Policy Brief
November 2021

CENTER FOR CLIMATE, ENERGY, ENVIRONMENT AND ECONOMICS

A Closer Look at RGGI and Grid Reliability

Sophia Hill, Kate Konschnik, Jonas Monast, and Martin Ross

CONTENTS

Author Affiliations

Sophia Hill is a student in the Master's of Environmental Management program at Duke University's Nicholas School of the Environment.

Kate Konschnik is the Director of the Climate and Energy Program at the Nicholas Institute for Environmental Policy Solutions.

Jonas Monast is the Director of the Center on Climate, Energy, Environment & Economics at the UNC School of Law.

Martin Ross is a Senior Research Economist at the Nicholas Institute for Environmental Policy Solutions.

Citation

Hill, S., K. Konschnik, J. Monast, and M. Ross. "A Closer Look at RGGI and Grid Reliability." NI PB 21-03. Durham, NC: Duke University.

Publication Number: NI PB 21-03

INTRODUCTION

Eleven Northeast and Mid-Atlantic states participate in the Regional Greenhouse Gas Initiative (RGGI),[1] a market-based initiative that limits carbon dioxide (CO_2) emissions from fossil fuel-fired power plants with a capacity of 25 megawatts (MW) or greater. Power plants must hold an allowance for each short ton of CO_2 they emit; each year, the number of allowances shrink in line with a declining limit on power sector pollution. All participating states require their power generators to purchase allowances at quarterly RGGI auctions. Auction proceeds are returned to the states, which most often invest those proceeds in energy efficiency, renewable energy, direct energy bill assistance, and other GHG emissions reduction programs.

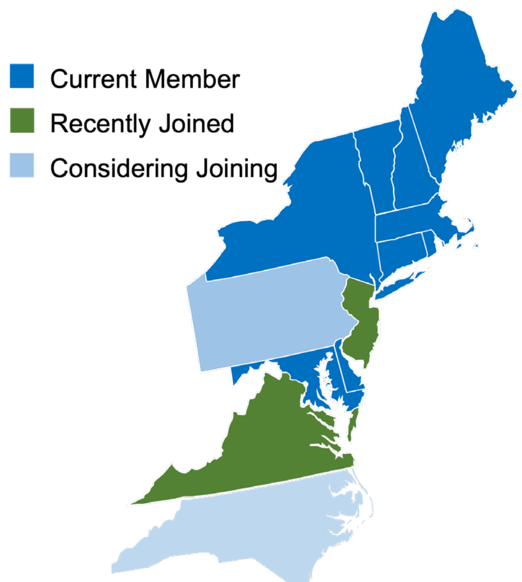
RGGI held its first auction of CO_2 allowances in 2008. State membership held steady from 2012 to 2019; more recently, state interest in the program has grown, initially in response to inaction on climate change at the federal level. Momentum continued beyond the 2020 elections, as states anticipated future federal regulation of CO_2 from the power sector and saw RGGI as a possible compliance strategy.[2] New Jersey

1. RGGI. Elements of RGGI. https://www.rggi.org/program-overview-and-design/elements.

2. In 2015, under the federal Clean Power Plan, EPA indicated that states could use RGGI participation as a compliance pathway for the federal requirements. See Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64662, 64835-36, 64887 (Oct. 23, 2015).

rejoined RGGI in 2020 after nearly a ten-year hiatus; Virginia joined in 2021. Pennsylvania is conducting a RGGI rulemaking process and could join the program as early as January 2022.[3] North Carolina initiated its own rulemaking process in 2021 to join RGGI.[4]

Figure 1. RGGI Membership



Stakeholders newer to RGGI have raised questions about the potential impacts of this program on electric reliability. They also have questions about the extent to which reliability is considered in RGGI analysis. As a new wave of states consider RGGI participation, and with RGGI's third program review just underway, this is an opportune time to consider and address these questions and to ensure that RGGI poses no threat to grid reliability.

This policy brief reviews how RGGI modeling has considered reliability issues and mines existing research on the real-world impacts of RGGI since 2008.

In short, research indicates that the program's implementation has not impacted grid reliability—and that RGGI may help to *improve* reliability through strategic demand-side investments—all while delivering important economic, public health, and emissions reduction benefits to consumers. Indeed, the inherent flexibility of a regional, market-based program that enables power plant operators to make efficiency upgrades, shift generation to lower-emitting options, or purchase allowances makes this policy tool a good fit with grid reliability goals.

