Aligning NYISO's Carbon Pricing with Existing Climate Policy

By

Jordan Stutt

Dr. Brian Murray, Advisor

April 24th, 2019

Masters project proposal submitted in partial fulfillment of the requirements
for the Master of Environmental Management degree
in the Nicholas School of the Environment of Duke University

Table of Contents

Executive Summary

As the costs of climate change become clearer, states are implementing increasingly bold policies to reduce carbon dioxide and other greenhouse gas emissions from the electricity sector. State climate and clean energy policies are necessary to decarbonize the electric sector and the economy more broadly, but they can also lead to energy resource constraints and electricity cost increases. These issues are of particular concern to the electricity grid operators charged with ensuring reliable, affordable electricity service.

In December 2018, the electricity grid operator for New York State—NYISO—issued a proposal to apply a price on carbon emissions from the state's power plants. The carbon pricing proposal is intended to help New York meet its climate and clean energy goals as cost-effectively as possible by incorporating the cost of carbon into New York's wholesale electricity market. Rather than relying on regulatory mandates to drive change in the electricity sector, this proposal would use a predictable, transparent price signal to reduce electric sector carbon emissions.

The development of this first-of-its-kind proposal and its potential implementation have raised many questions regarding the policy's design and impacts. This paper evaluates analysis conducted to-date on the NYISO carbon pricing proposal and contributes additional quantitative and qualitative analysis to answer the following questions:

How could NYISO's carbon pricing proposal affect the Regional Greenhouse Gas Initiative (RGGI)?
New York already participates in RGGI, a multi-state cap-and-invest program that charges owners of fossil fuel-fired power plants for their carbon emissions. The NYISO carbon price would be applied in addition to the cost of RGGI compliance, creating a stronger price signal to reduce carbon emissions from power plants in New York. Reduced demand for RGGI emissions allowances in New York could lead to lower RGGI allowance prices across the region, a reduced incentive to pursue emissions abatement in other RGGI states, and reduced RGGI proceeds for investment in energy efficiency and clean energy programs.

What are the projected emissions impacts of the proposed carbon price?
Based on energy sector modeling conducted to-date, NYISO's carbon pricing proposal is projected to have limited impacts on carbon emissions in New York. Multiple analyses have found that the carbon pricing proposal will account for approximately one million tons of carbon dioxide emissions reductions between 2022 and 2030, relative to a business-as-usual reference case. Early modeling also suggests that the program will have a modest impact on the RGGI market, but additional analysis is needed to explore this question more thoroughly.

What are the factors limiting the emissions impacts of the proposed carbon price?
One might expect that a substantial increase in the carbon price signal would result in more significant carbon emissions reductions. The emissions impact of NYISO's carbon pricing proposal is limited, however, due to three central factors. First, New York is expected to meet ambitious clean energy requirements that are already in place, reducing the potential for additional, low-cost emissions abatement. Second, there is limited opportunity in New York for fuel switching from more carbon-intensive fossil fuels, like coal and oil, to natural gas for electricity generation. Finally, modeling conducted to-date assumes that the proceeds generated by the carbon price will be returned to customers through electricity bill rebates, rather than invested in programs that reduce carbon emissions.

Following the consideration of the questions above, this paper offers two policy recommendations to ensure that the carbon adder delivers the greatest possible emissions benefits:

- **Utilities receiving NYISO carbon pricing proceeds should be required to invest a portion of those proceeds into energy efficiency programs.** The New York State Public Service Commission would oversee how utilities use these funds; by requiring utilities to use the funds to expand energy efficiency programs, the Public Service Commission can ensure that NYISO's carbon pricing proposal achieves greater emissions reductions while delivering long-term consumer benefits.

- **RGGI allowance supply should be adjusted to account for the projected emissions reductions driven by the NYISO carbon pricing proposal.** Whether New York acts alone by retiring allowances or the RGGI states act together by lowering the regional cap, action is necessary to ensure that NYISO's carbon pricing does not reduce the incentive for emissions abatement nor the funds available for clean energy investment in the other RGGI states.

Introduction

In the face of increasing urgency to address climate change and a lack of federal guidance, state policies to reduce carbon dioxide (CO_2) emissions are filling the void. Across the Northeast and Mid-Atlantic regions of the United States, states have implemented economy-wide greenhouse gas (GHG) reduction targets, clean energy requirements, and nation-leading energy efficiency programs. Nine of these states, shown in Table 1, also participate in the Regional Greenhouse Gas Initiative (RGGI), the first market-based program in the country to limit power sector CO_2 emissions. Together, these programs and policies should deliver substantial emissions reductions from the region's electric sector.

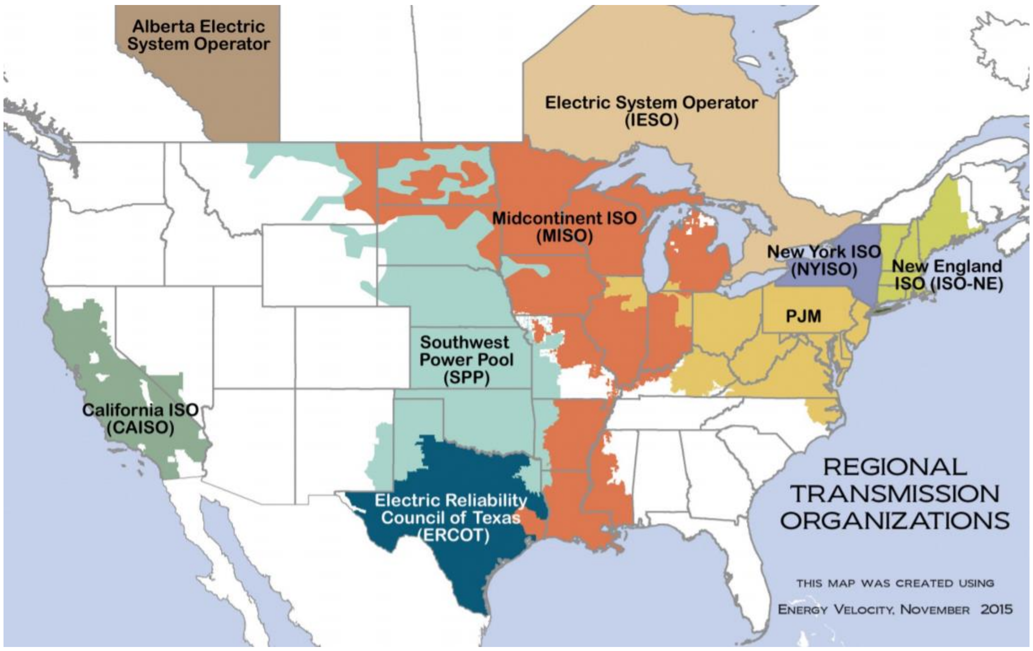
Table 1: Clean Energy and Climate Targets in the RGGI States

State	Economy-Wide GHG Reduction Target[1]	Renewable Energy Requirement[2]	National Energy Efficiency Rank[3]
Connecticut	45% below 2001 by 2030[4]	48% by 2030	5
Delaware	30% below 2008 by 2030	25% by 2025	14
Maine	10% below 1990 by 2020	10% by 2017	22
Maryland	40% below 2006 by 2030	25% by 2020	10
Massachusetts	25% below 1990 by 2020	40% by 2030	1
New Hampshire	20% below 1990 by 2025	25% by 2025	21
New York	**40% below 1990 by 2030**	**50% by 2030**	**6**
Rhode Island	45% below 1990 by 2035	31% by 2030	3
Vermont	40% below 1990 by 2030	72% by 2030	4

[1] GHG reduction targets from C2ES unless noted otherwise. *U.S State Greenhouse Gas Emissions Targets*, available at: https://www.c2es.org/document/greenhouse-gas-emissions-targets/
[2] Renewable energy requirements from DSIRE's renewable energy program database. *Database of State Incentives for Renewables & Efficiency*, available at: http://www.dsireusa.org/
[3] National energy efficiency rankings from the American Council for an Energy-Efficiency Economy, 2018. *The State Energy Efficiency Scorecard*, available at: https://database.aceee.org/state-scorecard-rank
[4] Connecticut Governor's Council on Climate Change, 2018. *Mid-term Target Recommendation and Statement of Principles*, available at: https://www.ct.gov/deep/lib/deep/climatechange/gc3/gc3_statement_of_principles_3_2018.pdf

Exactly how these electric sector requirements will be achieved is of great interest to the region's electric grid operators. There are three Independent System Operators (ISO) or Regional Transmission Organizations (RTO) that manage the electric grid across the Northeast and Mid-Atlantic, shown in Figure 1: PJM (spanning 13 states in the Midwest and Mid-Atlantic), New York ISO (NYISO, serving only New York), and ISO New England (serving the six New England states). All three of these RTOs manage the wholesale electricity markets in their respective territories and share a mission of ensuring reliable, cost-efficient electricity delivery.[5]

Figure 1: Regional Transmission Organizations in the United States[6]



RTOs must consider how to balance state-imposed requirements for clean energy procurement, GHG reductions and energy efficiency savings with their core mission of delivering reliable, low-cost electricity. Calls for rapid renewable energy deployment are frequently met with concerns about grid reliability and cost impacts; RTOs in states with ambitious clean energy and climate standards face the difficult task of ensuring that the achievement of those targets does not impair reliability or impose avoidable cost burdens on electricity consumers. Considering that state policies vary a great deal within RTOs, and that electricity flows across RTO boundaries, this can pose a complicated challenge.

One strategy that has been explored to balance these needs in each of the Northeast and Mid-Atlantic RTOs is the implementation of a price on carbon emissions, applied through wholesale electricity markets (PJM 2017 and ISO New England 2016). According to NYISO, "[a]cknowledging the social cost of carbon emissions, and capturing those impacts in the wholesale electricity markets provides a market-oriented, cost effective, approach to harmonize state policy and NYISO markets" (NYISO 2018). With a sufficiently high carbon price, this approach could help RTOs chart a more predictable, low-cost pathway to the decarbonization of the electric sector.

