Projection Methodology to Meet 2028 IPM Projected Emissions

My comments include the spreadsheet used for the analysis "RGGI 10 state 2009 2024 fuel type with analyses.xls" (Spreadsheet). The following table documents the spreadsheet.

Tab	Description	Comment
Notes	Documentation	
Projection Summary	Estimated Renewable Development Needed to Displace Generation	Analysis for one IPM scenario for RGGI as a whole shows improbable renewable deployment
Renewable Projection	Presentation tables	
IPM Generation	From Program_Review_Modeling_Results_9-23-2024 Spreadsheet	Copy of Emissions tab in the spreadsheet
IPM Emissions	From Program_Review_Modeling_Results_9-23-2024 Spreadsheet	Copy of Generation tab in the spreadsheet
Projection	CO2, heat input, and gross load totals projections	Did not complete all state projections
State Fuel Type	CO2, heat input, and gross load totals by year, fuel, and state	
Summary	Emissions and operating parameter totals by year and fuel	
Data	Edited input data	The primary fuel types were edited into the four categories
Fuels	Primary Fuel Documentation	Primary fuel type label consolidation categories
Input	Data downloaded from EPA Clean Air Markets Division	CAMD Query for all programs for 10-state RGGI states from 2009-2024

I made an estimate of the solar, onshore wind and offshore wind resources that would be needed to get emissions to the same level as the IPM modeling projections. Future RGGI source emission will be reduced mostly when wind and solar resources displace their generation. My approach extrapolated current emissions out to 2028 by reducing the RGGI source operations. The following table (Spreadsheet Tab – State Fuel Type) lists the 10-state CO2 emissions from the start of the program through the second quarter of 2024 by fuel types. I consolidated compound fuel types into the four categories shown.

10-State CAMD CO2 Emissions Data by Fuel Type, All Programs

Year	CO2 Total	Coal	Oil	Natural Gas	Other
2009	124,850,390	63,951,579	8,308,293	51,282,306	1,308,212
2010	138,296,441	67,871,067	9,162,006	60,189,238	1,074,130
2011	122,411,853	49,735,532	5,777,737	65,883,010	1,015,574
2012	112,255,222	32,812,092	7,489,168	70,660,990	1,292,972
2013	105,448,782	35,731,962	5,410,162	62,963,976	1,342,682
2014	108,167,363	35,095,553	5,721,204	65,090,048	2,260,558
2015	106,338,885	26,182,377	5,646,283	72,043,803	2,466,422
2016	104,456,902	23,332,013	2,722,703	75,543,522	2,858,664
2017	86,430,752	15,460,996	1,410,219	67,059,759	2,499,778
2018	94,198,352	16,349,938	2,441,685	72,843,684	2,563,046
2019	82,793,022	10,100,785	1,076,072	69,162,628	2,453,537
2020	78,275,058	6,323,826	708,303	69,189,015	2,053,914
2021	84,912,659	9,498,270	657,955	72,545,550	2,210,884
2022	87,639,175	6,766,792	1,603,531	77,322,568	1,946,283
2023	81,038,525	2,498,349	677,929	76,373,349	1,488,898
2024	37,777,457	1,706,991	298,357	35,164,634	607,474

I estimated the wind and solar resources necessary to displace these fossil generating resources. The first step projected emissions consistent with the RGGI IPM modeling. The next table lists the emission projections for the three RGGI IPM modeling scenarios. The assumptions for each year were:
- 2022 and 2023 are the observed annual emissions by fuel type
- 2024 projection doubles the observed first two quarters of 2024
- For 2028 I assumed the coal, oil, and other fuel types would linearly go to zero by 2028 and that natural gas emissions equal the emissions projected by IPM
    - This is unrealistic because, among other things, oil serves a reliability requirement in New York State and cannot be replaced in the foreseeable future.
- 2025 values are the average of 2022 – 2024 values
- 2026-2027 values are interpolated between the 2025 average and the assumed 2028 values

Observed 10-State CAMD CO2 Emissions Data by Fuel Type, All Programs and Projected Emissions Consistent with RGGI IPM 2028 Projection

Year	Total	Coal	Oil	Natural Gas	Other
CO2 Case A Exploratory Policy Scenario					
2022	87,639,175	6,766,792	1,603,531	77,322,568	1,946,283
2023	81,038,525	2,498,349	677,929	76,373,349	1,488,898
2024	75,554,913	3,413,983	596,714	70,329,269	1,214,948
2025	81,410,871	4,226,375	959,391	74,675,062	1,550,043
2026	66,191,647	2,831,671	642,792	61,678,654	1,038,529
2027	50,905,064	1,394,704	316,599	48,682,247	511,514
2028	35,292,009	0		35,292,009	0
CO2 Case B Exploratory Policy Scenario					
2022	87,639,175	6,766,792	1,603,531	77,322,568	1,946,283
2023	81,038,525	2,498,349	677,929	76,373,349	1,488,898
2024	75,554,913	3,413,983	596,714	70,329,269	1,214,948
2025	81,410,871	4,226,375	959,391	74,675,062	1,550,043
2026	68,048,862	2,831,671	642,792	63,535,870	1,038,529
2027	54,619,495	1,394,704	316,599	52,396,678	511,514
2028	40,919,935	0		40,919,935	0
CO2 Case B Flat Cap Scenario					
2022	87,639,175	6,766,792	1,603,531	77,322,568	1,946,283
2023	81,038,525	2,498,349	677,929	76,373,349	1,488,898
2024	75,554,913	3,413,983	596,714	70,329,269	1,214,948
2025	81,410,871	4,226,375	959,391	74,675,062	1,550,043
2026	70,893,983	2,831,671	642,792	66,380,991	1,038,529
2027	60,309,737	1,394,704	316,599	58,086,919	511,514
2028	49,541,513	0		49,541,513	0

The second step estimated the load expected for the projected emissions. The next table documents that methodology. In the spreadsheet the columns listed are adjacent to the emissions listed above. The observed 2022 and 2023 loads and the 2024 extrapolated for the entire year loads are listed. The load and emission values are combined to estimate the gross load per ton of CO2 relationship. The

gross load per ton of CO2 for 2022-2025 values were averaged and used to estimate the load for the projected emissions from the previous table.

