for RGGI to support the allowance trajectories proposed.

These comments address two of the topics for public consultation raised at the September 26 meeting: annual compliance and electricity sector analysis.

Annual Compliance

I disagree with the recommendation to change the compliance period from three years to one year. The rationale given for the change does not adequately consider inevitable changes to RGGI allowance market dynamics.

The rationale states:

> Implementing full annual compliance will improve RGGI design by reducing the risk that generators will not be in compliance with RGGI. This can happen under the current system if a generator declares bankruptcy during an interim control period, or in the case of untimely state withdrawal from RGGI.
>
> Three-year control periods with interim compliance were initially implemented to provide flexibility to generators by allowing them a long window of time to acquire the necessary allowances. After consulting with the independent RGGI market monitor, the RGGI states have concluded that the benefits of implementing annual compliance outweigh any loss of flexibility. Other flexibility mechanisms in RGGI design include the ability to acquire and bank allowances on the secondary market, and the cost containment reserve and emissions containment reserve.

The only benefit claim is that the “full annual compliance will improve RGGI design by reducing the risk that generators will not be in compliance with RGGI”. However, the interim control period was added to protect against this concern. It is not clear that this is still a significant issue.

The rationale does not document the ramifications of non-compliance. The ostensible purpose of RGGI CO2 emission reductions is to reduce the impact of global warming. In order to determine the impact of non-compliance it is necessary to consider RGGI emissions relative to global emissions.

The Global Energy Monitor mission is "to develop and share information in support of the worldwide movement for clean energy". As part of their mission, they have prepared a spreadsheet with data on all coal-fired power plants in the world. Table 1 is based on that data. It lists capacity and projected annual CO2 emissions for three categories of power plants: operating, permitted but not yet under construction, and under construction. This enables comparison of RGGI emissions to the rest of the world.

Table 1: Global Energy Monitor Coal-Fired Power Plant Emissions and Capacity

Country	Status	Capacity (MW)	Annual CO2 (MMT)
All	Operating	2,095,041	9,895
	Permitted	129,865	515
	Construction	204,153	819
China	Operating	1,108,908	5,033
	Permitted	98,940	389
	Construction	136,237	539

Table 2 compares the 2022 RGGI emissions relative to coal-fired power plants under construction in China and the world as documented by the Global Energy Monitor. These results show that the effect of these changes on global warming impacts is minimal. For example, if the 2022 emissions (8.99 million metric tons) for every affected source in Connecticut was out of compliance, those emissions would be subsumed by the expected emissions increases for coal-fired power plants under construction world-wide in four days and in six days just for those under construction in China.

Table 2: Comparison of 2022 RGGI Emissions Relative to Coal-Fired Power Plants Under Construction

RGGI Region	2022 CO2 Emissions Million Metric Tons	Days Until RGGI Emissions are Subsumed by Emissions Elsewhere	
		Global Constuction	China Constuction
CT	8.99	4	6
DE	1.90	1	1
ME	6.65	3	4
MD	11.50	5	8
MA	1.85	1	1
NH	2.36	1	2
NY	27.74	12	19
RI	2.78	1	2
VT	0.00	0	0
9-State RGGI Total	63.78	28	43
NJ	14.22	6	10
VA	22.86	10	15
PA	74.50	33	50
12-State RGGI Total	175.35	78	119

At the September 26 meeting in response to a question about implementation timing, the State speaker said that if adopted it would be targeted to start in 2025. She also said that compliance "has been very good". That raises the question why do it now?

Although the current state of RGGI is stable and certain I expect that there will be major changes in the market allowances available relative to the cap level soon. As a result, the three-year compliance period flexibility is a pragmatic and reasonable component to maintain. I explained in my comments last April that in the fifth compliance period the compliance entities are going to have to use allowances now held by non-compliance entities and in the sixth compliance period the allowance cap will likely be binding. These uncertainties, and additional issues concerning future allowance availability issues in these comments, all point to the need for compliance flexibility afforded by the three-year compliance period.

Electricity Sector Modeling Analysis Key Observations

I am concerned that the IPM modeling analysis is giving a false sense of certainty to proponents of a RGGI allowance trajectory to zero by 2035 or 2040. This is reflected in the key observations (Slide 30 in the September 26 meeting presentation) that state:

- Scenarios modeled to date show relatively low allowance prices compared to the ECR/CCR price triggers in the Model Rule
- Federal incentives for clean energy have the potential to rapidly transform the RGGI region generation mix
- Modeling shows how current state decarbonization and renewable requirements can significantly reduce emissions

Key Observation 1

The observation that the "Scenarios modeled to date show relatively low allowance prices compared to the ECR/CCR price triggers in the Model Rule" suggests that the modeling predicts that allowance availability relative to projected emissions will be large. However, the description of the emission results for the IPM analysis reveals significant questions about the use of this model to estimate the reasonableness of future emissions in a transitioning grid. The description of the emissions projections notes that the results show emissions drop significantly between 2025 and 2030 due to "renewable builds, retirement of coal capacity and fuel switching from coal to gas and also gas to renewables." This happens even for the procured renewables assumption set. Emissions in the zero by 2035 allowance supply scenario are lowest for all the cap level assumption sets (Table 3).

