Clean Energy in New York State:

The Role and Economic Impacts of a Carbon Price in NYISO's Wholesale Electricity Markets

SUMMARY FOR POLICY MAKERS AND FINAL REPORT

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Acknowledgments

This report has been prepared at the request of the New York Independent System Operator (NYISO) to supplement other analyses that have been conducted on the impacts of introducing a carbon pricing mechanism into the wholesale electricity markets administered by NYISO.

This is an independent report by Susan Tierney and Paul Hibbard of Analysis Group, Inc., and reflects the judgment of the authors alone. They wish to express their appreciation for the assistance of colleagues at Analysis Group: Sarah Cullinan (who recently left Analysis Group to take a position at the Massachusetts Department of Public Utilities); Benjamin Dalzell and Jacob Silver (who recently left Analysis Group to pursue graduate professional studies); and Scott Ario, Edmund Downie, and Grace Howland. Also, our work has benefited from input and comment from the participants in NYISO's Integrating Public Policy Task Force (IPPTF), a stakeholder forum hosted by NYISO to discuss concepts and proposals for incorporating carbon pricing into wholesale energy markets.

About the authors

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About Analysis Group

Analysis Group is one of the largest international economics consulting firms, with more than 1,000 professionals across 14 offices in North America, Europe, and Asia. Since 1981, Analysis Group has provided expertise in economics, finance, health care analytics, and strategy to top law firms, Fortune Global 500 companies, government agencies, and other clients worldwide.

Analysis Group's energy and environment practice area is distinguished by expertise in economics, finance, market modeling and analysis, regulatory issues, and public policy, as well as deep experience in environmental economics and energy infrastructure development. We have worked for a wide variety of clients, including (among others) energy producers, suppliers and consumers, utilities, regulatory commissions and other federal and state agencies, tribal governments, power-system operators, foundations, financial institutions, and start-up companies.

Preface

In February of 2019, NYISO engaged Analysis Group to study the potential impacts of introducing a carbon pricing mechanism into New York State's centrally organized wholesale electricity markets. Since that time, the setting for evaluating the need for and impacts of carbon pricing in New York has shifted in fundamental ways; consequently, Analysis Group's scope of work has evolved significantly over the course of the assignment.

At the start of the engagement in early 2019, Analysis Group set out to evaluate various topics not addressed in other studies of NYISO's proposed carbon pricing mechanism. Dr. Tierney and Mr. Hibbard from Analysis Group met early on with NYISO stakeholders to describe the anticipated areas of work and to identify a set of topics that would inform a balanced examination of benefits and costs of the carbon pricing proposal in NYISO markets. As discussed with stakeholders at the time, Analysis Group's focus was on supplementing and placing in a broader context the modeling results of prior studies.

But as work progressed, the Analysis Group team faced challenges in relying on such prior studies (conducted during 2017–2018) in light of a widening distance between the policy-related assumptions and analytic structure of those studies, on the one hand, and the changing policy conditions in the state, on the other. The most notable changes occurred as state policy makers considered Governor Andrew Cuomo's announcement in early 2019 that he supported much more aggressive goals for renewable energy development and reductions in greenhouse gas (GHG) emissions in the state's electric sector, with indications that New York State would pursue implementation of such goals primarily through actions of executive-branch agencies.

In late June 2019, the New York State Legislature passed the New York State Climate Leadership and Community Protection Act (Act), encoding into statute more-aggressive goals for renewable and zero-carbon electricity supply and for precipitous reductions in GHG emissions across the state's entire economy. The Act, signed by Governor Cuomo in July 2019, establishes statutory deadlines and responsibilities for a diverse set of actions in New York State, but is silent on whether a carbon price should be implemented within the NYISO wholesale markets.

This fundamental shift in the state's laws is now reality and bears directly on the setting for considering the carbon pricing policy. In response, Analysis Group has altered the premise of its analysis from *whether* New York would pursue aggressive goals for reducing carbon emissions and do so through administrative and other mechanisms, to *how* New York will best accomplish its goals and meet the Act's mandates for reducing GHG emissions in the power sector and in the economy at large.

This pivot has fundamentally changed the nature of this study. It now examines how NYISO's proposed carbon pricing mechanism can help New York meet its new statutory requirements for decarbonizing the electric system through efficient market design and at the lowest cost, and in turn how New York's wholesale competitive electric markets can help the state achieve its climate goals more broadly, efficiently, and effectively.

Please note that the study did not examine alternative designs for a carbon pricing mechanism; rather, it presumed carbon pricing would take the form that has been under discussion by NYISO and its stakeholders over the course of the past two years.

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Summary for Policy Makers

New York State's new climate legislation, embracing Governor Andrew Cuomo's vision for a Green New Deal, is arguably the strongest set of climate policies adopted anywhere in the U.S. In June of 2019, New York State lawmakers passed the Climate Leadership and Community Protection Act (the Act or CLCPA), setting a requirement for the state to eliminate greenhouse gas (GHG) emissions from all man-made sources in New York by 2050. (Other findings from the Act are excerpted at the end of this Summary for Policy Makers.) Among other things, the Act codifies a mandate for the electric system to rely on renewables for 70 percent of supply by 2030 and on zero-emitting resources for 100 percent of supply by 2040.

The Act is the newest chapter of New York's economic, clean energy, and environmental leadership. New York is already a major international economic force: If New York were a stand-alone country, it would be the world's 11th largest economy. The Act, which builds on years of leadership on clean energy policy, innovation, and supporting competitive markets, squarely positions New York as a leader among nations and American states in addressing the urgent issue of climate change. Considering that New York's economy accounts for one out of every 200 tons of energy-related carbon dioxide (CO_2) emitted anywhere in the world, the Act's new commitments represent a significant action to reduce and mitigate the costly impacts of global climate change.

This work will not be easy. New York must use every effective tool available to get the job done, and it must do so in the most efficient, lowest-cost way possible. Achieving the many requirements of the CLCPA will involve an unprecedented and focused effort by policy makers, market administrators, and private actors. It will require further innovation in policy, markets, technology, business models, financing, service-delivery mechanisms, workforce training, and many other things. It will require a clear focus on the incentives expressed through energy markets and on the potential for market mechanisms to help transition the state's economy through the upcoming changes at the lowest possible cost. While these actions and investments will help avoid the damaging impacts of climate change, they also can introduce new costs for energy consumers. To keep these costs as low as possible, New York will need to draw on the long and successful history of market-based policies and pursue every effective tool at its disposal.

The Act envisions using an array of measures, put in place as soon as possible. The world, and New Yorkers, will be watching the steps that the state takes. New York policy makers know this, as shown by Governor Cuomo's announcement of the nation's largest contracts for offshore wind at the same time he signed the CLCPA in July 2019. Many more actions will be needed and implemented as quickly as possible. The Act recognizes that climate change is already imposing real burdens on New York's economy and on the people who live in the state, and encourages early action and steps to avoid "leakage" of emissions into other regions beyond New York, so as to help protect the competitiveness of New York's economy.