RELIABILITY CONSIDERATIONS IN RGGI MODELING

From the start of RGGI and during program reviews, RGGI, Inc. has used electricity sector models to predict how the power sector will react to different emissions caps and program features. In addition, states considering participation in RGGI use modeling to estimate program effectiveness and costs for their particular circumstances. Most of the time, the model used for these analyses is the Integrated Planning Model (IPM). The U.S. Environmental Protection Agency (EPA) uses a version of IPM that has extensive publicly available documentation of data and assumptions. The consulting firm ICF runs a proprietary version most often used by RGGI, Inc. and the RGGI states (in this case the agency hiring ICF may offer additional data and modeling assumptions). Other users of IPM include electric utilities, merchant generators, and environmental advocates within the RGGI footprint.

3. Pennsylvania Department of Environmental Quality, "Independent Regulatory Review Commission Approves CO2 Budget Final Rulemaking" (Sept. 1, 2021), https://www.ahs.dep.pa.gov/NewsRoomPublic/articleviewer.aspx?id=21997&typeid=1.
4. North Carolina Environmental Management Commission, "Special Called Meeting EMC Agenda" (July 13, 2021), https://files.nc.gov/ncdeq/Environmental%20Management%20Commission/EMC%20Meetings/2021/july_special-call-mtg/FULL-EMC-Special-Meeting-Agenda-Revised-7-9-2021-Rev2.pdf.

Analyses usually begin with a base case modeling run that identifies how to meet electricity demand in the future under current or business-as-usual conditions. Specifically, the model selects the combination of power generators that will deliver the required electricity at least cost. Then, the model is run again to represent possible changes in policy going forward. It still works to select the least-cost mix of electricity generation but under constraints that represent the new policy. By comparing a policy run to a base case scenario, states can attribute changes in generation mix, levels of pollution from power plants, and electricity costs to the policy being tested.

For instance, a new state considering participation in RGGI might run a base case without RGGI at all, reflecting current policy in that state. Then, the state might run a policy case with RGGI as currently designed to evaluate the differences in generation mix, emissions, and cost.

Some stakeholders have questioned whether IPM considers electric reliability when it evaluates policy. The answer is yes. For base cases and policy cases, the model sets parameters that serve to represent real-world limits and requirements on the grid. Three particular types of parameters relate to unit and system reliability.[5] First, the model does not assume that generators are available 100% of the time but builds in likely maintenance outages and curtails electricity output at plants when they have hit permitted pollution limits. Second, the model ensures that total available capacity always exceeds electricity demand at any given time of day or day of the year, to protect against unexpected power plant outages (perhaps from a fire or a broken piece of equipment) or extreme weather events leading to increased electricity usage. IPM follows industry practice on the amount of excess capacity—known as the "reserve margin"—needed. Third, IPM builds in assumptions about transmission capacity and, for any given modeling run, does not let more power flow across a line than the line can carry.

The inset box contains additional information about the data used in IPM to characterize these reliability parameters, based on the version used by EPA. Electric utilities undertake more detailed modeling of power flows and distribution line systems to maintain reliability, but this modeling is not generally available to the public. Moreover, that level of detail has not typically been required to study the possible environmental, economic, or reliability impacts of air pollution policies. From the 1990 federal Acid Rain Program to RGGI, and for many air quality programs in between, IPM has been the industry and regulatory standard for policy evaluation.

RGGI AND RELIABILITY – A REVIEW OF PAST PROGRAM PERFORMANCE

Fortunately, states and the public do not have to rely solely on modeling projections to evaluate RGGI's reliability performance—there is a record of performance reaching back to 2008. After monitoring this topic for over a decade,[6] grid operators such as the New York Independent System Operator (NYISO) have yet to identify any adverse impacts of the RGGI program to electric grid reliability. To the contrary, many records echo a 2015 report by the Analysis Group, which found that "RGGI was implemented seamlessly from the very beginning, and without any reliability problems." This report, which focused on emissions reduction policies and electric system

5. *See, e.g.*, "Draft RGGI Reference Case IPM Assumptions," RGGI Program Review: February 8, 2017 Stakeholder Meeting (new date), https://www.rggi.org/sites/default/files/Uploads/Program-Review/2-8-2017/2017_Feb_08_IPM_Modeling_Draft_Assumptions.pdf (describing assumptions used for RGGI modeling).