Table 3: 2023 RGGI IPM Draft Program Review Case - Results Released 09/19/23 by ICF

Assumption Set A: Procured Only									
Allowance Supply	BAU Flat Cap Post-2030			Test Against Zero by 2040			Test Against Zero by 2035		
Year	2025	2030	20235	2025	2030	20235	2025	2030	20235
New York - NYISO	22.7	11.6	9.3	22.0	10.6	8.1	19.9	8.1	5.9
ISO-NE	14.7	6.8	6.2	14.5	6.6	5.9	13.7	4.9	5.0
RGGI PJM	85.9	61.2	45.8	81.2	56.1	37.0	66.7	39.4	22.8
Total RGGI Affected Emissions	123.3	79.5	61.3	117.6	73.3	51.0	100.3	52.4	33.7

Assumption Set B: Procured + In Statute or Regulation									
Allowance Supply	BAU Flat Cap Post-2030			Test Against Zero by 2040			Test Against Zero by 2035		
Year	2025	2030	20235	2025	2030	20235	2025	2030	20235
New York - NYISO	18.2	4.6	3.0	18.2	4.6	3.0	17.3	4.2	2.5
ISO-NE	17.5	5.9	6.2	17.5	5.9	6.2	16.4	4.0	4.2
RGGI PJM	82.0	51.8	35.3	82.0	51.8	35.3	69.0	42.3	23.7
Total RGGI Affected Emissions	117.7	62.4	44.5	117.7	62.4	44.5	102.7	50.4	30.4

Assumption Set C: Procured + In Statute or Regulation + Additional Goals									
Allowance Supply	BAU Flat Cap Post-2030			Test Against Zero by 2040			Test Against Zero by 2035		
Year	2025	2030	20235	2025	2030	20235	2025	2030	20235
New York - NYISO	20.2	5.4	4.1	18.1	4.6	3.3	16.8	4.0	2.6
ISO-NE	17.6	6.2	6.4	17.6	6.2	6.3	16.1	3.9	3.9
RGGI PJM	84.7	54.7	39.8	86.6	54.8	39.7	70.1	40.1	25.0
Total RGGI Affected Emissions	122.5	66.3	50.3	122.2	65.5	49.3	103.0	47.9	31.5

There are some inconsistencies with my expectations in the Table 3 modeling results shown. There are three assumption sets for potential regulations that reflect different emission limitations. I expect that Assumption Set C: Procured Only Plus in Statute or Regulation Plus Additional Goals that has the most stringent emission limitations should have the lowest projected emissions However, that is only the case for the Test Against Zero by 2035 allowance supply scenario in 2030. All the others are greater.

During this program review, the IPM results for New York can be checked for consistency with other models. New York's Climate Leadership and Community Protection Act (Climate Act) implementation has produced two independent projections of future resources.

Over the summer of 2021 the New York State Energy Research & Development Authority (NYSERDA) and its consultant Energy + Environmental Economics (E3) prepared an Integration Analysis. The Integration Analysis modeling used to develop the Draft Scoping Plan used a unique approach for this type of policy analysis. Contrary to usual practice the Integration Analysis baseline was a reference case that included "already implemented" programs. Due to a lack of detailed documentation, it is not clear whether this approach affected the emission projections. Assuming this novel approach did not affect the emission projections, I used Scenario 2: Strategic Use of Low-Carbon Fuels emission estimates for comparison here for my comparisons.

As part of its New York electric grid reliability responsibilities, the New York Independent System Operator (NYISO) has been applying its electric planning system models to scenarios representing Climate Act requirements. In these comments I have extracted information from the 2021-2040 System

& Resource Outlook for comparison. The NYISO Resource Outlook modeling analysis included three scenarios. I chose to use NYISO Policy Scenario 1 for comparisons in this analysis.

The comparison of these model results is hindered by differences in the modeling approaches and the categories used to present results. For example, the NYISO modeling treats distributed solar only as a reduction to expected load because they are concerned with resources linked to the grid. The NYISO modeling and Integration Analysis modeling treat energy storage differently so no direct comparison is possible.

Table 4 compares the RGGI IPM New York - NYISO - Net Generation, NYISO Resource Outlook Study, and Scoping Plan's Integration Analysis Scenario 2 net generation (GWh). To more easily see the differences, Table 5 compares the percentage differences. Overall, I think there are significant differences between these results that could impact the allowance availability projections. In the time available for developing these comments I did not document detailed questions about specifics for all the observed inconsistencies. I recommend that the modelers responsible for these analyses reconcile differences between the projections in an open forum.

Table 4: 2023 Draft Program Review Case Results New York - NYISO - Net Generation, NYISO Outlook Study, and and Integration Analysis Scenario 2 (GWh)

Assumption Set: Procured Only

	A_Flat cap			A_0x40			A_0x35			NYISO Outlook Scenario 1			Strategic Use of Low-Carbon Fuels		
Resource	2025	2030	2035	2025	2030	2035	2025	2030	2035	2025	2030	2035	2025	2030	2035
Nuclear	26,240	26,371	26,271	26,242	26,377	26,271	26,274	26,354	26,205	28,338	27,444	28,338	26,452	26,452	26,452
Fossil	58,180	34,778	31,563	56,915	32,775	29,670	53,330	25,677	23,411	54,174	19,987	14,516	54,280	22,646	22,826
DEFR										0	0	0	-	-	-
Hydro	37,312	48,242	48,256	37,304	48,234	48,273	37,261	48,346	48,293	36,418	46,342	46,392	37,246	48,594	51,640
LBW	9,655	15,935	25,629	9,713	16,972	26,853	9,709	23,327	31,318	8,189	26,971	38,297	10,148	22,386	34,769
OSW	7,676	17,288	17,269	7,672	17,304	17,272	7,674	17,265	17,260	7,331	20,186	35,460	4,459	25,687	37,237
Solar	20,393	24,596	24,076	20,356	24,559	24,082	20,297	24,396	23,980	16,300	19,884	20,800	18,135	32,005	53,392
Storage										4,347	7,004	10,084	-35	-1,059	-1,873
Other	2,215	2,105	2,102	2,216	2,105	2,102	2,304	2,104	2,102				2,721	2,721	2,721
Total	161,671	169,315	175,166	160,418	168,326	174,524	156,848	167,469	172,569	155,096	167,818	193,887	153,406	179,432	227,164