New York's low-carbon economy will continue to depend upon a vibrant and reliable electric system. Although buildings and the transportation sector are responsible for more than 80 percent of New York's energy-related CO_2 emissions, the Act assigns to the state's electric system an outsized role in helping to lower GHG emissions in the state's economy. This may in part reflect the fact that, over the past two decades, competitive electric markets have helped achieve near-continuous reductions in emissions of all air pollutants, while spurring innovation and investment in advanced energy technologies. The Act calls for the state's new Climate Action Council to include measures promoting "beneficial electrification" as part of the scoping plan that will make recommendations for attaining statewide GHG emission limits. The provisions to expand the role of electricity into transportation and buildings will go hand in hand with the Act's requirements that the state's electric system eventually eliminate its carbon emissions by 2040. But it will also dramatically change the demands on electric generating resources and transmission/distribution infrastructure used to reliably meet power demand.

New York has a home-grown policy tool—a proposed carbon pricing mechanism—that, embedded in well-functioning electric markets, can help New York meet its climate goals at lowest cost. NYISO can unleash the power and creativity of market forces through adoption of a carbon price in the state's wholesale electricity market. In fact, if NYISO were a state agency (which it is not), it would be obligated under Sections 7 and 8 of the Act to contribute to achieving the statewide GHG emission limits, and adoption of a carbon price would be a natural response to such a mandate.

A carbon price in the NYISO markets can help deliver New York's clean energy transition in faster, cheaper, more reliable, more efficient, and more creative ways. This is the core part of the value proposition of a NYISO carbon pricing mechanism.

- NYISO and key stakeholders have already developed a carbon pricing proposal that—once in place—can send positive signals to encourage early action, consistent with the Act's intent.

NYISO's Carbon Pricing Proposal:
The Essential Value Proposition

What outcomes can we expect to result from the adoption of a carbon price in NYISO's wholesale electric markets? What incentives will a carbon price add to New York's successful Clean Energy Standard (CES) approach?

- **Reinforcing and enhancing the state's position** as the national leader on climate action.
- **Lower-cost** achievement of New York's aggressive climate targets, through market efficiencies in power-sector transactions and investments as a result of a price on carbon.
- **Lower risks** for consumers through shifting investment risk to investors while providing investors a clear market price signal tied to low-carbon attributes.
- **Faster entry** of clean energy projects into the market that can be financed through market revenues reflecting carbon costs (without the need for long-term renewable energy credit (REC) contracts).
- **Efficient market incentives to site clean energy resources where they are particularly needed** for reliability, for reducing energy prices, for avoiding air pollution, and for local jobs in downstate locations and close to disadvantaged communities.
- **Efficient market incentives for the addition of transmission investments** to give downstate New Yorkers better access to valuable low-carbon and renewable resources in upstate regions.
- **Better protection against the possibility of federal regulators' actions to mitigate a broader set of clean energy resources** in New York, by establishing an economic basis to avoid mitigation through a carbon pricing mechanism as part of the NYISO wholesale market design.
- **Near-term price signals** to investors in renewables, storage, combined heat and power, energy efficiency, and demand-side measures.
- **Faster and broader access to financing** for some renewable projects that are or would be cost-competitive with prices reflecting carbon emissions, even without REC contracts.
- **Incentives for entrepreneurs to develop unexpected and innovative solutions** to reducing carbon emissions.
- **Efficient market incentives for owners to invest in maintaining well-performing existing facilities** with zero- and low-carbon output, and in repowering under-performing generating units, while hastening the retirement of less-efficient, higher-emitting, and uneconomic fossil units.
- **Further enhancement and harmonization of state policy and competitive markets—**addressing the absence of a price on carbon, and more completely incorporating external costs and impacts in market outcomes.
- **Prevention of leakage** of carbon emissions from New York into other regions.
- **A home-grown policy mechanism** that could be adopted by other regions looking to control carbon emissions through a market-based mechanism.

- A carbon price will send price signals to investors, entrepreneurs, and project developers to:
  - create innovative solutions and projects;
  - locate renewable projects closer to New York's population centers;
  - offer inventive and attractive services to help consumers reduce their demand and switch their vehicles and heating and cooling systems to electricity;
  - provide price signals to spur the development and expansion of electric-vehicle charging infrastructure across the state;
  - reduce emissions from fossil-fuel power plants that affect vulnerable communities; and
  - invest in additional transmission capacity to open up downstate New Yorkers' access to plentiful and relatively cheap zero-carbon/renewable resources in upstate New York.
- A carbon price will help retain existing generating units with zero or low carbon emissions in operation as long as safely possible. It will provide owners of many such plants—including units that will come to the end of their contracts for renewable energy credits (RECs) or zero-emissions credits (ZEC) over the next decade—with visibility into future wholesale-market revenues at levels that (for some generating resources) will support the ongoing investments needed to maintain those units in operation. This has material financial value to consumers, as New York transitions its electric system: For every 1,000 MW of nuclear capacity retained in any year, for example, New Yorkers will avoid the cost of replacing that zero-carbon energy with significantly larger and more costly amounts of capacity and investment in new zero-carbon-emitting power-supply projects. Meeting the Act's requirements over the next few decades will likely require market and policy mechanisms that result in *both* retaining nuclear capacity and adding renewable resources.
- Given the NYISO wholesale market's successful track record in delivering reliable power with billions of dollars in savings to consumers from increased efficiency, a carbon pricing mechanism can accelerate the electric-system transition at lower cost and less financial risk to consumers than otherwise. The state can leverage NYISO's markets to help realize the Act's directives to add 6,000 MW of solar photovoltaic (PV) by 2025 and 3,000 MW of storage capacity by 2030. In this context, a carbon price can spur faster access to sufficient revenue certainty, with local pricing incentives to site such projects in downstate locations, and with potential savings deriving from market efficiencies. Given NYISO's experience over the past two decades, we estimate such market efficiency savings (net present value) on the order of $280–850 million between 2022 and 2040 (2019$, 3 percent discount rate). This estimate is likely conservative, based on the unrealistically low assumption—given the decarbonization and electrification aspirations under the CLCPA—of a business-as-usual outlook for electricity demand. The full build-out of a zero-carbon economy over the next two decades will require significant investment in incremental low- and zero-carbon resources to accommodate decarbonization through electrification of buildings' and vehicles' energy use. Thus, the savings that can flow from an efficient carbon pricing mechanism in the electric sector will be vital in helping New York manage the costs of the clean energy transition.
- A carbon price will help support efficient electric-system reliability by sending investment signals to site new resources in areas where they will provide local reliability services at lower cost and with lower air pollution.
- The NYISO carbon pricing mechanism will explicitly address and mitigate leakage of carbon emissions from New York into other regions, consistent with the Act's directives for state policy.

New York's wholesale power market, including a carbon price, will help to position private investment and operations to row in the direction of the state's climate goals. New York has an integrated system of power suppliers and transmission facilities, coordinated and operated reliably and economically by NYISO. For over two decades, this system has operated efficiently based on a competitive market design. NYISO administers a market that is regulated by the Federal Energy Regulatory Commission (FERC), comprising a diverse set of more than 425 market participants—transmission owners with over 11,000 miles of transmission circuits, companies owning over 700 power plants, privately owned and publicly owned distribution utilities, end-use suppliers, consumer groups, environmental organizations, and others—and reliant on market rules designed to provide reliable and economical power to New Yorkers. Since 2000, private power companies and public power authorities have added nearly 13,000 MW of new power-production capacity (which now equals more than one-third of the capacity on today's NYISO system). Most of these more-modern and more-efficient power plants are located in downstate New York, where most of the state's power consumption occurs and where the operation of competitive and efficient markets minimizes production costs and investment risks for the state's consumers of electricity.