6. *See* NYISO's "Power Trends 2019" report: "The NYISO continues to closely monitor the electric power grid to ascertain the impact of RGGI and other programs on system reliability." NYISO, "Power Trends 2009," https://www.nyiso.com/documents/20142/2223154/2009-Power-Trends.pdf/fa52a83b-a290-37f3-3ef2-04a29f35f6df.

Detail and data sources for IPM's reliability parameters

(1) Planned/unplanned outages and maintenance

   (a) IPM groups potential planned and unplanned outages into a single availability factor. This factor is applied uniformly across time periods in the model and is expressed as a percentage.

   (b) For renewable generation, EPA collaborated with the National Renewable Energy Laboratory (NREL) to develop hourly generation patterns for wind and solar units, which are then aggregated into the blocks of time used in IPM. Nighttime blocks of time, for instance, will not assume solar is available to generate electricity.

(2) Planning reserve margins

   (a) Planning margins refer to the buffer of electricity generating capacity needed above peak demand to ensure reliability of the system even when generating units become unavailable or unexpected spikes in demand occur, or to back up intermittent renewables generation.

   (b) Data on percentage requirements above peak demand come from the North American Electric Reliability Corporation (NERC)[1] and EPA's data on IPM.[2]

   (c) For specific state analyses, these data may be replaced with practices adopted by local utilities.

(3) Transmission capacity and additions

   (a) Existing and planned transmission capacity are built into IPM.

   (b) Although IPM can also consider building new transmission lines, this capability is not used in the EPA base case. Whether these capabilities are included in analyses conducted for RGGI states would be up to the hiring agency.

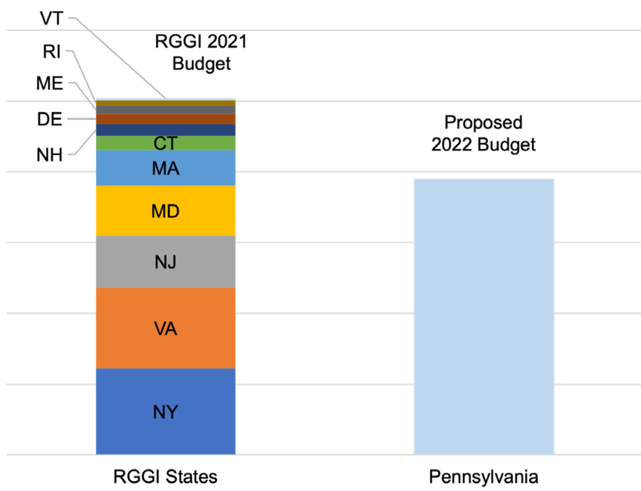
1. NERC M-1 Reserve Margin, https://www.nerc.com/pa/RAPA/ri/Pages/PlanningReserveMargin.aspx.

2. Documentation for EPA's Power Sector Modeling Platform v6 – Summer 2021 Reference Case, https://www.epa.gov/airmarkets/documentation-epas-power-sector-modeling-platform-v6-summer-2021-reference-case, at 3-18, Table 3-9. IPM assumes a reserve margin of 15% for New England; 16% for New York; and 15.4% for the Mid-Atlantic PJM market.

reliability in PJM (a Regional Transmission Organization, or RTO, operating in the Mid-Atlantic region and parts of the Midwest), also noted that since the start of the program, states in PJM that participate in RGGI "have successfully handled coal-fired deactivations at the same rate than the non-RGGI states."[7] Additionally, the North American Electric Reliability Corporation (NERC), regional grid operators, and RGGI, Inc. have each released statements indicating that they have not identified reliability issues related to RGGI.

7. Analysis Group, "Electric System Reliability and EPA's Clean Power Plan: The Case of PJM" (Mar. 16, 2015), https://www.analysisgroup.com/uploadedfiles/content/insights/publishing/electric_system_reliability_and_epas_clean_power_plan_case_of_pjm.pdf.