Assumption Set: Procured Only Plus In Statute or Regulation

	B_Flat cap			B_0x40			B_0x35			NYISO Outlook Scenario 1			Strategic Use of Low-Carbon Fuels		
Resource	2025	2030	2035	2025	2030	2035	2025	2030	2035	2025	2030	2035	2025	2030	2035
Nuclear	26,533	26,499	26,110	26,533	26,499	26,110	26,533	26,499	26,195	28,338	27,444	28,338	26,452	26,452	26,452
Fossil	46,972	12,989	8,713	46,972	12,989	8,713	45,549	12,249	7,700	54,174	19,987	14,516	54,280	22,646	22,826
DEFR										0	0	0	-	-	-
Hydro	37,548	48,530	48,972	37,548	48,530	48,483	37,553	48,551	48,486	36,418	46,342	46,392	37,246	48,594	51,640
LBW	9,858	23,474	34,389	9,858	23,359	34,716	9,858	23,569	34,756	8,189	26,971	38,297	10,148	22,386	34,769
OSW	4,237	27,514	40,150	4,237	27,514	40,150	4,237	27,514	40,150	7,331	20,186	35,460	4,459	25,687	37,237
Solar	21,018	33,412	53,303	21,018	33,527	53,546	21,018	33,284	53,519	16,300	19,884	20,800	18,135	32,005	53,392
Storage										4,347	7,004	10,084	-35	-1,059	-1,873
Other	2,262	2,022	1,368	2,262	2,022	1,368	2,287	2,022	1,374				2,721	2,721	2,721
Total	148,428	174,441	213,006	148,428	174,441	213,086	147,035	173,689	212,180	155,096	167,818	193,887	153,406	179,432	227,164

Assumption Set: Procured Only Plus In Statute or Regulation Plus Additional Goals

	C_Flat cap			C_0x40			C_0x35			NYISO Outlook Scenario 1			Strategic Use of Low-Carbon Fuels		
Resource	2025	2030	2035	2025	2030	2035	2025	2030	2035	2025	2030	2035	2025	2030	2035
Nuclear	26,533	26,352	26,110	26,533	26,352	26,110	26,550	26,499	26,110	28,338	27,444	28,338	26,452	26,452	26,452
Fossil	47,910	14,198	11,307	47,859	14,193	11,304	45,773	13,088	9,415	54,174	19,987	14,516	54,280	22,646	22,826
DEFR										0	0	0	-	-	-
Hydro	37,542	48,562	48,979	37,542	48,562	48,557	37,496	48,557	48,956	36,418	46,342	46,392	37,246	48,594	51,640
LBW	9,858	23,410	34,664	9,858	23,261	34,477	9,858	23,052	34,501	8,189	26,971	38,297	10,148	22,386	34,769
OSW	4,237	27,514	40,150	4,237	27,514	40,150	4,237	27,514	40,150	7,331	20,186	35,460	4,459	25,687	37,237
Solar	21,018	33,297	52,978	21,018	33,437	53,537	21,018	33,647	52,254	16,300	19,884	20,800	18,135	32,005	53,392
Storage										4,347	7,004	10,084	-35	-1,059	-1,873
Other	2,262	2,100	1,356	2,262	2,103	1,356	2,287	2,022	1,371				2,721	2,721	2,721
Total	148,428	174,441	213,006	148,428	174,441	213,086	147,035	173,689	212,180	155,096	167,818	193,887	153,406	179,432	227,164

Table 5: 2023 Net Generation Percentage Differences Between NYISO Outlook Study and the RGGI IPM New York - NYISO - Draft Program Review Cases, and Integration Analysis Scenario 2

Assumption Set: Procured Only

	A_Flat cap			A_0x40			A_0x35			Strategic Use of Low-Carbon Fuels		
Resource	2025	2030	2035	2025	2030	2035	2025	2030	2035	2025	2030	2035
Nuclear	7%	4%	7%	7%	4%	7%	7%	4%	8%	7%	4%	7%
Fossil	-7%	-74%	-117%	-5%	-64%	-104%	2%	-28%	-61%	0%	-13%	-57%
DEFR												
Hydro	-2%	-4%	-4%	-2%	-4%	-4%	-2%	-4%	-4%	-2%	-5%	-11%
LBW	-18%	41%	33%	-19%	37%	30%	-19%	14%	18%	-24%	17%	9%
OSW	-5%	14%	51%	-5%	14%	51%	-5%	14%	51%	39%	-27%	-5%
Solar	-25%	-24%	-16%	-25%	-24%	-16%	-25%	-23%	-15%	-11%	-61%	-157%
Storage												
Other												
Total	-4%	-1%	10%	-3%	0%	10%	-1%	0%	11%	1%	-7%	-17%

Assumption Set: Procured Only Plus In Statute or Regulation

	B_Flat cap			B_0x40			B_0x35			Strategic Use of Low-Carbon Fuels		
Resource	2025	2030	2035	2025	2030	2035	2025	2030	2035	2025	2030	2035
Nuclear	6%	3%	8%	6%	3%	8%	6%	3%	8%	7%	4%	7%
Fossil	13%	35%	40%	13%	35%	40%	16%	39%	47%	0%	-13%	-57%
DEFR												
Hydro	-3%	-5%	-6%	-3%	-5%	-5%	-3%	-5%	-5%	-2%	-5%	-11%
LBW	-20%	13%	10%	-20%	13%	9%	-20%	13%	9%	-24%	17%	9%
OSW	42%	-36%	-13%	42%	-36%	-13%	42%	-36%	-13%	39%	-27%	-5%
Solar	-29%	-68%	-156%	-29%	-69%	-157%	-29%	-67%	-157%	-11%	-61%	-157%
Storage												
Other												
Total	4%	-4%	-10%	4%	-4%	-10%	5%	-3%	-9%	1%	-7%	-17%