Embedding a carbon price in the NYISO energy markets will create a strong synergy between the state's electricity market design and the Act's GHG-reduction targets. Adoption of a carbon price would help to send efficient price signals to market participants about the value of clean energy resources and would establish an electric system strongly aligned with the goals of the Act. It is broadly understood that efficient competitive wholesale markets depend on transparent price signals that accurately reflect electric-system conditions, system needs, and the impacts of electricity production and consumption. With the Act, New York's electric system now needs to move quickly towards a lower-carbon footprint. The NYISO market design, therefore, should have a similar link, one that identifies the higher value that New York places on carbon-free and low-carbon resources through transparent wholesale market signals—something that the proposed carbon pricing mechanism can provide. Investors and developers depend upon such signals as they consider the types of investments, operational expenditures, and projects they bring to the system, and when and where to locate them. New York will benefit from aligning the NYISO market design with the state's climate goals, so that renewable energy and storage additions can enter the market at a pace that is both required under the Act and much faster than New York has ever seen.

A carbon price can work hand in hand with other policies to advance and amplify innovation in clean energy products and services, the control of air pollution, investment in advanced energy infrastructure, and improvements in public-health outcomes. A carbon price in the NYISO market can help to speed up the state's clean energy transition through early action. It can do its work immediately and throughout the Act's ramp-up period as the state's new Climate Action Council determines by mid-2021 the scoping plan for climate measures, and as the New York Public Service Commission (NY PSC) establishes by no later than mid-2024 the programs that will require New York's load-serving entities to procure at least 6,000 MW of solar capacity (by 2025), 3,000 MW of storage capacity (by 2030), and 9,000 MW of offshore wind (by 2035). A carbon price in NYISO markets would complement and accelerate the impact of other state policies (such as the New York State Energy Research and Development Authority's (NYSERDA's) competitive solicitations and long-term procurements of RECs and ZECs that have been a recent hallmark of the state's clean energy policy instruments). A carbon price would create targeted financial incentives for innovative solutions and for clean energy resources to locate in areas now served by fossil units, and for reducing output and air emissions at fossil-fueled power plants (especially in downstate New York environmental justice locations). A carbon price could help over time to better align retail and wholesale prices to send signals for efficient investment to reduce demand. It would send a signal to investors of the value of adding more transmission capacity between upstate and downstate New York, expanding the availability of plentiful, low-cost zero-carbon and renewable resources in upstate New York to downstate load centers (including those in New York City, which has adopted aggressive carbon-reduction and electrification goals of its own). A carbon price would provide an economic basis for avoiding FERC action to mitigate New York's market and avoiding consumer cost impacts of such mitigation policies. These many benefits support New York's other goals, some of which are embodied in the Act.

There will be out-of-pocket costs to transition the state's electric and other energy systems, but a price on carbon in NYISO's market would help lower these costs. Certainly, it will be difficult to achieve the goals of the Act without incurring costs. New York policy makers have decided, at least implicitly in the findings of the Act, that the real costs of climate change are significant enough to warrant urgent, aggressive action to transition the state's economy away from fossil fuels. The Act is premised on policy makers' recognition that New Yorkers are already experiencing hardships and real economic costs—in the form of air pollution, harm to public health (especially for vulnerable populations), damage to property and critical infrastructure, declines in fish populations, and injury to key industries such as "agriculture, commercial shipping, forestry, tourism, and recreational and commercial fishing." The Act seeks to reduce and mitigate even worse impacts from a changing climate by requiring the actions the state will undertake to reduce GHG emissions.

Given the newness of the Act, none of the prior studies that have performed quantitative modeling of consumer cost impacts from a carbon price in NYISO markets reflects the timing and depth of changes that will be needed in New York's electric system. For this reason, our report de-emphasizes the results of prior studies of consumer cost impacts and focuses on the incremental value of adding a carbon price to help drive accelerated changes at lower cost. Even with this caveat, we observe that previous studies indicate that a carbon price will lead to billions of dollars of positive economic benefits. Using results from a 2019 study by Resources for the Future, we calculate annual global social welfare benefits of $118–755 million (2019$). In addition, according to our calculations a Potomac Economics study indicates that a carbon price would result in a net present value (NPV) of benefits to New York consumers between 2022 and 2036 of $1.72–3.25 billion (2019$), depending

NYISO's Carbon Pricing Proposal: The Essence

NYISO's proposal would incorporate a carbon price in the NYISO-administered wholesale energy markets, in dollars per ton of CO_2 emissions resulting from power plant operations. The carbon price would be based on the social cost of carbon emissions, established by New York State officials.

Power plant operators would include in their NYISO market offer prices their expected cost of carbon, in dollars per unit of electricity sold. NYISO would determine the economic dispatch order of supply sources, taking into account these costs of emitting carbon. Like today, the clearing price of electricity in different locations would be based on the price of the "marginal" unit—the last unit turned on to meet demand.

Because the carbon charges included in suppliers' offer prices would increase the costs of carbon-emitting generation dispatched by NYISO, a carbon charge would raise the energy market clearing prices whenever carbon-emitting resources are on the margin. All suppliers, including clean energy resources, would receive the higher energy price. While suppliers of power with zero or low CO_2 emissions would benefit from higher net revenues, fossil generators' payments would reflect a deduction for the carbon charges related to their emissions.

Retail electricity suppliers (known as "Load Serving Entities" in the NYISO market) would be charged the locational price for power they need for their consumers, with that price reflecting carbon-related costs. They would also receive a credit to substantially offset the impact of carbon pricing, because NYISO would return to consumers the carbon charges collected from generators that emit CO_2.

The carbon charge would provide incentives to suppliers of power with low or no carbon emissions, including for innovative low-carbon technologies that may not yet be developed or be commercial in wholesale markets that do not provide compensation for the value those resources provide. Imports of power into New York would have a carbon adder, thus discouraging leakage of CO_2 emissions into neighboring regions.

upon the scenario modeled and use of the social versus private discount rate. Finally, again according to our calculations, results from a Brattle/IPPTF study indicate NPV benefits would be between $119–605 million (2019$) for the same period.

A carbon price can help move New York's clean energy economy forward, in ways that are hard to predict. Just as we do not really know the costs or benefits to consumers of New York's transition to a lower-carbon electricity system and economy, we do not really know what the exact costs of adding a carbon price into NYISO's market will be. Yet we strongly expect, based on the efficiencies achieved in electricity pricing since the start of competitive wholesale electricity markets and on the similarly successful history of sulfur dioxide and nitrogen oxides emissions pricing in electricity markets, that New York's economy and consumers will benefit from the operation of a carbon price to internalize the costs of carbon emissions into market prices *alongside* the deployment of myriad other public policies aimed at advancing the state's energy transition.

Powering more of the economy on electricity can help reduce New York's carbon emissions at lower cost than actions to directly reduce emissions in buildings and vehicles. This positioning of the electric system to help reduce carbon emissions in the economy is consistent with the academic literature, which strongly suggests that an electric system composed of diverse, zero-carbon supplies coupled with an economy that is more reliant on electricity increases the possibility of significantly reducing GHG emissions at lower costs than other approaches. This increases the relevance and importance of transparent carbon pricing in such electricity-market transactions.