Figure 2. RGGI CO_2 Allowances by State (million short tons CO_2)



States have similarly evaluated grid reliability related to RGGI. In Pennsylvania, in response to stakeholder concerns, state regulators closely considered the potential impacts of Pennsylvania joining RGGI, including impacts to grid reliability. The Pennsylvania Department of Environmental Protection (PA DEP) concluded in late 2020 that it did not expect adverse reliability impacts from participating in the program.[8] PA DEP relied on modeling projections that coal-fired generation was likely to retire with or without RGGI (although RGGI might accelerate the timeline) and that the program was projected to only moderately increase renewables buildout (to no more than 15% of generation in Pennsylvania by 2030, while the regional grid operator, PJM, estimated the system could absorb twice that without significant issue).[9] Meanwhile, modeling projects that by joining RGGI, Pennsylvania would reduce CO_2 emissions from electricity generation by roughly 190 million short tons by 2030, compared to a business-as-usual scenario, and incur significant public health benefits due to reductions in nitrogen oxides (NOx) and sulfur dioxide (SO_2).

THE FLEXIBILITY OF REGIONAL TRADING PROGRAMS

Inherent features of RGGI program design serve to alleviate potentially adverse reliability impacts. As a technology-neutral, market-based policy, RGGI does not command that a utility or generator take any particular action to meet tightening emission limits. This flexibility allows emissions reductions to happen wherever they are most cost-effective. In 2016, NERC noted the success of RGGI and other market-based emission reduction programs, stating: "The power industry has been successful in complying with prior mass-based emission cap and trade programs (e.g., Acid Rain Program, Clean Air Interstate Rule, and RGGI) without creating reliability impacts."[10] Moreover, the regional nature of RGGI's trading market allows for increased flexibility and liquidity, better allowing power plant operators to purchase emissions

8. PA DEP identified no concerns with reliability; when they asked PJM, the regional grid operator, to analyze potential reliability impacts of joining RGGI, the resulting study also did not identify any concerns. General Electric International, Inc., PJM Renewable Integration Study (2014), https://www.pjm.com/~/media/committees-groups/subcommittees/irs/postings/pris-executive-summary.ashx.
9. PA DEP, "CO2 Budget Trading Program: Comment and Response Document," (Nov. 7, 2020) https://files.dep.state.pa.us/Air/AirQuality/AQPortalFiles/RGGI/2021/03a_7-559_CO2_Budget_Trading_Final_CR_Doc.pdf; https://files.dep.state.pa.us/Air/AirQuality/AQPortalFiles/RGGI/PA_RGGI_Modeling_Report.pdf.
10. NERC, "Reliability Considerations for Clean Power Plan Development," (Jan. 2016), https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/Reliability%20Considerations%20for%20State%20CPP%20Plan%20Development%20Baseline%20Final.pdf#search=reliability%20regional%20greenhouse%20gas%20program.

allowances when needed. The program's three-year compliance periods can also help to mitigate any short-term reliability problems that could emerge due to shortages of emissions allowances.

RGGI's flexible compliance mechanisms also serve to mitigate potential reliability impacts. NYISO has highlighted the program's Cost Containment Reserve and emissions offsets features as some of the "several design features that are intended to avoid price spikes and to avoid situations where the CO_2 reduction requirement could interfere with electric system reliability." [11] Last year, NYISO remarked that "tighter [RGGI] requirements" compared to today's emissions cap "are not likely to trigger reliability concerns" due to the program's many flexible program design features.[12] Many of these flexible compliance features were designed intentionally in the development of the RGGI program for reliability reasons and otherwise.[13]

Lastly, grid operators and utility regulators continue to play essential roles in maintaining reliability under a variety of operating conditions, regardless of whether a state is in RGGI. The grid operators may direct certain emissions-intensive generators to come online during extreme conditions or to remain in reserve to serve as peaking units, where such units supply needed generation capacity and ancillary services in a specified region or location on the electricity grid. Independent system operators continue to closely monitor the electric grid and ascertain any potential impact of RGGI on grid reliability, as they have since the start of the program. In 2010, NERC noted that the Northeast Power Coordinating Council—the regional electric reliability council responsible for promoting and enhancing grid reliability in Northeastern North America—"does not expect that the presence of RGGI would result in reliability impacts to the region." [14] In 2019, NYISO acknowledged that the combination of climate and clean energy policies being layered on "raise[] uncertainties about the makeup of the future grid" but stated that tighter requirements through RGGI "are not likely to trigger reliability concerns." [15]

Further additional reliability safeguards exist at the state and federal level. For example, certain RGGI states have adopted regulatory provisions that allow the state to override RGGI requirements in the event of a reliability or other emergency.[16] In addition, the U.S. Department of Energy (DOE) has the authority to suspend environmental regulations for up to 90 days in cases of emergencies relating to energy shortages.[17]