Assumption Set: Procured Only Plus In Statute or Regulation Plus Additional Goals

	C_Flat cap			C_0x40			C_0x35			Strategic Use of Low-Carbon Fuels		
Resource	2025	2030	2035	2025	2030	2035	2025	2030	2035	2025	2030	2035
Nuclear	6%	4%	8%	6%	4%	8%	6%	3%	8%	7%	4%	7%
Fossil	12%	29%	22%	12%	29%	22%	16%	35%	35%	0%	-13%	-57%
DEFR												
Hydro	-3%	-5%	-6%	-3%	-5%	-5%	-3%	-5%	-6%	-2%	-5%	-11%
LBW	-20%	13%	9%	-20%	14%	10%	-20%	15%	10%	-24%	17%	9%
OSW	42%	-36%	-13%	42%	-36%	-13%	42%	-36%	-13%	39%	-27%	-5%
Solar	-29%	-67%	-155%	-29%	-68%	-157%	-29%	-69%	-151%	-11%	-61%	-157%
Storage												
Other												
Total	4%	-4%	-10%	4%	-4%	-10%	5%	-3%	-9%	1%	-7%	-17%

The most glaring difference between the RGGI IPM modeling and the New York only analyses is the generation fossil-fuels sector. I believe that the RGGI IPM modeling assumption set B, procured plus in statute or regulation, modeling assumptions most closely match the New York analyses. I highlight these differences in Table 6. The table subtracts the NYISO Resource Outlook Scenario 1 projected generation from the RGGI IPM modeling allowance supply scenarios for Assumption Set B and Integration Analysis Scenario 2. The percentage difference shows that the IPM projects substantially more generation than NYISO and the Integration Analysis but the Integration Analysis projects less than NYISO.

Table 6: Fossil Resource Sector Difference in Generation (GWH) Between the NYISO Resource Outlook and the RGGI IPM and Scoping Plan

Modeling Scenario	Year	Generation (GWh)	Difference (%)
B_Flat cap	2025	7,202	13%
	2030	6,998	35%
	2035	5,803	40%
B_0x40	2025	7,202	13%
	2030	6,998	35%
	2035	5,803	40%
B_0x35	2025	8,625	16%
	2030	7,738	39%
	2035	6,816	47%
Strategic Use of Low-Carbon Fuels	2025	-106	0%
	2030	-2,659	-13%
	2035	-8,310	-57%

There is an allowance relevant ramification of this information. Because RGGI affected source emissions are so strongly correlated with operations these higher operating rates mean that the RGGI IPM modeling projects lower fossil-fired emissions than the NYISO model. In Table 7 I estimated New York CO2 emissions by multiplying these projected generation differences times the 2022 calculated CO2 emission rate per MWh. In the NYISO Resource Outlook column the emissions are relative to those scenario differences. Similarly, the emission differences in the Integration Analysis are relative to the Scoping Plan projections. IPM underestimates the fossil sectors emissions significantly.

Table 7: Fossil Resource Sector Difference in Projected CO2 Emissions (tons) Between the RGGI IPM and NYISO Resource Outlook and Scoping Plan

Modeling Scenario	Year	NYISO Resource Outlook	Integration Analysis Scenario 2
B_Flat cap	2025	3,653,074	3,706,988
	2030	3,549,553	4,898,120
	2035	2,943,569	7,158,568
B_0x40	2025	3,653,074	3,706,988
	2030	3,549,553	4,898,120
	2035	2,943,569	7,158,568
B_0x35	2025	4,374,952	4,428,865
	2030	3,924,918	5,273,485
	2035	3,457,173	7,672,172
Integration Analysis Scenario 2 Strategic Use of Low-Carbon Fuels	2025	(53,914)	
	2030	(1,348,567)	
	2035	(4,214,999)	

The RGGI States chose not to include any allowance supply numbers so I was forced to make my own estimates to determine the significance of these emissions. I projected allowance availability using a linear interpolation between 2023 allowance allocations and zero by 2035 and 2040. For the zero by 2040 allowance supply scenario, the 2030 emissions difference represents 27% of my estimated allowance allocation. For the zero by 2035 allowance supply scenario, the 2030 emissions difference represents 42% of my estimated allowance allocation. This suggests that this modeling difference needs to be reconciled to determine its impact on the RGGI State allowance allocation trajectory proposal.

There is another issue associated with the modeling results. The ICF description of these modeling results notes that "due to the stringency of the program after 2040, the model shows an over-compliance of emissions in the early years (2025-2030) and banking of those allowances for when the cap is reduced in 2035 and beyond. " This is an artifact of the perfect foresight methodology of IPM and, I believe, is unlikely to occur.

I think this is wrong because the modeling approach claims affected sources "over-comply". RGGI sources do not "over-comply" but rather acquire allowances to meet their compliance obligations with a slight surplus to ensure compliance My primary concern is New York and in New York sources that could fuel switch to natural gas have already done so. They cannot directly affect their compliance except by limiting operations. Thus, RGGI sources in NY are at the point where they must rely on renewable energy to displace their need to operate. This means that they only purchase the allowances they expect to use for their compliance obligations. Based on the modeling description, IPM "perfect foresight" projects results over longer planning horizons than used in practice. I believe that affected-sources across RGGI treat the allowance requirements as a short-term, no more than a couple of compliance periods, compliance obligation. It is highly unlikely that most affected sources are making plans beyond short-term compliance periods so the idea that affected source would over-comply in early years for more stringent limits ten years ahead is incorrect. The open question is how does this affect the allowance trajectories.