As indicated in the Summary Table below, a carbon price in the NYISO markets can be a powerful policy in New York's toolkit to accomplish its clean energy transition as quickly as possible, and a concrete sign of New York's national leadership in addressing the urgency of climate change.

Summary for Policy Makers:
Incremental Value Proposition of Adding a Carbon Pricing Mechanism in NYISO Markets
In Conjunction with Reliance on Administrative Actions by New York State Agencies

Outcome	Impact of a Carbon Pricing Mechanism in NYISO Markets	Other Observations
State policy leadership	A carbon price can be exported to other states and regions, supporting New York's market approach.	Support for a carbon price will further position New York State as a national policy innovator and leader, and encourage other states to act.
Speed of adoption	A NYISO carbon pricing mechanism can be implemented relatively quickly.	NYISO and its stakeholders have already done a great deal of work to explore this proposal, which can shorten the lead time for filing at/approval by FERC.
Accelerated entry of renewable projects	A price on carbon will increase the opportunity for financing of clean energy resources to enter the market in the absence of a long-term REC contract.	Some clean energy technologies (e.g., offshore wind) will likely require support through long-term REC contracts in order to get financing. But a price on carbon in wholesale prices will help some renewable projects (e.g., onshore wind, some solar projects) gain financing without a contract.
Incentives for innovation	A carbon price in the NYISO energy market will increase incentives for entrepreneurs and others to develop new supply-side and demand-side technologies, products, and services.	Although Clean Energy Standard (CES) procurements may elicit innovative and valuable proposals, a carbon price can produce solutions not anticipated in administrative procurements, and spur or accelerate research and development (R&D) and commercialization activities for emerging clean energy technologies.
Incentives for energy efficiency and other customer-based actions	A carbon price has the potential to improve price signals over time to consumers reflecting the full costs of using electricity, and influence consumer access to and use of demand-management technology and practices.	The wholesale market's ability to influence consumers' behavior will be affected by retail pricing approaches adopted by utilities, the NY PSC, and Load Serving Entities. Nevertheless, carbon pricing at the wholesale level will likely contribute to societally efficient consumption decisions.
Incentives for efficient transmission investments	A location-based carbon price will create strong incentives for cost-effective investment in increased transfer capability between upstate and downstate.	Given the Act's goals to decarbonize the electric system and to electrify much of the energy used in New York's buildings and vehicles, additional transmission capability will be needed to provide downstate population centers with improved access to distant zero-carbon resources.
Acceleration of fossil retirements and reduced use of natural gas	The NYISO carbon price will put financial pressure on existing inefficient fossil units to retire and reduce use of fossil fuels, especially in downstate New York areas. It will also drive increased efficiencies in remaining fossil generation.	A price on carbon can accelerate retirements and/or efficient repowering of fossil units above and beyond policy requirements to retire peaking units, with positive impacts on air quality in downstate disadvantaged communities.
Compatibility with other policy instruments	A carbon price can be a seamless complement to other state policies (e.g., energy efficiency, REC and ZEC contracting) by providing a means to value low-carbon investment and operations in the electric system.	The pace and depth of New York's electric-system transition will require simultaneous reliance on multiple policies. A carbon price is not duplicative; instead, it efficiently and transparently reduces reliance on and the cost of meeting administrative clean energy policies.
Ability to harmonize policy and markets	The NYISO carbon price will internalize the cost of GHG emissions into the electric markets, and improve the performance of the wholesale market.	With the Act, New York's electric system's needs are now firmly linked to a lower-carbon footprint. NYISO's market design should similarly incorporate this price signal and introduce the cost of carbon into electricity decisions.
Alignment with wholesale market design	A NYISO carbon pricing mechanism will support the efficient operation of the NYISO markets.	The carbon pricing mechanism will dovetail seamlessly into the operation of NYISO wholesale markets.
Consumer cost impacts	The NYISO market's two-decade track record of extracting efficiencies out of the electric system's operations can provide confidence that an improved market design, aligned with the state's carbon reduction goals, will produce savings to consumers.	In light of the Act's recent and much more aggressive decarbonization targets, the results of prior modeling of the impacts of a carbon price do not shed light on (and likely underestimate) the relative value of a carbon price in producing consumer savings compared to exclusive reliance on CES procurements and administrative actions.
Public health impacts	Given the location of fossil generation in downstate New York, a carbon price will reduce local air pollution there.	A carbon price will dovetail with other state policies (e.g., the Peaker Rule) to encourage retirements and repowering.
Impacts on disadvantaged communities	Given the location of fossil generation in downstate New York, a carbon price will reduce emissions in downstate environmental justice areas.	A carbon price will dovetail with other state policies (e.g., the Peaker Rule) to encourage retirements and repowering.
Limitation of CO_2 emissions leakage to other regions	A carbon pricing mechanism will limit leakage due to the proposal's treatment of emissions related to cross-boundary electricity flows.	The Act identifies leakage as an issue the state should address and avoid; relying on CES procurements alone will not be as effective as a carbon price for this issue.
Revenue streams to public entities	Given the portfolio of zero-carbon supplies owned/ controlled by the New York Power Authority (NYPA), the carbon pricing mechanism will increase revenues to NYPA as a power provider in the NYISO markets.	These incremental additional revenues to NYPA can be used in a variety of net-positive ways to New York (e.g., investment in infrastructure to support clean energy, low-cost financings, discounted service offerings, R&D, and innovation that would otherwise be paid for in NYPA rates).

New York State Climate Leadership and Community Protection Act of 2019
Legislative Findings and Declaration

1. Climate change is adversely affecting economic well-being, public health, natural resources, and the environment of New York.
2. The severity of current climate change and the threat of additional and more severe change will be affected by the actions undertaken by New York and other jurisdictions to reduce GHG emissions.
3. Action undertaken by New York to reduce GHG emissions will have an impact on global emissions and the rate of climate change. Such action will encourage other jurisdictions to implement complementary strategies and provide an example of how such strategies can be implemented. It will also advance the development of green technologies and sustainable practices within the private sector.
4. It shall be a goal of the state of New York to reduce GHG emissions 100% over 1990 levels by 2050, with an incremental target of at least a 40% reduction by 2030, in line with international scientists' projections of what is necessary to avoid the most severe impacts of climate change.
5. Although substantial emissions reductions are necessary to avoid the most severe impacts of climate change, complementary adaptation measures will also be needed to address those risks that cannot be avoided.
6. New York should minimize the risks associated with climate change through a combination of measures to reduce statewide GHG emissions and improve the resiliency of the state with respect to the unavoidable impacts of climate change.
7. Climate change especially heightens the vulnerability of disadvantaged communities, which bear environmental and socioeconomic burdens as well as legacies of racial and ethnic discrimination. Actions undertaken to mitigate GHG emissions should prioritize the safety and health of disadvantaged communities, control potential regressive impacts of future policies on these communities, and prioritize the allocation of public investments in these areas.
8. Creating good jobs and a thriving economy is a core concern of New York State. Shaping the ongoing transition in our energy sector to ensure that it creates good jobs and protects workers and communities that may lose employment in the current transition must be key concerns of our climate policy.
9. Workers are at the front lines of climate change. It is in the state's interest to ensure labor harmony and promote efficient performance of work on climate change related work sites by requiring worker training and adequate compensation.
10. Ensuring career opportunities are created and shared geographically and demographically is necessary to ensure increased access to good jobs for marginalized communities while making the same neighborhoods more resilient.
11. The complexity of the ongoing energy transition, the uneven distribution of economic opportunity, and the disproportionate cumulative economic and environmental burdens on communities mean that there is a strong state interest in setting a floor statewide for labor standards, but allowing and encouraging individual agencies and local governments to raise standards.
12. By exercising a global leadership role on greenhouse gas mitigation and climate change adaptation, New York will position its economy, technology centers, financial institutions, and businesses to benefit from national and international efforts to address climate change.