The benefits of carbon pricing through wholesale electricity markets will be maximized if the policy is designed to complement existing electric sector decarbonization approaches. In states with existing carbon pricing policies, like RGGI, RTOs must account for the fact that many power plants are already

---

[5] *PJM's Mission and Vision*, available at: https://www.pjm.com/about-pjm/who-we-are/mission-vision.aspx

[6] Federal Energy Regulatory Commission, 2015. *Regional Transmission Organizations*, available at: https://www.ferc.gov/industries/electric/indus-act/rto/elec-ovr-rto-map.pdf

paying a market-determined price for CO_2 emissions, and the RTO carbon charge should be adjusted accordingly to avoid double charging. In the RGGI context, RTOs also need to consider how a carbon price in the wholesale electricity market would affect RGGI market and emissions dynamics. Finally, adding a price on carbon in the wholesale electricity market could produce substantial revenue. That revenue could be returned to electric utility consumers, it could be used to bolster energy efficiency and clean energy programs to further reduce CO_2 emissions, or RTOs and policymakers could determine than another use would be most appropriate.

Of these three RTOs that have been actively discussing carbon pricing, NYISO has made the most progress towards developing a carbon pricing policy. While PJM and ISO-NE manage the electricity grid across multiple states, NYISO is a one-state RTO, and can therefore act more quickly. Through 2017 and 2018, carbon pricing was the focus of the NYISO Integrating Public Policy Task Force (IPPTF).[7] The IPPTF focused on six “Issue Tracks”: straw proposal development, wholesale energy market mechanics, policy mechanics, interactions with other wholesale market processes, interaction with other state policies and programs, and impacts. Following robust energy market modeling, stakeholder engagement, and draft policy discussions, NYISO staff released a final carbon pricing proposal in December 2018 (NYISO 2018).

Overview of NYISO Carbon Adder Proposal

NYISO’s carbon pricing proposal would be applied through the wholesale energy market. In New York’s competitive wholesale electricity market, electricity generators submit bids to NYISO to sell electricity through the wholesale energy market. Those bids represent the marginal cost of supplying a specified amount of electricity (including fuel, operations and maintenance costs) associated with producing an additional MWh of electricity at a specific point in time. Under NYISO’s proposal, the cost of carbon would be included as an additional marginal cost component in generator bids: a carbon adder. The NYISO would automatically apply the carbon adder to generator bids based on previously reported emissions factors.

NYISO’s competitive wholesale electricity market is structured to ensure that the electricity demanded at any point in time is met by the least expensive sources of electricity available. To achieve that outcome, a bid stack is created in which electricity bids are ordered from least to most expensive. This represents the electricity supply curve. For a given quantity of electricity demanded, only the least expensive sources of electricity necessary to supply that quantity will be called upon. These “clearing” bids will supply electricity and be compensated by NYISO at the bid clearing price. Non-clearing bids will not be called upon, and those bidding generators will not operate. The inclusion of a carbon adder in the bids of emitting generators makes those bids more expensive relative to the bids of less-emitting generators, thereby increasing the share of electricity generated by low- or zero-emitting resources. The generator’s CO_2 emissions rate (tons of CO_2/MWh) and the price per ton of CO_2 (set by the New York State Public Service Commission) determine the carbon adder cost included in a specific bid.

In a competitive wholesale electricity market with a carbon price “[e]mitting facilities become less profitable to build and maintain, while non-emitting facilities become more profitable and competitive … [C]arbon pricing also sends a demand-side signal to reduce energy use when high carbon-emitting resources are operating. This will likely spur greater energy-efficiency investments, by making them more cost-effective” (ISO New England, 2017).

[7] Per NYISO: “The IPPTF is an open forum that solicits stakeholder input and feedback on concepts and proposals for incorporating carbon pricing into the wholesale energy markets to harmonize the state’s energy policies and the operation of those wholesale markets.” For more information, see: https://www.nyiso.com/ipptf

The carbon adders paid by generators would be collected by NYISO. This pool of funds, referred to as carbon residuals, represents the additional costs paid by consumers for electricity due to the carbon adder. NYISO has proposed to allocate the carbon residuals to Load Serving Entities (LSEs, henceforth referred to as utilities), but NYISO does not have jurisdiction to impose requirements regarding how utilities use the funds. Exactly how utilities use those funds—whether for consumer electric bill rebates, energy efficiency programs, or otherwise—would be subject to approval from the New York State Public Service Commission (PSC).

The Regional Greenhouse Gas Initiative

NYISO's proposed carbon adder would be implemented in addition to an existing program that applies a carbon charge to CO_2 emissions from New York's power plants: the Regional Greenhouse Gas Initiative (RGGI).

The Regional Greenhouse Gas Initiative (RGGI) is a cap-and-trade program that was launched in 2009 to reduce CO_2 emissions from power plants in the Northeast and Mid-Atlantic. Through RGGI, the participating states establish a regional cap on CO_2 emissions from compliance entities: power plants that are 25 megawatts (MW) or larger. The cap for the currently participating nine states was set at 165 million short tons in 2009, it is 80.2 million short tons in 2019, and is set to decline to 54.7 million short tons in 2030.

For each ton of CO_2 allowed by the cap, one allowance is created. Power plant owners must obtain and surrender to RGGI, Inc. one allowance for each ton of CO_2 they emit. Demand for a limited supply of allowances gives those allowances monetary value, which the RGGI states capture by distributing allowances through quarterly auctions. The allowances can also be resold on a secondary market providing real time price signals to market participants. This model creates a financial incentive to reduce emissions without prescribing any specific measures, allowing the market to identify the lowest-cost opportunities to reduce emissions. This model also results in a carbon price that fluctuates as compliance entities respond to numerous market factors.

Since RGGI was launched, CO_2 emissions from the region's power plants have fallen precipitously. From 2008 to 2018, emissions covered by the program fell by 47 percent.[8] That decline in emissions can be attributed to a number of factors, including the emergence of low-cost natural gas, declining renewable energy costs, improved energy efficiency, and RGGI itself. A counterfactual analysis of RGGI emissions reductions through 2011 found that RGGI played a much larger role in reducing emissions than the decline in natural gas prices (Murray and Maniloff, 2015).

RGGI contributes to emissions reductions through two primary program elements: the carbon price and the investment of auction proceeds. The carbon price is represented by the market price of RGGI allowances, and it affects emissions in the same manner—though not necessarily to the same extent—as the NYISO carbon adder would; generator bids in the wholesale electricity market include the marginal cost of RGGI allowances associated with the electricity offered.

RGGI states also achieve emissions reductions through the investment of RGGI auction proceeds. Through March 2019, RGGI auctions have generated $3.14 billion in proceeds for the participating states.[9] While each RGGI state uses its share of RGGI auction proceeds differently, the majority of proceeds have been invested in energy efficiency programs. Through 2016, energy efficiency accounted for 58 percent of RGGI-funded investments, followed by clean and renewable energy programs (14

---

[8] Since 2008, RGGI-covered emissions have fallen from 133 million short tons of CO_2 to 70 million short tons in 2018. Data from RGGI CO_2 Allowance Tracking System, *Summary Level Emissions Reports*, available at: https://rggi-coats.org/eats/rggi/index.cfm?fuseaction=search.rggi_summary_report_input&clearfuseattribs=true
[9] RGGI, Inc., 2019. *Auction Results*, available at: https://www.rggi.org/auctions/auction-results

percent), GHG abatement measures (14 percent), and energy bill rebates (eight percent).[10] The region-wide emphasis on energy efficiency investment can be attributed to the scale and variety of benefits achieved through energy efficiency measures.

> "[F]rom a strictly economic perspective, some uses of proceeds clearly deliver economic returns more readily and substantially than others. For example, RGGI investment in [energy efficiency] leads to lower electrical demand, lower wholesale power prices, and lower consumer electricity bills. These savings remain in the pockets of electricity users, and the [energy efficiency] investments also produce positive macroeconomic impacts locally as more dollars stay in and contribute to the local economy" (Hibbard, et al., 2018).

Independent analyses have found that RGGI has delivered substantial environmental, employment and economic benefits in the region, primarily as a result of the investment of RGGI auction proceeds. Through the program's first nine years, RGGI has added approximately $4 billion in net economic benefit to the participating states and 44,700 job-years (Hibbard, et al., 2018). This is the net result of the gains and losses experienced by consumers and owners of power plants, and the broader economic impacts resulting from those gains and losses (e.g. changes in spending and employment). Investment of RGGI proceeds through 2016 are projected to reduce electricity consumption by 34.9 million megawatt-hours (MWh) and to save consumers $8.6 billion on energy bills over the lifetime of the investments.[11] RGGI, Inc. also reports that RGGI-funded investments in energy efficiency and clean energy through 2016 will reduce CO_2 emissions by 27.8 million shorts tons. Some portion of those emissions reductions, however, could be canceled out. As energy efficiency investments reduce electricity demand, demand for RGGI allowances falls. But the RGGI cap is fixed, which together with the reduced demand causes a reduction in RGGI allowance prices. At lower RGGI allowance prices, less emissions abatement would be pursued. This outcome is mitigated, though not eliminated, by interventions that reduce allowance supply (cap reductions,[12] adjustments for banked allowances[13]) and RGGI mechanisms that limit the sale of allowances when prices fall below certain thresholds (for example, the auction reserve price[14] and emissions containment reserve[15]).