---

11. NYISO, "Clean Power Plan Assessment," (Dec. 2016), https://www.nyiso.com/documents/20142/1394495/Clean_Power_Plan_Assessment-Final_Report-December_2016.pdf/8f810be2-21aa-a5fb-a8db-085ca5d6d383.
12. NYISO, "2020 Reliability Needs Assessment," (Nov. 2020), https://www.nyiso.com/documents/20142/2248793/2020-RNAReport-Nov2020.pdf.
13. RGGI, Workshop on Electric Markets, Reliability, and Planning in Support of RGGI (Nov. 30, 2004), https://www.rggi.org/sites/default/files/Uploads/Design-Archive/Workshops/Electricity_Markets_Workshop.zip.
RGGI, "Potential Emissions Leakage and RGGI: Evaluating Market Dynamics, Monitoring Options, and Possible Mitigation Mechanisms," (Mar. 14, 2007), https://www.rggi.org/sites/default/files/Uploads/Design-Archive/Staff-Working-Group/il_report_final_3_14_07.pdf; Burtraw, D. and K. Palmer, "Summary of the Workshop to Support Implementing the Minimum 25 Percent Public Benefit Allocation in RGGI." Resources for the Future Discussion Paper DP-06-45 (Sept. 2006), https://media.rff.org/documents/RFF-DP-06-45.pdf.
14. NERC. 2010. "2010 Summer Reliability Assessment." https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/2010%20Summer%20Reliability%20Assessment.pdf#search=reliability%20regional%20greenhouse%20gas%20program.
15. NYISO, "Power Trends 2019: Reliability and a Greener Grid." https://www.nyiso.com/documents/20142/2223020/2019-Power-Trends-Report.pdf, at 41.
16. NERC, "2009 Summer Reliability Assessment," https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/summer2009.pdf#search=reliability%20regional%20greenhouse%20gas%20program.
17. 16 U.S.C. §824a(c).

RGGI also has existing processes to address any adverse impacts, such as reliability, were they to arise. Every few years, the RGGI participating states conduct comprehensive program reviews and consider whether any changes should be made to improve the program. The RGGI states are beginning their third program review in 2021.[18]

States' participation in RGGI may in fact *improve* electric grid reliability if states choose to invest allowance auction proceedings in measures such as energy efficiency that reduce peak electric demand.[19] As RGGI explains in a 2017 press release, "Investments through RGGI improve the cost-effectiveness and reliability of the grid by reducing peak demand, which in turn lowers wholesale power prices and helps avoid the need for costly infrastructure investments." [20] To date, states have elected to invest more than half of the program's cumulative auction proceeds since the start of the program in energy efficiency.[21]

CONCLUSION

RGGI analysis uses the same power sector model that the U.S. EPA, states, utilities, and environmental groups have used to analyze other state and federal air pollution policies for three decades. This model, known as the Integrated Planning Model, includes three sets of parameters that relate to electric reliability.

Moreover, RGGI has an established record of performance reaching back to 2008. Reviewing that history indicates that RGGI has not compromised electric grid reliability. This may be in large part due to the inherent flexibility of the program. Built-in program reviews also provide space for the RGGI states and stakeholders to assess periodically the program's performance and make changes as necessary. Finally, in some instances the RGGI program may even improve reliability when states invest auction proceeds in measures such as energy efficiency and peak demand shaving.

18. The Regional Greenhouse Gas Initiative, "Program Review," https://www.rggi.org/program-overview-and-design/program-review.
19. For example, the Rhode Island Office of Energy Resources (OER) used RGGI auction proceedings to invest in a "System Reliability Procurement Distributed Generation Pilot, which explored the ability of solar arrays to reduce peak electricity needs on the local electric distribution system and thereby provide cost savings by postponing the need for utility upgrades." RGGI, "The Investment of RGGI Proceeds in 2019" (June 2021), https://www.rggi.org/sites/default/files/Uploads/Proceeds/RGGI_Proceeds_Report_2019.pdf
20. RGGI, "RGGI States Announce Proposed Program Changes: Additional 30% Emissions Cap Decline by 2030" (Aug. 23, 2017), https://www.rggi.org/sites/default/files/Uploads/Program-Review/8-23-2017/Announcement_Proposed_Program_Changes.pdf.
21. RGGI, "The Investment of RGGI Proceeds in 2019" (June 2021), https://www.rggi.org/sites/default/files/Uploads/Proceeds/RGGI_Proceeds_Report_2019.pdf.