I. Introduction

A. Background

1. New York State leadership in clean energy

In June 2019, New York State enacted the Climate Leadership and Community Protection Act,[1] arguably the most sweeping climate law ever adopted in the U.S. It commits New York to eliminating virtually all greenhouse gas (GHG) emissions from the state's economy over the next 30 years. This new statutory commitment builds on the work of policy makers in New York State over several decades, as they have led efforts to reduce carbon emissions in the power sector, to rely increasingly on power supply from renewable energy, and to focus on market mechanisms to produce efficient solutions for reliable, affordable, and clean energy in the power sector.

New York has led energy policy innovation for many years, with significant gubernatorial and regulatory leadership under Governor Andrew Cuomo and prior New York governors, and with the New York State legislature working with Governor Cuomo in 2019 to enact the CLCPA. In recent years, other states have followed New York's lead. (Examples of New York's policy leadership are discussed further in Section II.) Many other public officials have had a meaningful role in these decisions, including policy innovators at the New York Department of Public Service (DPS), the New York State Energy Research and Development Authority (NYSERDA), New York's Department of Environmental Conservation (DEC), and the state's two power authorities, the New York Power Authority (NYPA) and the Long Island Power Authority (LIPA).

The Act not only requires GHG reductions but also identifies a wide array of public and private tools and actions that will be needed to meet the emissions reduction standards. In addition to setting new targets for GHG-emissions reduction, for example, the Act recognizes the significant leadership role New York has played and will play in clean energy policy, markets, and innovation, and explicitly considers this a strategic element of the state's actions.[2]

2. Federal interest in New York's clean power policies

Because many aspects of New York's electric system are also directly regulated by federal agencies—most notably, the Federal Energy Regulatory Commission (FERC) and the U.S. Environmental Protection Agency (EPA)—participants in New York's electric industry conduct their business within a combined framework of state and federal regulations. In August 2016, the New York Public Service Commission (PSC), for example, noted how this shared governance structure affected the design of the state's Clean Energy Standard (CES) when the PSC adopted

[1] Senate Bill S. 6599 and Assembly Bill A. 8429, 2019–20 Session (hereafter the Act or CLCPA).

[2] The Act's findings and declarations include the following:

> 3. Action undertaken by New York to reduce greenhouse emissions will have an impact on global greenhouse gas emissions and the rate of climate change. In addition, such action will encourage other jurisdictions to implement complementary greenhouse gas reduction strategies and provide an example of how such strategies can be implemented. It will also advance the development of green technologies and sustainable practices within the private sector, which can have far-reaching impacts such as a reduction in the cost of renewable energy components, and the creation of jobs and tax revenues in New York. …
>
> 12. By exercising a global leadership role on greenhouse gas mitigation and climate change adaptation, New York will position its economy, technology centers, financial institutions, and businesses to benefit from national and international efforts to address climate change. New York state has already demonstrated leadership in this area …

a centralized procurement model for the environmental attributes of renewable and nuclear generation.[3] That fall, the New York Independent System Operator (NYISO) established a stakeholder process to examine market and regulatory approaches for integrating state policies with the NYISO wholesale market design, including through the possible use of a carbon pricing mechanism.[4]

In March 2017, FERC signaled its own interest in exploring ways to harmonize the design and performance of wholesale markets with "increased interest by state policy makers to pursue policies that prioritize certain resources or resource attributes" (e.g., such as carbon emissions).[5] FERC invited ideas for doing so at a Technical Conference in May 2017,[6] focusing on "how the competitive wholesale markets, particularly in states (like New York) or regions that restructured their retail electricity service, can select resources of interest to state policy makers while preserving the benefits of regional markets and economic resource selection."[7]

3. NYISO efforts to explore a carbon price in the wholesale market

Since then, NYISO, market participants, and other stakeholders (including representatives from New York State's executive-branch agencies and power authorities) have engaged in a process coordinated by the Integrating Public Policy Task Force (IPPTF) to explore design options and potential impacts of incorporating a price on carbon in the NYISO energy market. The collaboration between the DPS and NYISO "reflects the shared commitment to a unified work effort that explores the potential for developing an approach to value carbon in the wholesale energy market as an instrument of state policy."[8]

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[3] Renewable energy credits (RECs) and zero-emission credits (ZECs) were the subject of these procurements and contracts. PSC, "Order Adopting a Clean Energy Standard," in Case 15-E-0302 (Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard) and Case 16-E-0270 (Petition of Constellation Energy Nuclear Group LLC; R.E. Ginna Nuclear Power Plant, LLC; and Nine Mile Point Nuclear Station, LLC to Initiate a Proceeding to Establish the Facility Costs for the R.E. Ginna and Nine Mile Point Nuclear Power Plants), August 1, 2016 (hereafter CES Order), pages 9–11.

[4] Mike DeSocio, NYISO, "2017 Integrating Public Policy Scope Update," presentation to the NYISO Budget & Priorities Working Group September 12, 2016, available at https://www.nyiso.com/documents/20142/1403075/2017%20Integrating%20Public%20Policy%20Scope.pdf/1410bb51-d50a-05de-7e2c-e1d9ea33dedb.

[5] FERC, "Notice of Technical Conference," in Docket No. AD17-11-000 (State Policies and Wholesale Markets Operated by ISO New England Inc., New York Independent System Operator, Inc., and PJM Interconnection, L.L.C.), March 3, 2017 (hereafter FERC Notice of Technical Conference), pages 1–2.

[6] FERC Technical Conference on State Policies and Wholesale Markets Operated by ISO New England Inc., New York Independent System Operator, Inc., and PJM Interconnection, L.L.C., Docket No. AD17-11-000, May 1 and 2, 2017 (hereafter FERC Conference on State Policies), https://www.ferc.gov/EventCalendar/EventDetails.aspx?ID=8663&CalType=.

[7] FERC Notice of Technical Conference, page 1. FERC observed that at "one end of the spectrum, state policies would be satisfied through the wholesale energy and capacity markets. At the other end of the spectrum, state policies would be achieved outside of the wholesale markets, and the wholesale markets would be designed to avoid conflict with those state policies." FERC Notice of Technical Conference, page 2.