Investments in energy efficiency and clean energy programs are closely aligned with the goals mentioned in the original RGGI Memorandum of Understanding, which include reducing CO_2 emissions, increasing clean energy development, reducing dependence on imported fossil fuels, and improving economic welfare.[16]

---

[10] RGGI, Inc., 2018. *The Investment of RGGI Proceeds in 2016*, available at: https://www.rggi.org/sites/default/files/Uploads/Proceeds/RGGI_Proceeds_Report_2016.pdf

[11] *Ibid.*

[12] Following both of RGGI's periodic program reviews, the participating states have chosen to reduce future RGGI cap levels. RGGI, Inc., 2019. *Program Review,* available at: https://www.rggi.org/program-overview-and-design/program-review

[13] Following both of RGGI's periodic program reviews, the participating states have implemented adjustments for banked allowances. Through these adjustments, the RGGI states reduce future cap levels to address current allowance oversupply. RGGI, Inc., 2019. *Elements of RGGI*, available at: https://www.rggi.org/program-overview-and-design/elements

[14] RGGI allowances will only be sold through auctions if the clearing price is equal to or above the auction reserve price, or the "price floor." The price floor is $2.26/allowance in 2019, increasing by 2.5% each year. *Ibid.*

[15] The Emissions Containment Reserve (ECR) will begin in 2021 with a trigger price of $6.00/allowance. A reduced quantity of allowances will be made available if the auction clearing price falls below the ECR trigger price. *Ibid.*

[16] *Regional Greenhouse Gas Initiative Memorandum of Understanding*, 2015, available at: https://www.rggi.org/sites/default/files/Uploads/Design-Archive/MOU/MOU_12_20_05.pdf

Potential Impacts of the Carbon Adder on RGGI

Given the similarities between RGGI and NYISO's proposed carbon adder, it should be a priority for relevant regulators and policymakers to ensure that the initiatives are aligned, rather than operating with inefficient redundancies.

Aligning Price Signals

The first and most straightforward alignment issue is that of the carbon price imposed by the two policies. RGGI allowance prices—which represent the price per ton of CO_2—have ranged from $1.86 to $7.50 through RGGI's auctions.[17] The RGGI price is not set at predetermined levels, but is instead responsive to market forces which determine the marginal cost of meeting the cap. NYISO's carbon adder, on the other hand, would be tied to the Social Cost of Carbon (SCC), as determined by the PSC. The SCC represents the cost to society from the release of one ton of CO_2 into the atmosphere, calculated through a robust scientific process examining projected CO_2 emissions, impacts of climate change, and the monetization of those impacts (Pizer, et al., 2014). In recent proceedings, the PSC has used a 2020 SCC price of $47.30, escalating to $69.32 by 2030 (NYISO 2018). Rather than adding the SCC on top of the RGGI price, NYISO has proposed to deduct the RGGI price from the "Gross SCC", creating a "Net SCC" that would be applied to the bids of generators that already participate in RGGI. Table 2, below, from NYISO's carbon adder proposal provides an example of potential Net SCC charges, based on projected RGGI prices.

Table 2: Gross and Net Social Cost of Carbon (NYISO 2018)

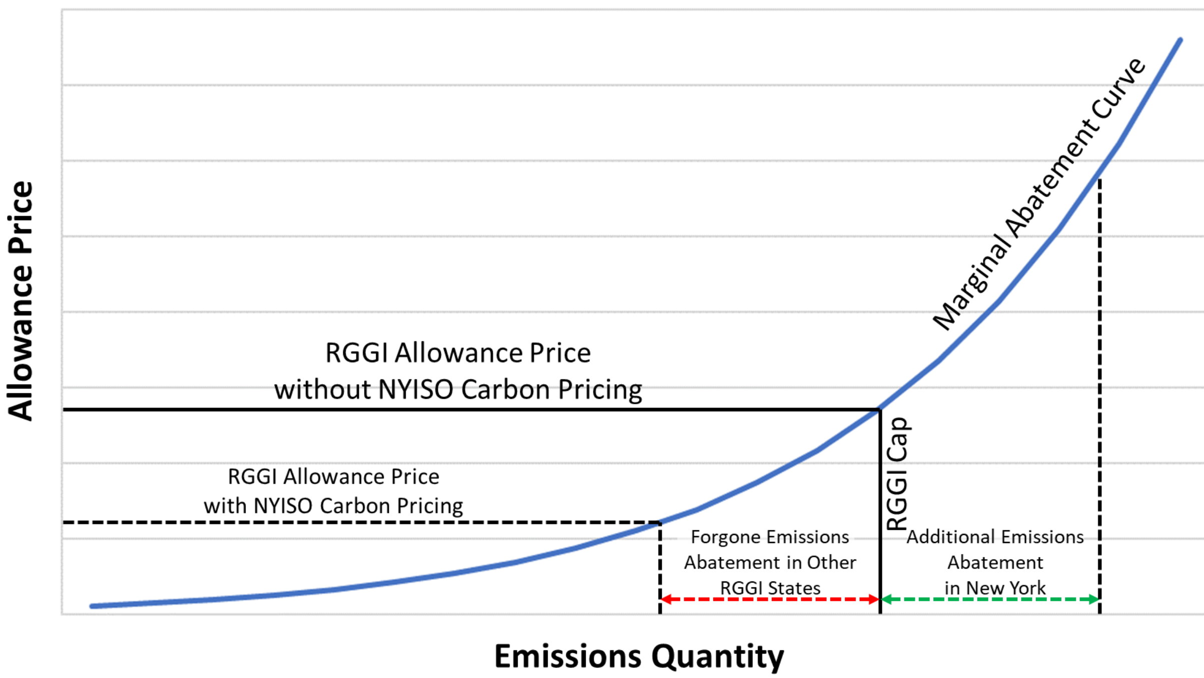
	Gross SCC	RGGI, Inc.	Net SCC
	$nominal/US-ton	$nominal/US-ton	$nominal/US-ton
2020	47.30	6.56	40.74
2021	48.30	6.98	41.32
2022	50.48	7.39	43.09
2023	52.74	7.81	44.93
2024	55.07	8.45	46.62
2025	57.48	9.09	48.39
2026	59.96	9.73	50.23
2027	62.52	10.35	52.18
2028	65.17	10.96	54.20
2029	66.54	11.58	54.96
2030	69.32	12.55	56.77

RGGI Market Impacts

The implementation of NYISO's proposed carbon adder would establish a significantly higher price on carbon emissions than the existing price imposed by RGGI. Importantly, this higher carbon price would only be applied in New York, while generators in the rest of the RGGI states would face a comparably lower price on carbon emissions. The stronger price signal in New York should cause greater emissions abatement to occur in New York. These resulting emissions reductions would reduce demand for RGGI allowances, which would result in lower RGGI allowance prices. This dynamic is depicted below in Figure 2, which draws on the Brattle Group's initial carbon pricing proposal for NYISO (Newell, et al., 2017). The additional carbon abated in New York should be equal in quantity to the forgone carbon abatement in other RGGI states.

[17] RGGI, Inc., 2019. *Auction Results*, available at: https://www.rggi.org/auctions/auction-results

Figure 2: NYISO Carbon Adder Impact on RGGI Price and Emissions Abatement



This potential decrease in RGGI allowance prices would be problematic for two reasons. First, a lower carbon price signal in the rest of the RGGI states would likely cause generators in those states to emit more CO_2. Second, lower clearing prices in RGGI auctions would result in less auction revenue for the states to invest in energy efficiency and clean energy programs.

Emissions Leakage Caused by Lower RGGI Price

The NYISO carbon adder has the potential to cause CO_2 emissions reductions in New York that are partially offset by emissions increases in other states. This is referred to as emissions leakage. The NYISO carbon adder proposal includes a policy framework to mitigate emissions leakage caused by differential treatment of CO_2 emissions from electricity generated inside New York and electricity generated outside of New York.[18] That framework, however, does not account for the potential emissions impact of a reduced RGGI allowance price. Therefore, if the NYISO carbon adder causes emissions abatement in New York that reduces the demand for and price of RGGI allowances, some degree of increased CO_2 emissions would be expected in the rest of the RGGI states.

As discussed earlier, RGGI does have a reserve price, or a "price floor", below which no allowances will be sold through auctions, as well as an Emissions Containment Reserve (ECR), through which a reduced amount of allowances are withheld from auctions if the auction clearing price falls below a predetermined trigger price. If the NYISO carbon adder were to push RGGI prices downward to (or below) the price floor or ECR trigger price, allowances would be withheld, allowance supply would be reduced, and some

[18] From NYISO proposal: "Imports would earn the LBMP without the carbon effect, at the relevant border; similarly, exports would buy energy at the LBMP without the carbon effect" (NYISO 2018).

degree of emissions leakage would be mitigated. However, if the NYISO carbon adder pushes RGGI prices downward, but not all the way to the ECR trigger price, emissions leakage could go unaddressed.

For example, at a RGGI allowance price of $5.27 (the most recent auction clearing price[19]), rational actors in Maine, Maryland, or any other RGGI state would pursue emissions abatement opportunities that cost less than $5.27 per ton of CO_2, while forgoing more expensive abatement opportunities in favor of purchasing RGGI allowances. If the RGGI allowance price fell to $5.00 as a result of the NYISO carbon adder causing lower demand for allowances from New York power plants, these same rational actors would forgo emissions abatement opportunities that cost between $5.00 and $5.27 per ton of CO_2.

Reduction in RGGI-Funded Investment

In addition to emissions leakage within the RGGI region, a reduction in RGGI prices would impact regional emissions due to a decrease in RGGI-funded investments in energy efficiency and clean energy. Lower RGGI prices would result in reduced RGGI auction proceeds. Given that the majority of RGGI proceeds have been invested in programs that reduce CO_2 emissions, any reduction in those proceeds could be expected to result in reduced emissions abatement.