Key Observation 2

The second key observation is that "Federal incentives for clean energy have the potential to rapidly transform the RGGI region generation mix". Recent events suggest "rapid transformation" is overly optimistic and that has allowance trajectory implications. Renewable developments are struggling due to soaring interest rates and rising equipment and labor costs. Reuters describes two "procured" projects that have been cancelled:

> On Monday, Avangrid (AGR.N), a U.S. subsidiary of Spanish energy firm Iberdrola (IBE.MC), said it filed agreements with power companies in Connecticut to cancel power purchase agreements for Avangrid's proposed Park City offshore wind project.
>
> "One year ago, Avangrid was the first offshore wind developer in the United States to make public the unprecedented economic headwinds facing the industry," Avangrid said in a release.

> Those headwinds include "record inflation, supply chain disruptions, and sharp interest rate hikes, the aggregate impact of which rendered the Park City Wind project unfinanceable under its existing contracts," Avangrid said.
>
> Avangrid has said it planned to rebid the Park City project in future offshore wind solicitations. Also over the past week, utility regulators in Massachusetts approved a proposal by SouthCoast Wind, another offshore wind developer, to pay local power companies a total of around $60 million to terminate contracts to provide about 1,200 MW of power.

In New York, on October 12, 2023 the Public Service Commission turned down a request to address the same cost issues. Times Union writer Rick Karlin summarizes:

> At issue was a request in June by ACE NY, as well as Empire Offshore Wind LLC, Beacon Wind LLC, and Sunrise Wind LLC, which are putting up the offshore wind tower farms.
>
> All told, the request, which was in the form of a filing before the PSC, represented four offshore wind projects totaling 4.2 gigawatts of power, five land-based wind farms worth 7.5 gigawatts and 81 large solar arrays.
>
> All of these projects are underway but not completed. They have already been selected and are under contract with the New York State Energy Research and Development Authority, or NYSERDA, to help New York transition to a clean power grid, as called for in the Climate Leadership and Community Protection Act, approved by the state Legislature and signed into law in 2019.

Developer response suggests that “a number of planned projects will now be canceled, and their developers will try to rebid for a higher price at a later date — which will lead to delays in ushering in an era of green energy in New York”. Karlin also quotes Fred Zalcman, director of the New York Offshore Wind Alliance: “Today’s PSC decision denying relief to the portfolio of contracted offshore wind projects puts these projects in serious jeopardy,”

These issues impact the proposed RGGI allowance trajectories based on the “potential to rapidly transform the RGGI region generation mix”. The IPM modeling projects significant emission reductions presuming that procured renewable energy projects will come on line consistent with the contracts at the time of the modeling. The two cancelled projects in New England total 2,000 MW and the threatened New York wind projects total 11,700 MW. All these projects could all be delayed so RGGI-affected source emissions will not be displaced. If the allowance trajectory proposed does not account for this new information, then compliance will be threatened because affected sources have so few options available to reduce emissions. I recommend that a modeling scenario be run to consider the effect of a delayed implementation schedule before finalizing Third Program Review recommendations. In fact, given the importance of renewable development on the emission trajectories it might even be appropriate to delay the timing of completion of this program review.

There is another consideration regarding feasibility. As shown in the Addendum, the accumulated annual emission reductions due to RGGI investments is 3,893,925 tons and RGGI investments over the same time frame total $3,608,950,013 so the cost per ton avoided is $927. If the only source of future emission reductions were the result of RGGI investments, then RGGI allowance prices would have to equal $927 to get the necessary reductions. Of course, other investments will also reduce emissions but the RGGI States should still consider cost considerations for the viability of renewable energy resources needed to get RGGI affected source emissions to zero. IPM does not address this uncertainty.

Key Observation 3

Table 8 lists the emissions from the 11 states currently in RGGI for the years that the state was part of the RGGI program. Therefore, it cannot be used for trend analyses. It is included to make a point about the third key observation that "Modeling shows how current state decarbonization and renewable requirements can significantly reduce emissions".

I think Key Observation 3 over-estimates the potential for future emission reductions. In 2022 RGGI CO2 emissions totaled 158,176,470 tons. Of that total 35,390,244 tons came from sources that used coal as the primary fuel. If future fuel switching is like New York's shift from coal to natural gas, I estimate that if those sources shift to natural gas that CO2 emissions from natural gas will increase by 20,716,883 tons so the net decrease in total RGGI tons would be 14,673,361 tons. I conclude that fuel switching is only going to provide sufficient emission reductions to meet an allowance supply trajectory to net-zero by 2035 or 2040 for a few years. At that point the RGGI-affected sources will have to rely on displacement of their generation to wind and solar resources to comply with expected allowance trajectories.

Table 8: 2009-2022 RGGI Affected Source CO2 Emissions (Tons) by Primary Fuel Type

RGGI Third Program Review						
	Total	Coal	Residual Oil	Diesel Oil	Natural Gas	Other
2009	123,883,794	63,806,505	6,567,062	1,291,952	51,282,306	935,969
2010	137,379,820	67,765,335	8,072,392	469,275	60,173,729	899,088
2011	121,567,452	49,689,687	5,076,067	249,129	65,866,204	686,365
2012	94,869,107	29,079,810	6,765,424	196,040	57,781,951	1,045,881
2013	88,169,673	31,755,977	4,841,712	253,713	50,624,566	693,705
2014	88,197,686	31,047,932	5,270,099	267,120	50,319,682	1,292,852
2015	84,769,466	23,324,775	5,323,396	166,555	54,723,207	1,231,533
2016	80,660,499	20,961,793	2,440,791	172,280	55,883,008	1,202,626
2017	66,242,523	13,566,687	1,256,674	112,346	50,152,104	1,154,712
2018	73,402,550	14,519,823	2,151,926	198,097	55,373,893	1,158,811
2019	61,797,453	8,435,602	907,388	112,121	51,336,912	1,005,429
2020	76,651,859	6,323,826	425,838	242,107	68,997,058	663,031
2021	83,163,848	9,498,270	408,082	222,547	72,405,997	628,952
2022	158,176,470	35,390,244	1,284,570	251,489	120,723,133	527,035