[8] Letter from Brad Jones, President and CEO of NYISO, and John Rhodes, CEO of the DPS, August 10, 2017, available at https://www.nyiso.com/documents/20142/2244202/2017-Pricing_Carbon_into_NYISOs_Wholesale_Energy_Market-Brattle-Report.pdf/ec266c79-d819-9466-77c8-66c6db8e3b53. NYISO further described the process in a December 2018 NYISO white paper: "New York has adopted policies to reduce [carbon dioxide] emissions in the electric power sector, including the Clean Energy Standard. However, the wholesale electricity markets operated by … NYISO do not fully align with these policy objectives. As a result, the wholesale markets are restricted in their ability to signal cost-effective carbon dioxide (carbon) abatement options and send effective price signals to retain needed units to sustain the reliable operation of the grid. Acknowledging the social cost of carbon emissions, and capturing those impacts in the wholesale electricity markets provides a market-oriented, cost effective, [*sic*] approach to harmonize state policy and NYISO markets. The [Carbon Pricing] Draft Recommendations aimed to propose market design concepts to incorporate the social cost of carbon emissions in a manner that (1) is economically efficient, (2) avoids major cost shifts among New York customers, (3) is transparent, and (4) provides market and regulatory stability…." NYISO, "IPPTF Carbon Pricing Proposal Prepared for the Integrating Public Policy Task

To support the IPPTF process, NYISO engaged The Brattle Group (Brattle) in August 2016 to assess different approaches and analyze how a price on carbon in NYISO energy markets might affect wholesale prices, starting from the assumption that the carbon pricing mechanism would be incremental to New York State's clean energy policies in place at the time of the analysis.[9]

In April of 2018, NYISO released a straw proposal for carbon pricing.[10] In August of 2018, NYISO posted a set of draft recommendations related to such an approach.[11] Brattle finalized an assessment of this proposal in December 2018,[12] and NYISO published a contemporaneous white paper to summarize the carbon pricing concept.[13] This approach is still under consideration, and no decisions have been made about its adoption as of the writing of this report. On May 9, 2019, NYISO's market monitor, Potomac Economics (Potomac), presented the results of its technical enhancements to the Brattle/IPPTF Study.[14]

B. The NYISO carbon pricing proposal

The essential structure of the carbon pricing mechanism under consideration in New York is as follows (as described in NYISO's IPPTF Carbon Pricing Proposal):[15]

> The NYISO would incorporate the social cost of carbon emissions into the NYISO-administered wholesale energy markets using a carbon price in dollars per ton of carbon dioxide emissions. The NYISO would apply the carbon price by debiting each energy supplier a charge for its carbon emissions at the specified price as part of its settlement. Suppliers would embed these additional carbon charges in their energy offers (referred to as the supplier's carbon adder or adjustment in $/MWh) and thus incorporate the carbon price into the unit commitment, dispatch, and price formation through the NYISO's existing processes. In addition to charging internal emitting generators, the NYISO would charge imports and

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Force," December 7, 2018 (hereafter IPPTF Carbon Pricing Proposal), page 3, available at https://www.nyiso.com/documents/20142/3911819/Carbon-Pricing-Proposal%20December%202018.pdf.

[9] Samuel A. Newell et al., The Brattle Group, "Pricing Carbon into NYISO's Wholesale Energy Market to Support New York's Decarbonization Goals," August 10, 2017 (hereafter Brattle/IPPTF 2017 Preliminary Report), available at https://www.nyiso.com/documents/20142/2244202/2017-Pricing_Carbon_into_NYISOs_Wholesale_Energy_Market-Brattle-Report.pdf/ec266c79-d819-9466-77c8-66c6db8e3b53.

[10] NYISO, "Carbon Pricing Straw Proposal," April 30, 2018, available at https://www.nyiso.com/documents/20142/1393516/Carbon%20Pricing%20Straw%20Proposal%2020180430.pdf/e9003d1e-0557-5292-0f7f-24dbcfd68ac5.

[11] NYISO, "Carbon Pricing Draft Recommendations," August 2, 2018, available at https://www.nyiso.com/documents/20142/2179214/Carbon%20Pricing%20Draft%20Recommendations%2020180802.pdf/575a6d2b-ad09-d8f8-e566-39a0c04f9a43.

[12] Sam Newell et al., The Brattle Group, "Analysis of a New York Carbon Charge (Updated)," presented to the NYISO IPPTF, December 21, 2018 (hereafter Brattle/IPPTF Study), available at https://www.nyiso.com/documents/20142/2244202/Brattle-Study-Analysis-of-a-New-York-Carbon-Charge.pdf/0930b5ec-aa1b-b837-4cd8-cd8f8768d57d.

[13] IPPTF Carbon Pricing Proposal.

[14] Pallas LeeVanSchaick, Potomac Economics, "MMU Evaluation of Impacts of Carbon Pricing," presentation to the NYISO Market Issues/ICAP Working Group, May 9, 2019 (hereafter Potomac Carbon Pricing Evaluation), available at https://www.nyiso.com/documents/20142/6474763/MMU%20Study%20re%20Carbon%20Pricing__5092019.pdf/40b832a6-b1f7-f973-9f60-4aaf4e9ab22f.

[15] IPPTF Carbon Pricing Proposal, page 4 (footnotes in the original have been omitted).

credit exports the LBMP [location-based marginal price] carbon impact to prevent the carbon charges on internal generation from causing emissions leakage and costly distortions.

Because the carbon charges on suppliers would increase the variable costs of carbon-emitting generation dispatched by the NYISO, a carbon charge would raise the energy market clearing prices whenever carbon-emitting resources are on the margin (referred to as the carbon pricing effect on LBMPs, or LBMPc). All suppliers, including clean energy resources, would receive the higher energy price, net of any carbon charges due on their emissions. A carbon charge would also provide incentives for innovative low carbon technologies that may not yet be developed. Low carbon dioxide emitting New York resources, including efficient carbon-emitting units, renewables, hydropower, and nuclear generators, would benefit from higher net revenues. Load Serving Entities (LSEs) would continue to be charged the LBMP for wholesale energy purchases, which would account for the carbon adder of the marginal units. The NYISO would return the carbon charge residuals (Carbon Residuals), collected from carbon dioxide-emitting suppliers and net imports, to LSEs….The New York Public Service Commission (PSC) would set the Gross Social Cost of Carbon (SCC) pursuant to the appropriate regulatory process.

C. Studies of the impacts of the NYISO carbon pricing proposal

1. Brattle/IPPTF Study (2018)

Starting in late summer 2016, Brattle began to study the impacts of a carbon pricing proposal.[16] With Brattle analysts providing key assumptions, NYISO ran its GE-MAPS production-simulation model to evaluate the effects of the carbon proposal on system dispatch, emissions, and LBMPs for three study years (2022, 2025, and 2030), with 2022 serving as the first year in which the carbon pricing mechanism was assumed to go into effect.[17] The base case, without the carbon pricing mechanism, reflected Brattle's assumption that New York's clean energy policies (e.g., CES, Regional Greenhouse Gas Initiative (RGGI)) would have been fully implemented in future years.[18] With these assumptions, the Brattle/IPPTF Study estimated (in Brattle's view, conservatively[19]) that the carbon pricing mechanism would lead to the following incremental impacts:[20]

- Overall cost savings in the wholesale market, with a minor effect on customer costs in the short run and cost savings to consumers in the long term
- Lower carbon dioxide (CO_2) emissions in New York State, along with lower annual nitrogen oxide (NO_x) emissions (with emission reductions occurring primarily in downstate locations)
- Increased LBMPs in the short run, which would be offset by customer credits from emitting resources, lower renewable energy credit (REC) and zero-emission credit (ZEC) prices, increased value of transmission congestion contracts (TCCs), entry of new renewables in regions with higher marginal CO_2 emissions, possible

[16] Brattle/IPPTF 2017 Preliminary Report, page iv.

[17] Brattle/IPPTF Study, page 8.

[18] Brattle/IPPTF Study, page 8. Notably, since it had not been adopted, this did not include any of the major policies and requirements added through passage of the Act in July 2019, including acceleration of New York's clean energy targets.