Addressing RGGI Allowance Price Impacts

While the NYISO carbon pricing proposal does not include measures to address RGGI allowance price impacts, a stakeholder has proposed an alternative to the NYISO carbon adder that could contain a potential solution.

The Long Island Power Authority (LIPA) has proposed that New York State retire RGGI allowances until the price of RGGI allowances reaches the Cost Containment Reserve (CCR) trigger price.[20] Through the CCR, the RGGI states make additional allowances available for purchase when the allowance auction price exceeds a predetermined threshold.[21] This increase in allowance supply is intended to mitigate high allowance prices and protect electricity consumers from additional cost burden. Were an individual RGGI state to take an action intended to raise RGGI allowance prices, as LIPA proposes New York should do, the other RGGI states may object. Decisions regarding the RGGI cap level and program elements that affect RGGI prices have historically been made with the agreement of all participating states; a unilateral action to increase allowance prices would not be aligned with that approach.

A similar approach that would be more closely aligned with NYISO's goals and RGGI's history would be for New York State to retire a quantity of RGGI allowances equal to the CO_2 emissions abatement caused by the NYISO adder. Under this approach, the impacts of reduced demand for RGGI allowances resulting from the NYISO adder would be offset by a reduction in the supply of RGGI allowances. While the calculation of emissions abatement caused by the carbon adder could be difficult, this approach would effectively mitigate any distortion to the RGGI price as a result of the NYISO carbon adder.

This policy would reduce the RGGI auction revenue that New York receives. However, that revenue could be recouped through the strategic use of NYISO carbon residuals, described below.

---

[19] Auction 43, held on March 13, 2019, resulted in a clearing price of $5.27 per allowance. RGGI, Inc., 2019. *Auction Results*, available at: https://www.rggi.org/auctions/auction-results

[20] LIPA, 2018. *Harmonizing Carbon Prices and Expected CES Reductions,* available at: https://www.nyiso.com/documents/20142/1408121/Harmonizing%20Carbon%20Prices%20and%20CES%20Reductions.pdf

[21] The Cost Containment Reserve trigger price in 2019 is $10.51/allowance. RGGI, Inc., 2019. *Elements of RGGI*, available at: https://www.rggi.org/program-overview-and-design/elements

.

Modeled Impacts of the NYISO Carbon Adder

RGGI Impacts

The degree to which the NYISO carbon adder will affect the RGGI market is an important issue for New York and the rest of the RGGI states to understand. The RGGI states make programmatic decisions based on shared expectations of future emissions reductions and RGGI allowance prices; if one state's actions change those expectations, the other RGGI states would have to reevaluate their positions on regional issues like the RGGI cap and other program design elements. Of the many analyses that have been conducted to examine the effects of the NYISO carbon adder, only one has included findings regarding the impact of the adder on RGGI allowance prices.

Resources for the Future examine the question of how the NYISO carbon adder would affect RGGI allowance prices in *Benefits and Costs of New York's Carbon Pricing Initiative: A Dynamic, Simulation-Based Analysis*, an analysis conducted in 2018 (Shawhan, et al., 2018). Contrary to the discussion above which hypothesizes that the NYISO carbon adder would result in lower RGGI allowance prices, Shawhan finds that the carbon adder would cause RGGI prices to increase relative to the business-as-usual (BAU) scenario. As shown in Table 3 the BAU scenario assumes that the RGGI allowance price will be $9.10 in 2025 (measured in 2013 dollars), while the 2025 RGGI allowance price with the NYISO carbon adder in place would be $9.59, an increase of 5.4 percent.

Table 3: RGGI Impacts, 2025 (Shawhan, et al., 2018)

	BAU	Policy	Change
Assumed Cap (Thousand Short Tons)	111,285	111,285	0
Allowance Price (2013$/Short Ton)	$9.10	$9.59	$0.49

This counterintuitive outcome is a result of the fact that the NYISO carbon adder would be applied to all power plants that are subject to RGGI in addition to smaller power plants that are exempt from RGGI. Under the RGGI regulations that are currently in place, emitting power plants with a nameplate capacity below 25 MW are not required to purchase RGGI allowances. Under the NYISO carbon adder those same units would have to pay the Gross SCC ($47.30/ton in 2020), while units subject to RGGI would pay the Net SCC ($40.74/ton 2020), effectively leveling the playing field from a carbon costs perspective (NYISO 2018). Shawhan's analysis shows that under this scenario New York's smaller power plants will operate less and larger power plants (that are subject to RGGI) will operate more. As RGGI power plants generate more electricity, demand for RGGI allowances increases and so do RGGI allowance prices. In short, by equalizing the currently uneven carbon charges applied to RGGI and non-RGGI power plant emissions, the NYISO carbon adder would lead to an increase in RGGI allowance prices.

This analysis includes the assumption that all power plants smaller than 25 MW will remain exempt from RGGI through 2025, but there is reason to believe that will not be the case. Throughout the 2016 RGGI program review, numerous stakeholders objected to the exemption of certain power plants that are individually below the 25 MW threshold, citing concerns that these plants are responsible for a disproportionately large amount air pollution in environmental justice communities.[22] In 2018, Governor Cuomo announced that a change would be made to New York's RGGI regulations to end the RGGI

[22] RGGI, Inc., 2017. *Northeast Environmental Justice and Climate Justice Regionwide Stakeholder Comments to RGGI*, available at: https://www.rggi.org/sites/default/files/Uploads/Program-Review/9-25-2017/Comments/Environmental_Justice_Joint_Comments.pdf

exemption for power plants that are 15 MW or larger.[23] At the time of writing this paper the New York State Department of Environmental Conservation (NYSDEC) has yet to publish updated RGGI regulations to officially enact Governor Cuomo's proposed change. We can, however, consider how the implementation of this proposed change would affect Shawhan's findings regarding the NYISO carbon adder and RGGI allowance prices.

If Shawhan and Palmer created a new BAU scenario ("BAU 2") in which all emitting New York power plants that are 15 MW or larger were subject to RGGI, the projected effect of the NYISO carbon adder on RGGI prices would likely change. Under this BAU 2 scenario, there would likely be a smaller amount of electricity generated by 15-25 MW power plants than in the original BAU, and more electricity generated by plants larger than 25 MW. The effect of this change on Shawhan's analysis could be a reduction in the magnitude of the RGGI price impact (e.g. 2025 RGGI allowance prices increase by three percent instead of five percent) or the direction of the impact (e.g. 2025 RGGI allowance prices decrease instead of increasing).

Emissions Reductions

Three major analyses have been conducted to better understand the impacts of the NYISO carbon adder. Each of these analyses, conducted by Resources for the Future, Daymark Energy Advisors, and the Brattle Group, produced similar findings regarding the proposed carbon adder's impact on CO_2 emissions: when compared to a business-as-usual reference case, the carbon adder results in "reductions of less than one million metric tons across the study period" spanning 2022 to 2030.[24]

Factors Limiting the Emissions Impact of the NYISO Carbon Adder

Ambitious Baseline

The emissions reductions achieved by the proposed carbon adder are limited as a result of three primary factors. First, the carbon adder scenario is compared to an ambitious "base case." Under this base case, all of the analyses assume that New York will achieve the targets of the Clean Energy Standard, which requires that at least 50 percent of the state's electricity comes from renewable energy sources by 2030.[25] Importantly, this assumption includes a gradually escalating RGGI price and compliance with the RGGI cap, but excludes the NYISO carbon adder. By complying with these two existing policies, New York's electric sector will emit much less CO_2 than it does today. As a result, the layering of a carbon adder on top of these existing policies drives a relatively small amount of additional abatement activity.[26]

---

[23] New York State, 2018. *Governor Cuomo Unveils 20th Proposal of 2018 State of the State: New York's Clean Energy Jobs and Climate Agenda*, available at: https://www.governor.ny.gov/news/governor-cuomo-unveils-20th-proposal-2018-state-state-new-yorks-clean-energy-jobs-and-climate

[24] The business-as-usual reference case assumes compliance with policies that are currently in place, including RGGI and New York's Clean Energy Standard. NYISO, 2018. *The Brattle Group, Daymark Energy Advisors, and Resources for the Future Carbon Charge Analysis Summaries and Synthesis*, available at: https://www.nyiso.com/documents/20142/3745115/2018.11.06%20Brattle%20RFF%20Daymark%20Carbon%20Charge%20Analysis%20Synthesis%20FOR%20POSTING.pdf

[25] State of New York Public Service Commission, 2016. *Order Adopting a Clean Energy Standard*, available at: http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7b44C5D5B8-14C3-4F32-8399-F5487D6D8FE8%7d

[26] While modeling conducted to date shows that the implementation of the NYISO carbon adder does not cause significant emissions abatement beyond what is achieved under the baseline scenario, the carbon adder could result in the achievement of similar emissions levels at a lower cost.