Estimated Renewable Development Needed to Displace 2028 IPM Emissions

Year	Gross Load Total	Coal	Oil	Natural Gas	Other	Gross Load/Ton CO2 Total	Coal	Oil	Natural Gas	Other
2022	169,224,592	5,648,033	1,931,704	160,779,022	865,833	1.931	0.835	1.205	2.079	0.445
2023	163,696,398	2,188,465	852,152	159,885,687	770,094	2.020	0.876	1.257	2.093	0.517
2024	155,823,493	3,040,158	695,329	151,495,216	592,791	2.062	0.891	1.165	2.154	0.488
2025	163,060,449	3,664,458	1,159,876	157,486,925	749,189	2.004	0.867	1.209	2.109	0.483
2026	133,812,246	2,455,187	777,117	130,077,986	501,957	2.004	0.867	1.209	2.109	0.483
2027	104,508,309	1,209,271	382,759	102,669,046	247,233	2.004	0.867	1.209	2.109	0.483
2028	74,429,533	0	0	74,429,533	0	2.004	0.867	1.209	2.109	0.483

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2022	169,224,592	5,648,033	1,931,704	160,779,022	865,833	1.931	0.835	1.205	2.079	0.445
2023	163,696,398	2,188,465	852,152	159,885,687	770,094	2.020	0.876	1.257	2.093	0.517
2024	155,823,493	3,040,158	695,329	151,495,216	592,791	2.062	0.891	1.165	2.154	0.488
2025	163,060,449	3,664,458	1,159,876	157,486,925	749,189	2.004	0.867	1.209	2.109	0.483
2026	137,729,045	2,455,187	777,117	133,994,784	501,957	2.004	0.867	1.209	2.109	0.483
2027	112,341,906	1,209,271	382,759	110,502,644	247,233	2.004	0.867	1.209	2.109	0.483
2028	86,298,620	0	0	86,298,620	0	2.004	0.867	1.209	2.109	0.483

Year	Gross Load Total	Coal	Oil	Natural Gas	Other	Gross Load/Ton CO2 Total	Coal	Oil	Natural Gas	Other
2022	169,224,592	5,648,033	1,931,704	160,779,022	865,833	1.931	0.835	1.205	2.079	0.445
2023	163,696,398	2,188,465	852,152	159,885,687	770,094	2.020	0.876	1.257	2.093	0.517
2024	155,823,493	3,040,158	695,329	151,495,216	592,791	2.062	0.891	1.165	2.154	0.488
2025	163,060,449	3,664,458	1,159,876	157,486,925	749,189	2.004	0.867	1.209	2.109	0.483
2026	143,729,299	2,455,187	777,117	139,995,038	501,957	2.004	0.867	1.209	2.109	0.483
2027	124,342,413	1,209,271	382,759	122,503,151	247,233	2.004	0.867	1.209	2.109	0.483
2028	104,481,206	0	0	104,481,206	0	2.004	0.867	1.209	2.109	0.483

The purpose of this analysis is to estimate how many MWh must be displaced by renewable energy to reduce the emissions consistent with the IPM model results. The existing generation gross load is the average of 2022-2024 values and is listed in Year 2025. The difference between that average and the projected loads in 2028 represents the load that renewables must displace. In the following table I list the value for each scenario at the top of the tables, e.g. 88,630,916 MWh of renewable energy must displace fossil fired generation for the Case A Exploratory Policy Scenario.

I determined the relative contributions of solar PV, onshore wind, and offshore wind based on the distribution of expected net generation ("Generation" tab) in the RGGI Program_Review_Modeling_ Results_9-23-2024 spreadsheet. Those percentages were multiplied by the total load that renewables must displace. I assumed some conservatively high capacity factors for the renewable resources and calculated the capacity (MW) of each resource. The end result is the capacity (MW) for the renewable resources needed to displace RGGI CO2 emissions consistent with the IPM modeling results presented in the Program_Review_Modeling_Results_9-23-2024 spreadsheet.

Projected Renewable Capacity (MW)

Case A Exploratory Policy Scenario

Renewables load needed to displace emissions

88,630,916

	Percent	MWh	C.F.	MW
Solar PV	32%	28,204,235	23%	13,999
Onshore wind	42%	37,010,947	35%	12,071
Offshore wind	26%	23,415,734	45%	5,940

Projected Renewable Capacity (MW)

CaseB Exploratory Policy Scenario

Renewables load needed to displace emissions

76,761,829

	Percent	MWh	C.F.	MW
Solar PV	32%	24,427,240	23%	12,124
Onshore wind	42%	32,054,594	35%	10,455
Offshore wind	26%	20,279,996	45%	5,145

Projected Renewable Capacity (MW)

Case B Flat Cap Scenario

Renewables load needed to displace emissions

58,579,242

	Percent	MWh	C.F.	MW
Solar PV	32%	18,641,156	23%	9,252
Onshore wind	42%	24,461,817	35%	7,978
Offshore wind	26%	15,476,270	45%	3,926