[19] Brattle/IPPTF Study, pages 10–11.

[20] Brattle/IPPTF Study, pages 10–14.

retention of some upstate nuclear units in 2030, possible incremental investment in energy efficiency, and possible greater incentives for investing in storage and for repowering or otherwise improving the efficiency of existing fossil units.

Brattle and others have noted a number of potentially significant conservative assumptions in the analysis above and beyond the inherently conservative foundational assumption that all CES resources would be online in the base case without a carbon price (and without any indication of underlying costs for New York to accomplish that outcome).[21]

2. Other studies

In September 2018, researchers at Resources for the Future (RFF) presented the results of their modeling of the NYISO carbon price in the context of simulating the performance of the interconnected Eastern electrical grid to examine the effects of the policy on New York consumers' costs, power plant owners' revenues, power flows in and out of New York, CO_2 and other air emissions, public health outcomes, and interactions with RGGI carbon allowance markets.[22]

More recently, in July 2019, these same RFF researchers published the results of an updated modeling analysis of a carbon adder in the NYISO market.[23] The study compared a "business as usual" case[24] to a world with the proposed NYISO carbon pricing mechanism in place under two scenarios reflecting (a) relatively low solar and wind costs and high natural gas prices, and (b) relatively high solar and wind costs and low natural gas prices.[25] The authors estimated that the carbon pricing mechanism would have the following key impacts: [26]

- Help meet the state's clean power goals
- Prevent a large federal penalty on non-emitting New York generation
- Reduce CO_2 emissions in the range of 6–22 percent in 2025
- Avoid leakage of CO_2 emissions to neighboring regions, and in fact lower such emissions in neighboring states
- Drive REC and ZEC prices to zero

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[21] Brattle/IPPTF Study, page 14. Note that other commenters (e.g., Multiple Intervenors) have pointed out less conservative assumptions, e.g., that there might not be a one-to-one dollar reduction in ZEC and REC prices in conjunction with the introduction of a carbon price. See, for example, Multiple Intervenors' Comments on "Carbon Pricing Proposal Recommendations: Preliminary Statement," November 15, 2018.

[22] Daniel Shawhan, Karen Palmer, and Paul Picciano, "Benefits and Costs of New York's Carbon Pricing Initiative: Dynamic, Simulation-Based Analysis," Resources for the Future, September 24, 2018.

[23] Daniel Shawhan, Paul Picciano, and Karen Palmer, "Benefits and Costs of Power Plant Carbon Emissions Pricing in New York: A Dynamic, Simulation-Based Analysis," Resources for the Future, July 18, 2019 (hereafter RFF 2019 Study), available at https://www.rff.org/publications/reports/benefits-and-costs-of-the-new-york-independent-system-operators-carbon-pricing-initiative/.

[24] RFF's business-as-usual *policy* assumptions differed from Brattle/IPPTF's in that RFF assumed that in 2025 (the modeled year), the market would reflect only those New York clean energy policies in place as of 2018—i.e., RGGI, the New York Renewable Portfolio Standard (RPS) with a target of 12 percent for new wind and solar (Tier 1), and the ZEC program for nuclear units. RFF 2019 Study, page 4.

[25] RFF 2019 Study, page 5, with other assumptions shown on pages 6, and 14–16.

[26] RFF 2019 Study, pages 8, 9, 20, 24, 31, 33. The authors point out that their study differs from Brattle/IPPTF's analysis in several other ways: RFF did not assume (as Brattle did) that New York would achieve the full CES targets in a base case, but rather assumed that generation investments, retirements, and new resource additions would result from profitability analysis as part of the study; different sets of natural gas price and technology-cost assumptions.

- Lower consumer costs in the range of 0.1–1.1 percent of the retail electricity rate in 2025, which reflects the net results of higher zonal average wholesale energy prices, lower capacity prices, and revenue rebates to consumers
- Generate net profits to NYPA amounting to $298 million in 2025
- Produce net benefits to society of $108–691 million per year as of 2025
- Help to influence other states/regions to adopt a similar approach or to increase the stringency of their own existing programs

Potomac's May 2019 analysis of the NYISO carbon pricing proposal incorporated a number of methodological enhancements to the Brattle/IPPTF study's approach.[27] Potomac's analysis reflected: the effects of modeling local reliability requirements in the New York City area (which provide a more accurate picture of power plant operations in a zone where local-area reliability concerns have required fossil units to run in out-of-economic-merit order); impacts on capacity prices, in light of higher energy-market prices with a carbon price; and the potential impact of greater incentives to repower inefficient fossil units in the downstate parts of the state. Based on these adjustments, Potomac estimated a smaller increase in consumer costs in 2022 (i.e., roughly half of the Brattle/IPPTF estimate) and long-term net cost savings to consumers in later years.[28]

Another study conducted by Daymark Energy Advisors, Inc. (Daymark) also estimated direct impacts of a carbon price in the NYISO markets.[29] At the request of stakeholders, NYISO, Brattle, RFF, and Daymark prepared a document in November 2018 explaining the differences in methods, time periods, data, assumptions, and results of the Brattle/IPPTF, RFF, and Daymark studies.[30]

Notably, although the DPS staff prepared a benefit/cost analysis in April 2016 as part of the PSC's consideration of the then-proposed CES,[31] there has not been a comprehensive study of the cost to implement the provisions of the Act. As such, focusing primarily on the results of studies that relied on prior assumptions, which are now out of date, about what will be required to transition New York's energy economy would leave the inappropriate impression that a carbon price will introduce costs to consumers while other state policies (e.g., REC procurements under long-term contracts) do not.

D. Purpose and scope of this Analysis Group study

As described in the Preface, at the start of this project in early 2019, Analysis Group was asked to focus on topics not addressed in other studies. Originally, we intended to quantitatively examine various macroeconomic impacts, including effects on jobs, flows of dollars in and out of the state, and economic value added to New York's economy as a result of implementing the carbon pricing mechanism. In the beginning, Analysis Group anticipated building on the modeling results of the prior studies, as we described to stakeholders at that time.

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[27] Potomac Carbon Pricing Evaluation.

[28] Potomac Carbon Pricing Evaluation, pages 26–28.

[29] Marc Montalvo and Matthew Loiacono, "Carbon Charge Proposal Evaluation – Updated," Daymark Energy Advisors, October 17, 2018.

[30] See NYISO, "The Brattle Group, Daymark Energy Advisors, and Resources for the Future Carbon Change Analysis Summaries and Synthesis," November 7, 2018.

[31] DPS, "Clean Energy Standard White Paper – Cost Study," April 8, 2016 (hereafter DPS CES Cost Study), available at https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard/Important-Orders-Reports-and-Filings/Filings-Orders-and-Reports/Before-the-CES-Orderhttp://tinyurl.com/hmjkmfa.

But as work progressed, the Analysis Group team faced challenges in relying on the prior studies (conducted between 2017 and early 2019) for such purposes, in light of widening differences between the prior studies' policy-related assumptions and the changing policy conditions in the state. In June, as it became clearer that the New York legislature would pass the CLCPA and that Governor Cuomo would sign it into law, Analysis Group began to shift the premise of its study from *whether* New York would pursue aggressive goals for reducing carbon emissions and do so through administrative and other mechanisms, to *how* New York would best accomplish its goals for reducing carbon emissions in the power sector and in its economy more broadly.