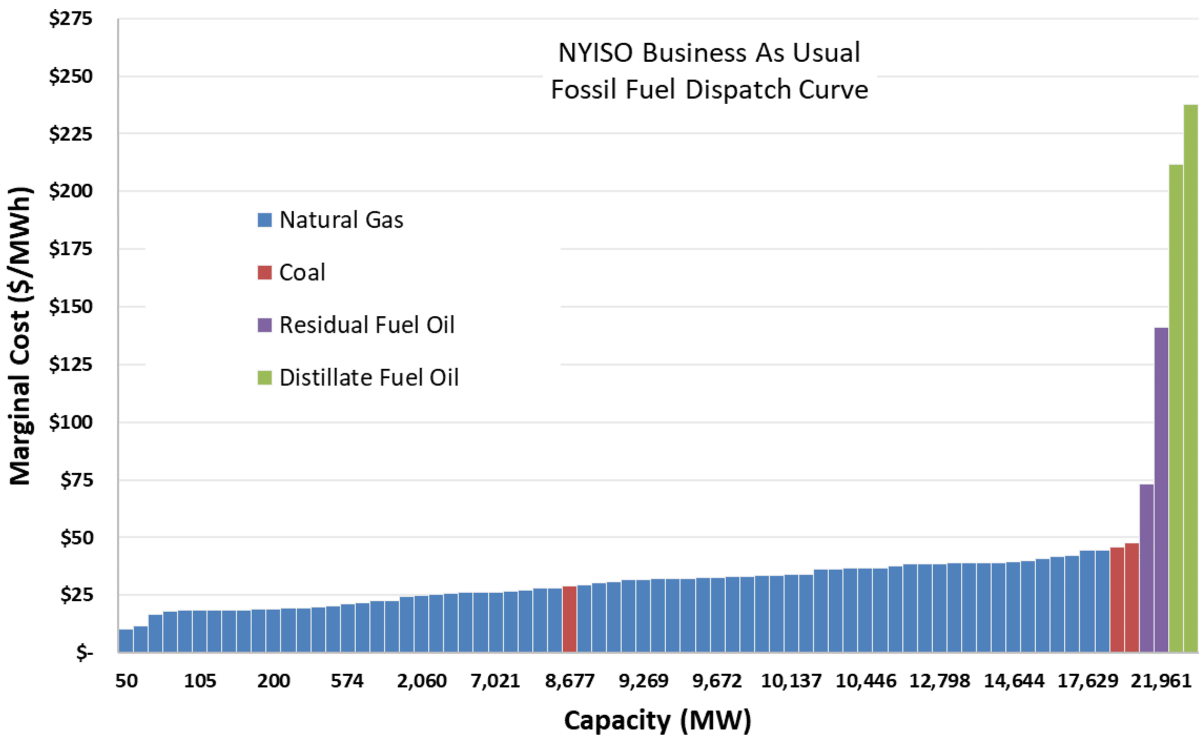
Limited Opportunity for Fossil-to-Fossil Fuel Switching

Second, there is limited opportunity to achieve emissions reductions through fossil-to-fossil fuel switching. To understand how the implementation of a carbon adder would affect NYISO generator dispatch, I created an illustrative dispatch curve based on active fossil fuel-fired generating units in New York (a detailed description of the assumptions and methodology behind this dispatch curve can be found in the "Assumptions, Data Sources and Methodology" section of this paper). Figure 3, below, is a Business as Usual scenario displaying the combined marginal fuel and carbon costs for fossil fuel-fired generators in New York. In this scenario, carbon costs represent the current treatment of RGGI allowances, based on recent price data,[27] in the NYISO wholesale energy market.

The dispatch curve is intended to show the opportunity—or lack thereof—for carbon pricing in New York's wholesale energy markets to shift generation from more- to less-carbon intensive fossil fuel generation. Therefore, the power plants included in this dispatch curve are limited to fossil fuel-fired plants, excluding renewable sources and nuclear power plants.

This illustrative dispatch curve shows that natural gas plants tend to have lower marginal fuel and carbon costs than coal, which has lower costs than residual fuel oil and distillate fuel oil, respectively. It also shows a clear stratification in costs, with natural gas and coal plants facing generally similar marginal fuel and carbon costs (ranging from $10/MWh to $45/MWh), with residual fuel oil plants representing the next tier ($72/MWh to $141/MWh), and finally, the much more expensive distillate fuel oil plants ($215/MWh to $237/MWh).

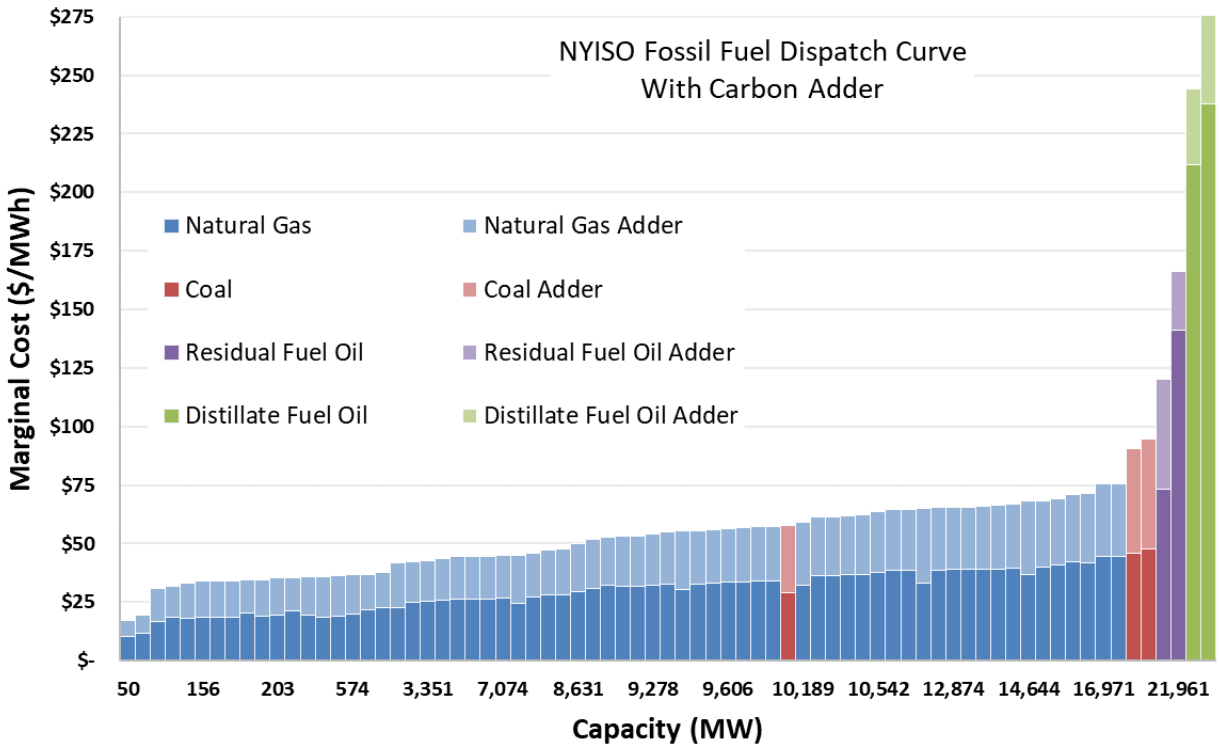
Figure 3: Business as Usual NYISO Fossil Supply Curve



[27] Auction 43, held on March 13, 2019, resulted in a clearing price of $5.27 per allowance. RGGI, Inc., 2019. *Auction Results*, available at: https://www.rggi.org/auctions/auction-results

To understand how the implementation of NYISO's proposed carbon adder would affect dispatch, I created a second fossil fuel-fired generator dispatch curve to represent the NYISO Carbon Adder scenario, shown in Figure 4. This scenario applies the Net SCC to power plant bids that are subject to RGGI, and the Gross SCC to emitting power plants that are exempt from RGGI.

Figure 4: NYISO Carbon Adder Supply Curve



The dispatch curve for the NYISO Carbon Adder scenario reveals that the fossil-fuel fired plant dispatch order does not change dramatically as a result of the higher carbon cost. Due to the near homogeneity in fuel sources of the lower-cost generators, only one coal plant falls behind in the dispatch order. Beyond fuel switching, there is some reshuffling of the dispatch order of natural gas plants as a result of the NYISO carbon adder, pushing more carbon-intensive gas plants further to the right in the bid stack.

At a gross Social Cost of Carbon of $47.30 per ton, the average per/MWh carbon adders by fuel type for New York's fossil fuel-fired generators are shown in Table 4 below:

Table 4: Average CO_2 Emissions Rate and Carbon Cost by Fossil Fuel Type for NYISO Generators

	Natural Gas	Distillate Fuel Oil	Residual Fuel Oil	Coal
Average CO_2 Emissions Rate (tons CO_2/MWh)	0.49	0.81	0.86	0.95
Average carbon adder with $47.30/ton SCC ($/MWh)	$23.29	$38.50	$40.51	$45.14

For a basic illustration of how the NYISO could affect dispatch, emissions, and electricity costs, it is useful to evaluate impacts at specific demand levels. Historic electricity demand and generation data from NYISO reveal how much electricity was generated by New York power plants at every five-minute interval, as well as the types of power plants that were used to generate that electricity. In NYISO, available nuclear and renewable resources typically have lower marginal costs than the dispatchable, emitting resources shown in Figures 3 and 4. Therefore, this analysis includes the simplifying assumption that nuclear and renewable resources are dispatched first, and that emitting resources are dispatched next, to the extent needed to meet demand.

2018 peak demand occurred on August 29th.[28] At 3:10pm on that day, NYISO generators met a high of 28,840 MW of electricity demand.[29] Of that total, 9,782 MW were supplied by non-emitting resources, including renewables (5,372 MW) and nuclear (4,410 MW) power plants, with the remaining 19,058 MW met with a mix of fossil fuel-fired power plants. Placing that demand in the context of the illustrative fossil fuel dispatch curves in Figure 3 and Figure 4 can provide a sense of the emissions and cost impacts of NYISO's proposed carbon adder during a peak period. Without the carbon adder, 19,058 MW of demand for fossil fuel fired-electricity results in a market clearing price of $47.86/MWh. With the carbon adder, that same level of demand yields a market clearing price of $94.76/MWh.

A similar analysis of the impacts during a more typical period is also valuable. Average hourly load in 2017 was 17,850 MW.[30] If the same amount of capacity were supplied by nuclear as in the August 2018 example (4,410 MW) and slightly less were supplied by renewables (4,558 MW) to account for less generation from solar during this non-peak period,[31] that would leave 8,882 MW to be met by emitting resources. Without the carbon adder, 8,882 MW of demand for fossil fuel fired-electricity results in a market clearing price of $30.61/MWh. With the carbon adder, that same level of demand yields a market clearing price of $53.12/MWh.