Coal											
	CT	DE	MA	MD	ME	NH	NJ	NY	PA	RI	VT
2009	2,757,768	2,984,153	9,039,567	25,674,653	0	3,230,673	6,627,332	13,492,359	0	0	0
2010	2,977,802	2,949,892	8,288,387	27,173,265	0	3,396,504	8,134,425	14,845,061	0	0	0
2011	621,153	1,602,430	4,261,015	24,462,967	0	2,529,289	5,864,396	10,348,435	0	0	0
2012	156,454	1,502,779	2,361,698	18,519,356	0	1,526,091	0	5,013,433	0	0	0
2013	765,427	1,630,928	4,081,371	18,078,835	0	1,738,852	0	5,460,564	0	0	0
2014	910,432	877,251	2,847,141	20,311,486	0	1,446,601	0	4,655,020	0	0	0
2015	692,803	627,478	2,314,251	16,367,766	0	1,092,753	0	2,229,725	0	0	0
2016	242,327	527,384	2,085,845	16,019,528	0	497,759	0	1,588,950	0	0	0
2017	251,352	398,763	1,260,131	10,517,803	0	374,778	0	763,861	0	0	0
2018	393,321	313,243	0	12,232,533	0	877,349	0	703,377	0	0	0
2019	80,738	180,121	0	7,260,683	0	442,092	0	471,969	0	0	0
2020	4,945	163,735	0	4,354,430	0	151,918	1,474,438	174,360	0	0	0
2021	274,870	385,658	0	7,015,918	0	325,997	1,495,827	0	0	0	0
2022	0	169,755	0	5,496,742	0	363,457	736,838	0	28,623,452	0	0

Residual Oil											
	CT	DE	MA	MD	ME	NH	NJ	NY	PA	RI	VT
2009	354,457	46,267	604,335	330,092	242,370	197,436	57,359	4,734,746	0	0	0
2010	625,934	58,122	229,667	822,774	198,691	216,603	96,363	5,824,238	0	0	0
2011	225,416	134,500	133,495	565,867	107,642	127,608	102,909	3,678,631	0	0	0
2012	166,979	339,248	168,666	2,128,674	77,825	68,600	0	3,815,432	0	0	0
2013	184,526	138,170	207,106	510,238	211,641	89,708	0	3,500,323	0	0	0
2014	296,608	336,917	492,283	318,038	231,610	137,278	0	3,457,367	0	0	0
2015	193,607	222,748	451,379	15,679	434,966	129,086	0	3,875,931	0	0	0
2016	63,290	336,090	85,328	8,225	93,552	45,105	0	1,809,201	0	0	0
2017	108,309	93,734	30,062	3,128	103,597	43,648	0	874,196	0	0	0
2018	183,447	165,928	80,102	9,176	151,727	121,120	0	1,440,426	0	0	0
2019	23,922	63,048	26,897	5,356	10,136	6,654	0	771,375	0	0	0
2020	57,463	64,296	4,166	1,953	16,457	15,086	0	266,417	0	0	0
2021	63,971	124,233	21,361	4,435	9,298	50,607	0	134,176	0	0	0
2022	0	165,987	145,553	13,753	218,462	134,065	0	419,292	187,458	0	0

Natural Gas											
	CT	DE	MA	MD	ME	NH	NJ	NY	PA	RI	VT
2009	4,211,062	677,192	9,002,940	518,083	3,401,122	2,341,771	9,658,301	18,055,052	0	3,416,783	0
2010	4,925,732	1,290,245	11,250,752	801,180	3,744,766	2,286,341	11,576,438	20,793,883	0	3,504,392	0
2011	6,282,171	2,413,016	11,227,239	1,509,566	3,229,818	2,868,472	11,563,818	22,825,522	0	3,946,582	0
2012	6,788,213	2,996,920	10,679,011	1,475,592	2,862,248	3,048,207	0	26,195,974	0	3,735,785	0
2013	6,482,064	2,417,172	9,377,748	816,856	2,400,783	1,824,635	0	24,534,203	0	2,771,105	0
2014	6,025,394	2,663,655	8,424,258	882,142	2,022,934	1,989,299	0	25,544,710	0	2,767,290	0
2015	7,233,679	2,498,258	9,502,216	2,257,496	1,343,380	2,596,539	0	26,215,992	0	3,075,646	0
2016	7,355,390	2,975,071	9,375,445	2,804,512	1,469,197	2,003,945	0	27,069,587	0	2,829,861	0
2017	6,450,150	2,597,269	9,832,580	2,751,009	965,759	1,563,621	0	22,778,506	0	3,213,211	0
2018	8,148,841	2,122,367	8,232,012	6,165,181	1,031,488	1,299,297	0	24,835,682	0	3,539,026	0
2019	7,995,780	1,574,347	6,655,903	6,869,405	794,693	1,515,988	0	22,779,307	0	3,151,489	0
2020	9,356,897	1,650,195	6,336,839	6,773,321	850,883	1,555,226	13,404,524	25,488,893	0	3,580,279	0
2021	9,616,267	1,280,023	6,666,100	7,089,395	1,457,164	1,914,752	13,157,836	27,443,344	0	3,781,117	0
2022	0	1,752,825	7,170,062	7,133,046	1,817,255	2,101,312	14,927,029	29,483,944	53,268,810	3,068,849	0