Table 5, below, shows the CO_2 emissions and wholesale electricity costs associated with fossil fuel-fired electricity generation necessary to meet demand, as described above, during average load and peak load periods. For both periods, results are shown for both the business as usual and NYISO carbon adder scenarios.

Table 5: Projected Effects of NYISO Carbon Adder on CO_2 Emissions and Electricity Costs During Average and Peak Load Periods

	CO_2 Emissions		Wholesale Electricity Costs	
	Average Load (8,882 MWh)	Peak Load (19,058 MWh)	Average Load (8,882 MWh)	Peak Load (19,058 MWh)
Business as Usual	3,739	10,838	$225,581	$632,151
NYISO Carbon Adder	3,702	10,838	$381,808	$1,080,944
% Change	**-1%**	**0%**	**69%**	**71%**

As Table 5 shows, the NYISO carbon adder's effect on wholesale prices and fossil fuel-fired generator dispatch drives significant cost increases but minimal emissions reductions. In fact, during the peak load period, the same power plants would be called on to operate in both the business as usual and NYISO carbon adder scenarios. Under the average load scenario, the NYISO carbon adder causes some less-

[28] RTO Insider, 2018. *NYISO Management Committee Briefs: Sept 26, 2018*, available at: https://www.rtoinsider.com/nyiso-peak-loads-tcc-100811/

[29] Historic electricity generation data provided by NYISO. *Reports & Info*, available at: https://www.nyiso.com/reports-information

[30] NYISO, 2018. Power Trends 2018: New York's Dynamic Power Grid, available at: https://www.nyiso.com/documents/20142/2223020/2018-Power-Trends.pdf

[31] There are 1,628 MW of installed solar capacity in New York. Solar Energy Industry Association, 2019. *Solar Spotlight – New York*, available at: https://www.seia.org/sites/default/files/2019-03/Federal_2019Q1_New%20York.pdf. This analysis applies the simplifying assumptions that New York's solar capacity was producing electricity at a capacity factor of 100% during the peak period and 50% during this non-peak period, thereby reducing generation from renewables by 814 MWh during this period relative to the peak period.

carbon intensive power plants to be dispatched instead of more heavily polluting plants, but that amounts to a one percent reduction in CO_2 emissions and a 69 percent increase in wholesale electricity costs.

Beyond shifting the dispatch order of the existing fossil fuel-fired generation fleet, the carbon adder would be expected to cause emissions reductions by changing investment behavior. The additional price on carbon emissions should provide a significant incentive in favor of building new renewable energy generation and deploying more energy storage relative to building new emitting generation (Newell, et al., 2018). If this were the case, some of the existing fossil fuel-fired generators—and the CO_2 they emit—would be displaced by cheaper renewable energy in the bid stack. The assumption that the carbon adder will change investment behavior, however, has yet to be proven through modeling. The modeling conducted by Resources for the Future finds that the carbon price will have a minimal impact on investments in new electricity generation sources in 2025 (Shawhan, et al., 2018).

Carbon Residuals Returned as Rebates

Finally, emissions reductions driven by the NYISO carbon adder are limited by the assumed use of carbon residuals. All of the analyses assume that all of the carbon residuals allocated to utilities will be returned to customers through energy bill rebates. The use of carbon residuals as energy bill rebates helps to mitigate consumer cost impacts of the proposed carbon adder (Newell, et al., 2018) but fails to maximize emissions reductions.

The imposition of a carbon adder will increase wholesale electricity prices, which in turn will increase customer costs. The most direct way to reduce the costs borne by consumers may be for utilities to distribute carbon residuals back to consumers in the form of energy bill rebates. Doing so would ensure that consumers receive the full value of carbon residuals, but it would also reduce the incentive for consumers to reduce electricity consumption.

In its final carbon adder proposal, NYISO notes that the PSC has jurisdiction to determine how utilities deliver carbon residual value to customers (NYISO 2018). The PSC could allow utilities to return all carbon residual value directly to customers through rebates or, alternatively, the PSC could require that utilities use some or all of the carbon residuals they receive from NYISO to fund energy efficiency programs. Like electricity bill rebates, energy efficiency programs reduce electricity bills, albeit through different means. Unlike rebates, additional investment in energy efficiency programs would deliver CO_2 emissions reductions.

Opportunity for NYISO Carbon Adder to Bolster Energy Efficiency Programs

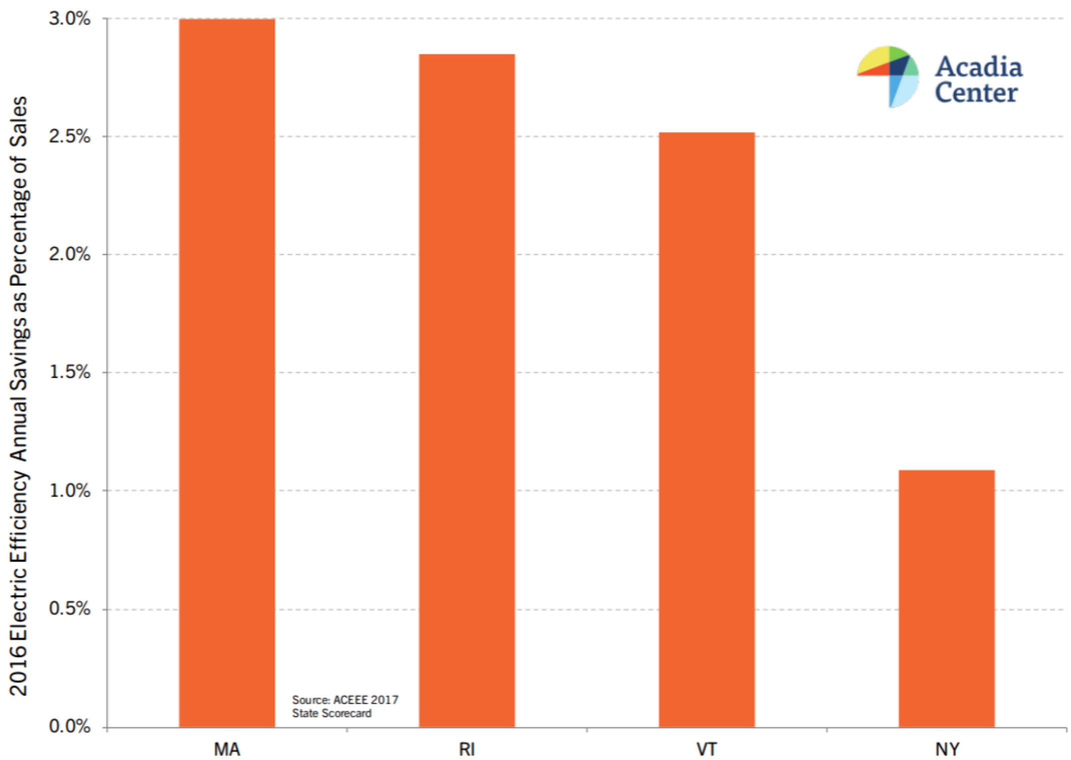
New York's Electric Utility Energy Efficiency Programs

New York is ranked sixth in the country in energy efficiency according to the American Council for an Energy-Efficient Economy's (ACEEE) scoring system which assesses each state's energy efficiency policies.[32] That ranking, however, is weighed down by New York's utility-run energy efficiency programs which lag behind other states in the region including Connecticut, Massachusetts, Rhode Island and Vermont.[33] Notably, New York lost points in this category due to relatively low scores in the "electricity program savings" and "electricity energy efficiency spending" categories, suggesting that more efficiency savings are possible and more energy efficiency spending is necessary (Berg, et al., 2018). New York's

[32] National energy efficiency rankings from the American Council for an Energy-Efficiency Economy, 2018. *The State Energy Efficiency Scorecard*, available at: https://database.aceee.org/state-scorecard-rank
[33] According to ACEEE's scoring system, Connecticut (15/20), Massachusetts (20/20), Rhode Island (20/20), and Vermont (18.5/20) all outperform New York's utilities (12.5/20) on energy efficiency. *Ibid*.

utility savings targets are compared to the achieved savings levels in Massachusetts, Rhode Island, and Vermont in Figure 5 below.

Figure 5: Comparison of 2016 Electric Efficiency Savings in NY, MA, RI and VT (Howe and Howland, 2018)



New York's relevant agencies are aware of this relative shortcoming, and in April of 2018 the New York State Energy Research and Development Authority (NYSERDA) and New York Department of Public Service (DPS) produced a joint whitepaper outlining a plan to improve the state's energy efficiency performance. The whitepaper, *New Efficiency: New York*, establishes an electric energy efficiency savings target for New York utilities that reaches approximately three percent of electricity sales by 2025 (DPS and NYSERDA, 2018). The three percent annual savings target for 2025 is roughly equal to the efficiency savings that were achieved in Massachusetts and Rhode Island in 2016, as shown above in Figure 5. The *New Efficiency: New York* proposal will help New York catch up to the states that are leading on energy efficiency, but more can be done, cost effectively and faster.

A recently conducted energy efficiency potential study for New York shows that cost-effective energy efficiency savings exist beyond the requirements of *New Efficiency: New York*. This study uses Massachusetts energy efficiency potential findings as an indicator of what could be achieved in New York. The study finds that between 2019 and 2025 New York could cost effectively achieve annual average efficiency savings of 3.15 percent of electricity sales (Optimal Energy, Inc., 2018).

Over the 2019-2025 period, *New Efficiency: New York* calls for average annual savings of approximately two percent of electricity sales. Greater savings can be achieved, and augmenting utility energy efficiency budgets with carbon residuals from the NYISO carbon adder could fund those additional measures.

With sufficient funding, New York's utilities should be capable of reaching three percent annual savings earlier than 2025. In an evaluation of energy efficiency savings potential under the Clean Power Plan, the Environmental Protection Agency (EPA) found that high-achieving energy efficiency program administrators (those achieving 1.5 percent or higher annual savings) achieved an average annual increase in savings of 0.38 percent (EPA 2015). Based on the fact that New York's utility energy efficiency programs have achieved lower annual savings (1.17 percent in 2016[34]) than the program administrators in EPA's study group, there should be enough low-cost energy efficiency potential for New York's utilities to achieve a comparable trajectory of incremental savings increase.

Furthermore, there is likely cost-effective energy efficiency savings potential beyond what New York's leading utilities are planning to pursue. In their most recent filings pertaining to New York's Comprehensive Energy Efficiency Initiative, New York's largest electric utilities, Consolidated Edison (Con Ed) [35] and Niagara Mohawk (referred to here by the name of its parent company, National Grid),[36] have projected that their electric energy efficiency programs will deliver benefits that far outweigh the costs,[37] as shown in Table 6.

Table 6: Projected Benefit Cost Ratio of Con Ed and National Grid Electric Energy Efficiency Programs

	Con Ed		National Grid	
	2019	2020	2019	2020
Benefits	$347,690,088	$312,940,156	$147,582,695	$144,533,289
Costs	$254,123,091	$218,955,364	$104,128,582	$103,945,865
Benefit Cost Ratio	**1.37**	**1.43**	**1.42**	**1.39**

Given that these utilities expect their energy efficiency programs to deliver approximately 40 percent more in societal benefits than they cost, some degree of additional investment in these programs may be cost effective. While one would expect that the marginal benefit of additional efficiency investments would decline as more money is invested and the most cost-effective savings opportunities are exhausted, experience in neighboring states suggests that sustained, high levels of efficiency savings can be achieved cost effectively.

For example, National Grid has achieved—and is required to continue achieving—much higher energy efficiency savings in Massachusetts and Rhode Island than it has in New York, as shown below in Figure 6 (Howe, 2018). Even as National Grid meets Massachusetts' ambitious energy efficiency savings requirements, the company projects that its 2019-2021 Massachusetts electric energy efficiency programs will yield a benefit cost ratio of 2.5.[38]

[34] American Council for an Energy-Efficiency Economy, 2018. *The State Energy Efficiency Scorecard*, available at: https://database.aceee.org/state-scorecard-rank

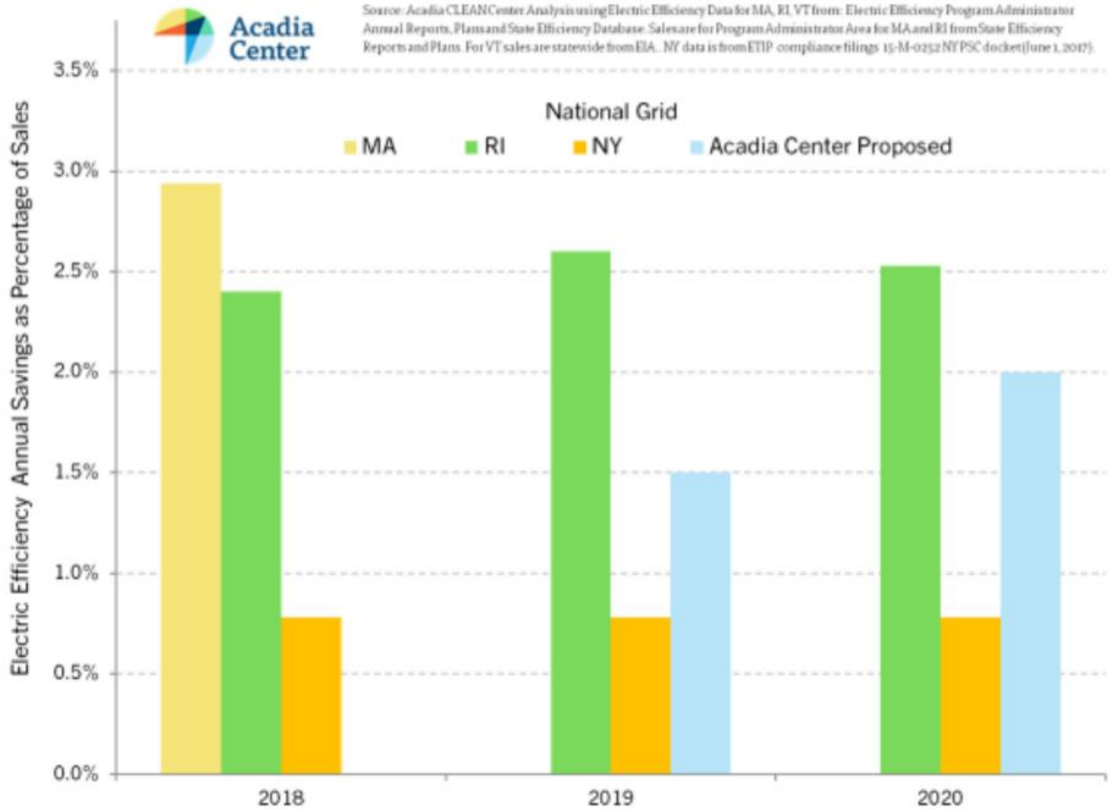
[35] Consolidated Edison, 2019. *Energy Efficiency Transition Implementation/System Energy Efficiency Plan 2019-2020*, available at: http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={2E42D41A-47FB-47AC-8D1D-01122C905C23}

[36] National Grid, 2019. *Niagara Mohawk Power Corporation d/b/a National Grid 2019-2020 Electric and Gas System Energy Efficiency Plan,* available at: http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={C010B92D-F819-472D-B3A0-BB67C6FFD462}

[37] New York's utilities are required to evaluate the cost-effectiveness of their energy efficiency programs using the Societal Cost Test (SCT). Unlike other, more narrowly defined tests that consider only energy-system costs, the SCT accounts for non-energy benefits and emissions reductions that result from energy efficiency measures.

[38] National Grid, 2019. *Massachusetts Electric Company and Nantucket Electric Company each d/b/a*

Figure 6: National Grid's Efficiency Savings Targets in MA, RI and NY 2018-2020 (Howe, 2018)



Role of the Public Service Commission

There are clear tradeoffs between investing NYISO carbon residuals in energy efficiency and returning those residuals to customers through rebates. When evaluating utility plans for using those residuals, the PSC must weigh the tradeoffs. The PSC makes that point clearly in its 2018 *Order Adopting Accelerated Energy Efficiency Targets*: "every significant undertaking of utilities must be evaluated for its costs, benefits, and potential bill impacts" (State of New York Public Service Commission, 2018). Considering the scale of potential investment and/or rebates, this warrants the PSC's careful evaluation.

The PSC has also acknowledged its role in considering how decisions affect CO_2 emissions: "[r]educing carbon emissions is a critical priority and a significant portion of the Commission's responsibility" (State of New York Public Service Commission, 2018). In addition to being a prudent economic decision, investing NYISO carbon residuals in cost-effective energy efficiency measures is aligned with the PSC's stated responsibility to reduce CO_2 emissions.

National Grid, D.P.U. 18-118 – Compliance Filing, available at: https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/10381539. Massachusetts utilities use the Total Resource Cost Test (TRCT) to evaluate energy efficiency cost effectiveness. The TRCT does not include the non-energy benefits that the SCT accounts for.

Policy Recommendations

Require Electric Utilities to Invest Carbon Residuals into Energy Efficiency Programs

As currently proposed, the NYISO carbon adder is likely to have limited near-term impacts on CO_2 emissions if carbon residuals are not used to advance carbon abatement. The carbon residuals would, however, provide a significant source of funding to expand New York's utility energy efficiency programs, which lag behind comparable utility programs in neighboring states. NYISO has proposed to allocate carbon residuals to utilities in a manner proportional to cost distribution in order to balance costs across utility service areas (NYISO 2018). Increased investment in these utility energy efficiency programs would yield CO_2 and co-pollutant reductions while reducing ratepayer electricity bills.

The New York PSC should require the utilities receiving NYISO carbon residuals to use the necessary share of those funds to expand electric energy efficiency programs to the point that they capture all cost-effective energy savings. The PSC should also seek to promote balance in costs and benefits between utility customer classes resulting from additional utility investments in energy efficiency. If none of the carbon residuals are used to bolster energy efficiency programs, NYISO's proposed carbon adder is only projected to have a modest impact on CO_2 emissions.

Ensure that RGGI Allowance Supply is Adjusted to Account for NYISO Carbon Adder Impact

Given the global nature of CO_2's impacts on climate, NYISO's efforts to reduce CO_2 emissions must consider the policy's total impact on CO_2, not just the impact in New York. NYISO's proposed border adjustments would help to address that concern, ensuring that in the context of generator dispatch, CO_2 emissions from New York power plants and out-of-state power plants are treated equally. This should effectively prevent emissions leakage that could be caused by the NYISO carbon adder's effect on wholesale electricity markets. The carbon adder should also address potential CO_2 emissions leakage that could occur as a result of the policy's effects on the RGGI market.

As discussed earlier, the NYISO carbon adder could result in lower RGGI allowance prices due to depressed demand for allowances from New York's emitting power plants. That, in turn, would reduce the incentive to pursue carbon abatement in other RGGI states, while also reducing RGGI auction revenue that is used for investments in carbon abatement measures. To ensure that the NYISO carbon adder does not cause those unintended consequences, RGGI allowance supply should be adjusted to reflect the expected emissions reductions driven by the NYISO carbon adder.