Diesel Oil and Other Fuels											
	CT	DE	MA	MD	ME	NH	NJ	NY	PA	RI	VT
2009	2,201	720	14,303	45,854	0	567,175	16,452	1,579,250	0	0	1,965
2010	4,810	1,010	37,901	112,439	0	520,856	37,601	649,990	0	0	3,756
2011	24,655	450	13,509	92,706	0	471,165	30,681	295,791	0	0	6,537
2012	9,383	575	9,151	67,188	0	537,704	0	615,603	0	0	2,319
2013	26,298	194	11,237	89,230	0	553,195	0	264,502	0	0	2,761
2014	41,074	3,476	31,425	197,467	0	508,163	0	775,660	0	0	2,708
2015	37,476	1,588	12,494	140,880	0	508,512	0	695,922	0	0	1,216
2016	23,699	235	17,818	98,664	0	505,037	0	726,776	0	0	2,678
2017	25,711	344	23,422	37,637	0	501,570	0	674,024	0	0	4,349
2018	19,192	2,219	23,682	107,439	0	453,850	0	748,453	0	0	2,072
2019	8,592	569	13,450	42,720	0	425,553	0	626,119	0	0	546
2020	13,731	136	8,115	44,315	0	43,701	4,728	789,327	0	0	1,085
2021	15,953	354	8,765	23,213	0	0	7,435	792,720	0	0	3,059
2022	0	2,816	14,409	35,250	0	0	6,135	677,593	38,418	0	3,903

I expect that as the opportunities to switch fuels diminish that the allowance market will get tighter and allowance prices will go up. This could trigger the cost containment reserve release of additional allowances to the market. If the allowance trajectory is too aggressive and emissions do not decrease as expected because wind and solar do not come on line as planned or there is an abnormal weather year increasing load and decreasing wind and solar availability, then there could be a situation where there simply are not enough allowances available for compliance. The Cost Containment Reserve could prevent this from occurring. No scenarios with this feature have been modeled yet. The RGGI States should model a scenario where the renewable implementation is delayed and the Cost Containment Reserve is employed.

Other Modeling Concerns

This section highlights other concerns that should be addressed before the final program review decisions are made.

The New York - NYISO - Incremental Capacity Added (MW) assumption descriptions from the March 29, 2023 Public Meeting presentation notes state that "For Cases B and C, NYISO buildout will align with the NY CAC Scoping Plan, Scenario 2". In Table 9 I compare the capacity projections. Only the offshore wind in 2025 and 2030 and battery storage in 2030 incremental capacity is the same. Why aren't the other projections the same?

Table 9: Compare RGGI IPM NYISO - Scoping Plan Incremental Capacity (MW)

Delta Incremental Capacity (MW)			
Scenario 2	**2025**	**2030**	**2035**
Nuclear	1,505	-	-
Gas & FO	(71)	2,934	(1,064)
Wind	(486)	2,683	2,546
Wind_Offshore	-	-	434
Solar	(3,297)	(5,344)	1,344
Battery Storage	(666)	(1)	2,199
In-State Hydro	2	-	(170)

There is another question related to these differences and the RGGI IPM modeling results. The IPM model output does not include projections for DEFR. During the September 26 presentation I thought I heard mention that ICF does not think DEFR is necessary until 2040 so that is why it is not included. If the NYISO thinks it is needed in 2030 that assumption is a problem. Note that although NYISO includes capacity the generation produced is below the threshold of their reporting so it shows up as zero.

During the September 26 meeting I asked if the modeling considers feasibility. The ICF representative said that there are feasibility considerations within the IPM model but his concept of feasibility is different than mine. My concerns are related to issues described in the Key Observation 2 section, namely financing issues related to high interest rates; permitting delays; supply chain issues associated with components and raw materials needed; limited trained and experience tradespeople to do the

work; and the need to develop installation infrastructure, particularly for offshore wind projects. IPM projects availability of renewable energy across the RGGI region using EPA assumptions that includes a "more granular assessment of availability of different resource classes". Unfortunately, the response broke up so I couldn't get all the aspects of feasibility that the speaker claimed are captured. Given recent events, the RGGI modeling analysis should consider the possibility that renewable energy developments will not come on line as fast as previously expected.

I also asked if the modeling addressed DEFR. ICF said that they did and when pressed said they used green hydrogen compliant with zero emission targets as the place holder technology. However, ICF also said that it was incorporated from 2040 onwards and NYISO modeling projects that it is needed earlier. The NYISO use of DEFR is substantially different than the Integration Analysis. Unfortunately, the IPM modeling results did not provide information for this resource category. This is a major technological feasibility challenge that does not appear to be addressed by IPM and the RGGI States.

Someone asked Does IPM consider interconnection costs and siting restrictions? ICF claimed that the EPA version of IPM does include interconnection costs but I think they were referring to several procured transmission projects. What about the costs to get offshore wind integrated into the system. So far NYISO is projecting $3.28 billion for the transmission upgrades needed for 3,000 MW of New York offshore wind. In addition, there are significant costs associated with upgrading and expanding the transmission and distribution systems for onshore wind and solar projects. If those costs were included in the NYISO Resource Outlook and the Integration Analysis modeling but not in the RGGI IPM analysis, then that could explain some of the differences observed.

Personal Background

I have extensive experience with air pollution control theory, implementation, and evaluation having worked on every cap-and-trade program affecting electric generating facilities in New York including the Acid Rain Program, RGGI, and several Nitrogen Oxide programs since the inception of those programs. I follow and write about the RGGI cap and invest CO2 pollution control program. The opinions expressed in these comments do not reflect the position of any of my previous employers or any other company I have been associated with, these comments are mine alone.

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Addendum: RGGI Emission Reduction and Investment Outcome Results

There is an unfortunate disconnect between the results of RGGI to date relative to the expectations in the Third Program Review. During the September 26 meeting the explanation of cap-and-trade systems stated that "States reinvest the proceeds in decarbonization and other programs to deliver benefits to their communities." What was missing was any mention of the efficacy of those investments relative to the emission reductions observed.

The primary cause of the observed RGGI emission reductions has been the fuel switch from coal and residual oil to natural gas. Table A-1 lists the emissions by fuel types for the nine RGGI states that have been members since the start. I believe the biggest driver for operational costs is fuel costs which made the switches to natural gas economic. The cost adder of the RGGI carbon price to date has been too small to drive the use of natural gas over coal and oil. If the RGGI States don't recognize the implications of this, it suggests that future reductions will be harder than they project.

Table A-1: RGGI Program Unit CO2 Emissions (tons) by State and Year

	9-State RGGI Units				
	Coal	Residual Oil	Diesel Oil	Natural Gas	Other
2009	57,179,173	6,509,703	1,275,500	41,620,881	935,969
2010	59,630,911	7,976,030	431,674	48,590,115	899,088
2011	43,825,291	4,973,159	218,448	53,400,331	1,583,183
2012	29,079,810	6,765,424	196,040	57,122,624	1,701,752
2013	31,755,977	4,841,712	253,713	50,622,830	693,705
2014	31,047,932	5,270,099	267,120	50,317,539	1,292,852
2015	23,324,775	5,323,396	166,555	54,720,006	1,231,533
2016	20,961,793	2,440,791	172,280	55,879,645	1,202,626
2017	13,566,687	1,256,674	112,346	50,149,316	1,154,712
2018	14,519,823	2,151,926	198,097	55,372,356	1,158,811
2019	8,435,602	907,388	112,121	51,336,029	1,005,429
2020	4,849,388	425,838	237,378	55,592,465	663,031
2021	8,002,443	403,894	212,399	59,242,347	628,952

RGGI sources within the nine-state region have already implemented most of the coal and residual oil fuel switching opportunities so this control strategy will be less impactful in the future. For example, in New York, all coal-fired electric generation has ceased operation and the remaining units that burn residual oil primarily run to only provide critical reliability support so their emissions are not expected to change much from current levels. In the future, New York's RGGI affected source emission reductions will rely on the displacement of natural gas fired units with wind and solar zero emitting sources.

The 2021 investment proceeds report released on June 27, 2023 provides insight into the success of RGGI investments as an emission reduction tool. The report breaks down the investments into five major categories:

Energy efficiency makes up 51% of 2021 RGGI investments and 55% of cumulative investments. Programs funded by these investments in 2021 are expected to return about $418 million in lifetime energy bill savings to more than 34,000 participating households and over 570 businesses in the region and avoid the release of 2.3 million short tons of CO2.

Clean and renewable energy makes up 4% of 2021 RGGI investments and 13% of cumulative investments. RGGI investments in these technologies in 2021 are expected to return over $600 million in lifetime energy bill savings and avoid the release of more than 1.7 million short tons of CO2.

Beneficial electrification makes up 13% of 2021 RGGI investments and 3% of cumulative investments. RGGI investments in beneficial electrification in 2021 are expected to avoid the release of 370,000 short tons of CO2 and return nearly $164 million in lifetime savings.

Greenhouse gas abatement and climate change adaptation makes up 11% of 2021 RGGI investments and 8% of cumulative investments. RGGI investments in greenhouse gas (GHG) abatement and climate change adaptation (CCA) in 2021 are expected to avoid the release of more than 10,000 short tons of CO2 and to return over $20 million in lifetime savings.

Direct bill assistance makes up 14% of 2021 RGGI investments and 13% of cumulative investments. Direct bill assistance programs funded through RGGI in 2021 have returned over $29 million in credits or assistance to consumers.

There is an important caveat to the emission reductions reported in the report. The RGGI compliance metric is annual emissions and the above quote lists lifetime emission reductions. The sum of the lifetime emission reductions is 4.38 million tons but the 2021 annual emission reductions due to RGGI investments were only 235,299 tons (Figure A-1). The 9-state allowance allocation annual reduction in 2021 was 2,275,000 allowances so RGGI was only responsible for around 10% of the emission reductions required.

Figure A-1: Table 1 from the 2021 investment proceeds report

Table 1: Benefits of 2021 RGGI Investments

Category	Annual Benefits of 2021 Investments	Lifetime Benefits of 2021 Investments
Short Tons CO_2 Avoided	235,299	4,445,594
Energy Bill Savings	$94,118,252	$1,235,674

The results in 2021 are consistent with historical observations. To make a comparison to the CO2 reduction goals I had to sum the annual values in the previous reports because RGGI does not report the annual RGGI investment CO2 reduction values accumulated since the beginning of the program. Table A-2 lists the annual avoided CO2 emissions generated by the RGGI investments from previous reports. The accumulated total of the annual reductions from RGGI investments is 3,893,925 tons while the difference between the three-year baseline of 2006-2008 and 2021 emissions is 58,334,373 tons. This means that RGGI investments are only directly responsible for 6.7% of the total observed annual reductions over the baseline to 2021 timeframe.

Table A-2: Accumulated Annual RGGI Benefits Through 2021

Time Period	RGGI Investments ($)	Avoided CO2 (Short tons)
Cumulative (2008-2014)	$1,365,479,615	1,700,000
2015	$ 410,158,329	298,410
2016	$ 436,397,471	382,266
2017	$ 315,600,000	438,099
2018	$ 248,000,000	273,217
2019	$ 217,000,000	167,211
2020	$ 196,000,000	399,493
2021	$ 374,000,000	235,229
Cumulative Annual Totals	$3,608,950,013	3,893,925

The final point is that the cumulative RGGI investment emission reduction is $927 per ton reduced. This suggests that future investments will have to be more effective for RGGI to support the allowance trajectories proposed. If the only source of future emission reductions were the result of RGGI investments, then RGGI allowance prices would have to equal $927 to get the reductions needed. Of course, other investments will also reduce emissions but the RGGI States should still consider cost considerations for the viability of renewable energy resources needed to get RGGI affected source emissions to zero.