This could be achieved in two ways. First, New York could act independently by calculating the CO_2 emissions reductions caused by the NYISO carbon adder and retiring an equal quantity of RGGI allowances. The second and more straightforward but slower approach would be for New York to wait for the next RGGI Program Review and work with the other RGGI states to ensure that the regional cap is adjusted downwards to account for the expected emissions impacts of the NYISO carbon adder. Either way, it is imperative that NYISO's actions do not reduce the incentive to pursue CO_2 emissions abatement in the rest of the RGGI states by causing RGGI allowance prices to fall.

Assumptions, Data Sources, and Methodology

The information below provides an overview of the assumptions, data sources and methods used to create the NYISO supply curves and conduct demand-specific analysis of the NYISO carbon adder's emissions and cost impacts.

Data and criteria used for selecting generating units

- Generator data source:
  - eGrid2016 Data File, released February 15, 2018
  - Available at: https://www.epa.gov/sites/production/files/2018-02/egrid2016_data.xlsx
  - Data columns used:
    - Plant primary fuel
    - Plant nameplate capacity
    - Plant annual CO_2 total output emission rate (lb/MWh)
    - Plant nominal heat rate (Btu/kWh)
- Plants included met the following criteria:
  - State: NY
  - Capacity Factor: ≥ 0.05
  - Plant Primary Fuel:[39] NG (natural gas), BIT (coal), RFO (residual fuel oil), or DFO (distillate fuel oil)
- Fuel and carbon price assumptions:
  - Natural gas:
    - $/thousand cubic feet, delivered to NY: $3.44/TCF
      - https://www.eia.gov/dnav/ng/ng_pri_sum_dcu_SNY_a.htm
    - Converted $/thousand cubic feet to $/mmBtu based on EIA conversion: $3.22/mmBtu
      - https://www.eia.gov/tools/faqs/faq.php?id=45&t=7
  - Coal:
    - $/short ton, delivered to NY: $75.17/short ton
      - https://www.eia.gov/coal/data/browser/#/topic/45?agg=1,0&geo=vvvvvvvvvvvvo&freq=A&start=2008&ctype=linechart&ltype=pin&rtype=s&pin=&rse=0&maptype=0
    - Converted $/short ton to $/mmBtu based on EIA conversion: $3.86/mmBtu
      - https://www.eia.gov/tools/faqs/faq.php?id=72&t=2
  - Residual fuel oil
    - $/mmBtu, NY price in 2020: $13.59/mmBtu
      - https://www.epa.gov/sites/production/files/2015-07/documents/chapter_11_other_fuels_and_fuel_emission_factors.pdf
  - Distillate fuel oil
    - $/mmBtu, NY price in 2020: $19.98/mmBtu
      - https://www.epa.gov/sites/production/files/2015-07/documents/chapter_11_other_fuels_and_fuel_emission_factors.pdf
  - RGGI allowance price
    - Auction 43 clearing price, 3/13/19: $5.27
      - https://www.rggi.org/auctions/auction-results

[39] This analysis only included emitting units, exempting solar, wind, hydro and nuclear units. This analysis also exempted biomass units, due to the uncertain treatment of biomass CO_2 emissions. The remaining fuel types for generators that met the above criteria were NG, BIT, RFO and DFO.

Methodology

The following methodology was used to rank generators from least to most expensive in terms of their marginal cost ($/MWh) of fuel plus carbon.

1) Calculate $/MWh fuel cost for each plant
   a) Plant nominal heat rate (Btu/kWh) / 1,000 = (mmBtu/MWh)
   b) (mmBtu/MWh) x ($/mmBtu) = ($/MWh)
2) Calculate $/MWh carbon cost for each plant for RGGI (applied only to plants with a nameplate capacity of 25 MW or greater)
   a) Plant annual CO_2 total output emission rate (lb/MWh) / 2,000 = (ton/MWh)
   b) (ton/MWh) x $5.27/ton = $/MWh
3) Calculate $/MWh Gross Social Cost of Carbon ($47.30/ton)
   a) For plants below 25 MW, apply Gross SCC = $47.30/ton
   b) For plants 25 MW and larger, apply Net SCC = $47.3/ton – $5.27/ton = $42.03/ton
   c) Plant annual CO_2 total output emission rate (lb/MWh) / 2,000 = (ton/MWh)
   d) (ton/MWh) x $/ton [3a or 3b] = $/MWh
4) Total marginal fuel plus carbon cost
   a) Business as usual scenario: 1b + 2b
   b) Wholesale carbon adder scenario: 1b + 3d
5) Creating the supply curve in Excel
   a) Business as usual scenario
      i) For each plant, marginal fuel plus carbon cost is entered into the corresponding primary fuel column, other three primary fuel columns = 0
      ii) Using a stacked bar chart shows only the non-zero value in that row
      iii) X axis shows cumulative capacity (not to scale)
   b) Wholesale carbon adder scenario
      i) Create four additional columns, one for each primary fuel type – these columns represent the additional cost resulting from the carbon adder
      ii) Four new columns calculated by subtracting 4a from 4b
      iii) Four new columns, when stacked with first four columns, show additional costs resulting from carbon adder implementation

References

Berg, W., Nowak, S., Relf, G., Vaidyanathan, S., Junga, E., DiMascio, M., and Cooper, E. (2018), The 2018 state energy efficiency scorecard, *American Council for an Energy-Efficient Economy*, https://aceee.org/sites/default/files/publications/researchreports/u1808.pdf

Environmental Protection Agency (2018), Clean power plan technical support document on demand-side energy efficiency. https://www.epa.gov/sites/production/files/2015-11/documents/tsd-cpp-demand-side-ee.pdf

Hibbard, P., Tierney, S., Darling, G. and Cullinan, S. (2018), The economic impacts of the regional greenhouse gas initiative on nine Northeast and Mid-Atlantic states. *Analysis Group*, https://www.analysisgroup.com/globalassets/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_april_2018.pdf

Howe, C. and Howland, J. (2018), Assessing New York's proposed 'New Efficiency' initiative: Recommendations for maximizing and accelerating energy efficiency procurement. *Acadia Center*, https://acadiacenter.org/wp-content/uploads/2018/07/Acadia-Center-Assessment-NY-Energy-Efficiency-Initiative-2018-07-16.pdf

Howe, C. (2018), An energy efficiency proposal for New York: Investing in a low-cost resource. *Acadia Center*, https://acadiacenter.org/wp-content/uploads/2018/06/2018-03-26-Acadia-Center-EE-Proposal-for-NY.pdf

ISO New England (2017), NEPOOL 2016 IMAPP Proposals: Observations, Issues, and Next Steps. https://www.iso-ne.com/static-assets/documents/2017/03/iso-ne_jan_2017_imapp_memo_vtransmit2.pdf

Murray, B. and Maniloff, P. (2015), Why have greenhouse emissions in RGGI states declined? An econometric attribution to economic, energy market, and policy factors. *Energy Economics*, 51: 581-589. doi.org/10.1016/j.eneco.2015.07.013

Newell, S., Lueken, R., Weiss, J., Spees, K., Donohoo-Vallett, P. and Lee, T. (2017), Pricing carbon into NYISO's wholesale energy market to support New York's decarbonization goals. *The Brattle Group*, https://www.nyiso.com/documents/20142/2244202/2017-Pricing_Carbon_into_NYISOs_Wholesale_Energy_Market-Brattle-Report.pdf/ec266c79-d819-9466-77c8-66c6db8e3b53

Newell, S., Tsuchida, B., Hagerty, M., Lueken, R. and Lee, T. (2018), Analysis of a New York carbon charge. *The Brattle Group*, https://www.nyiso.com/documents/20142/2624985/2018_09_12%20Customer%20Cost%20Impacts%20of%20New%20York%20Carbon%20Charge_For%20Posting.pdf/b2cd24ac-8176-ef5a-89d2-e30b3189bee0

NYISO (2018), IPPTF Carbon Pricing Proposal: Prepared for the Integrating Public Policy Task Force. https://www.nyiso.com/documents/20142/3911819/Carbon-Pricing-Proposal%20December%202018.pdf/72fe5180-ef24-f700-87e5-fb6f300fb82c

Optimal Energy, Inc. (2018), Analysis of energy efficiency savings targets in New York State. https://assets.nrdc.org/sites/default/files/optimal-energy-analysis-of-energy-efficiency-savings-targets-in-new-york-state_2018-04-02.pdf

Pizer, W., Adler, M., Aldy, J., Anthoff, D., Cropper, M., Gillingham, K., Greenstone, M., Murray, B., Newell, R., Richels, R., Rowell, A., Waldhoff, S. and Wiener, J. (2014), Using and improving the social cost of carbon. *Science*, 346: 1189-1190. doi.org/10.1126/science.1259774

PJM (2017), Advancing Zero Emissions Objectives through PJM's Energy Markets: A Review of Carbon-Pricing Frameworks. https://www.pjm.com/~/media/library/reports-notices/special-reports/20170502-advancing-zero-emission-objectives-through-pjms-energy-markets.ashx

Shawhan, D., Palmer, K. and Picciano, P. (2018), Benefits and costs of New York's carbon pricing initiative: A dynamic, simulation-based analysis. *Resources for the Future*, https://www.nyiso.com/documents/20142/2625121/revised%20RFF%20NYCarbonAnalysis%20for%20Sep24%20IPPTF.pdf/f24450f6-b162-548d-4962-d43c714aff78

State of New York Public Service Commission (2018), CASE 18-M-0084 - In the Matter of a Comprehensive Energy Efficiency Initiative: Order Adopting Accelerated Energy Efficiency Targets, http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={B330F932-3BB9-46FA-9223-0E8A408C1928}

Woolf, T., Napoleon, A., Luckow, P., Ong, W. and Takahashi, K. (2016), Aiming higher: Releazing the full potential of cost-effective energy efficiency in New York. *Synapse Energy Economics, Inc*., http://www.synapse-energy.com/sites/default/files/Aiming-Higher-NY-CES-White-paper-15-056.pdf