This pivot has fundamentally changed the nature of this study. Our study now examines how NYISO's proposed carbon pricing mechanism might help New York meet its statutory goals for decarbonizing the electric system, and in turn might position the electric system for its new role in helping the state achieve its climate goals more broadly. In light of the inherent uncertainties associated with how New York's transition will unfold, we concluded that the approach we had originally formulated would not produce practically useful results and observations. Thus our analysis is now tailored to a more appropriate contextual review, one that presumes the challenges New York will face in administering the Act. Where this review contains quantitative analysis, we present the results in the body of the report and describe our methods in the Technical Appendix.

II. The context for NYISO's consideration of incorporating a price on carbon into its wholesale energy market

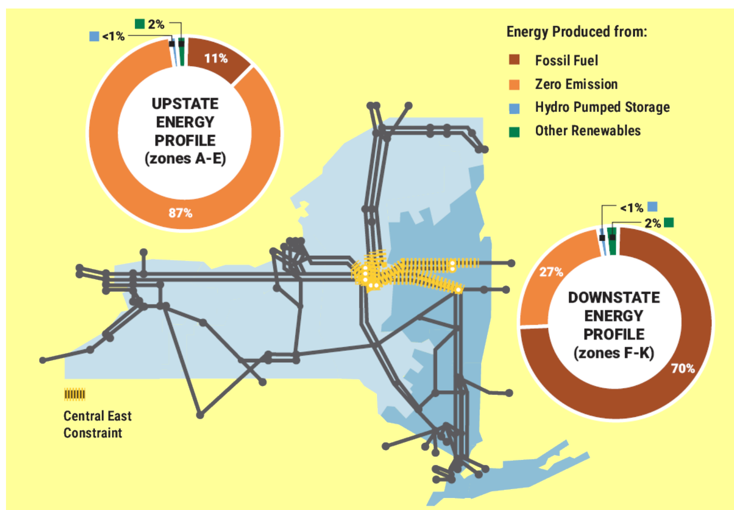
A. Introduction

New York has established an aggressive path to reducing GHG emissions and to fundamentally transforming how energy is used in the state. There are at least four key influences we review that will inform, if not drive, the pathways through which, and pace at which, New Yorkers will lower, reduce, and move toward eliminating GHG emissions from the state's electric system in the future: (1) the current conditions in New York's electric industry; (2) New York State's varied policies—especially the Act—that affect the electric system and its potential to help decarbonize energy use in buildings and the transportation sector; (3) FERC's regulation of wholesale electricity markets; and (4) insights from the literature on how the introduction of carbon pricing mechanisms in energy markets can reduce emissions in an economically efficient way.

B. Current conditions in New York's wholesale electric system

NYISO operates an integrated grid serving all of the state. However, in many ways New York's electric system can be divided into two quite different systems that are interconnected by high-voltage transmission lines. NYISO has called this "a tale of two grids."[32] The "upstate system" (i.e., the western, middle, and northern parts of the state, shown in light blue in Figure 1) has significant amounts of zero-emitting, non-fossil generating resources with low operating costs, low wholesale energy prices, and low CO_2 emissions. The "downstate system" (shown in the darker blue areas of New York in Figure 1) depends much more on fossil generation, and has operating costs and air emissions tied more directly to the combustion of natural gas and oil in power plants. The two sub-regions of the NYISO system are connected by a series of transmission lines that are not sufficiently large, in terms of the amount of power that can flow across them, to allow for the full and unimpeded transfer of low-cost, low-carbon resources from the upstate system to the downstate system.

Figure 1: New York State's "Two Interconnected Grids"



Source: NYISO, Power Trends 2019, page 10.

Under the NYISO market design, prices are determined on the basis of the balance of local supply and demand conditions when transmission limits the flow of power. Accordingly, in many hours, power prices are much lower

[32] NYISO, "Power Trends 2017: New York's Evolving Electric Grid," page 8, available at https://www.nyiso.com/documents/20142/2223020/2017-Power-Trends.pdf (hereafter Power Trends 2017); NYISO, Power Trends 2019, page 10.

in upstate New York relative to prices in downstate New York, because not enough low-cost power can make it through the "Central East Constraint" (shown in Figure 1) to help to lower prices to consumers in electric service territories in the downstate region. Nearly two-thirds of New York's population and 60 percent of electrical loads of New York are located in the downstate region.[33] This results in much higher average electricity prices to customers served by suppliers in downstate zones relative to those in upstate zones.[34]

This situation—a bifurcated system within a single NYISO market, with upstate and downstate systems affected by the transmission constraint between them—has persisted for years, if not decades. In recent years, however, several new transmission lines have been identified and approved through the coordinated NYISO/PSC process to designate transmission facilities needed to support "public policy requirements."[35] In April 2019, NYISO's board approved facilities that will enhance transfer capacity across the Central East and other interfaces. Those facilities are anticipated to go online at the end of 2023[36] and begin to provide downstate New York with greater access to lower-cost resources.

Even so, if significant new renewable-energy project capacity to meet the targets in the Act is located in upstate New York (because there are good wind and other resources there), then the new transmission additions will not be enough to provide access to those resources for consumers in downstate New York. Without further transmission additions, those new zero-carbon resources will compete with other upstate clean energy resources to meet a relatively small share of the state's customers; likely depress prices in upstate New York and reduce revenues to these and other upstate generators; lead to potential curtailments of clean energy resources that exceed local demand, further reducing revenues to renewable generators; and be prevented from helping to reduce fossil generation in downstate New York where most electricity sales and air pollution occurs.

New York therefore would benefit from some combination of investment in zero-carbon supply in downstate areas and/or further additions to the state's transmission grid serving north-to-south power flows. Locational pricing, including a price on carbon, can provide efficient economic incentives to spur such development.

C. New York State's public policy context

As previewed in Section I, New York State policy makers have exercised leadership in ways that have directly and indirectly influenced the structure, performance, and character of the electric system in the state, as well as the electric system's ability to serve consumers in one of the largest and most productive economies in the world. If New York were a standalone country, it would be the world's 11th-largest economy.[37] The Act, which builds on

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33 In 2017, 63 percent of bundled and delivery customers of investor-owned utilities (IOUs) and municipally owned utilities (munis) in New York State were located in the downstate portion of the state. Data for numbers of customers and sales by utility are from EIA 861 data, available at https://www.eia.gov/electricity/data/eia861/.

34 In 2017, for example, the average retail price for electricity was 21.6 cents/kWh for customers of downstate IOUs and 11.7 cents/kWh for upstate IOUs. Also in 2017, the average retail price was 19.1 cents/kWh for customers of upstate munis and 6.0 cents/kWh for customers of downstate munis. U.S. Energy Information Administration (EIA) 861 data, available at https://www.eia.gov/electricity/data/eia861/. These data are for customers taking bundled electricity service.

35 NYISO, Power Trends 2019, pages 57–61.

36 NYISO, Power Trends 2019, pages 59–60.

37 In terms of 2017 GDP. Countries' 2017 gross-domestic-product (GDP) data are taken from the International Monetary Fund (IMF); New York State 2017 data are from the U.S. Bureau of Economic Analysis. New York State's 2017 GDP was $1.60 trillion US dollars. IMF, "GDP, Current Prices," available at

years of leadership on clean energy policy, innovation, and competitive markets, squarely positions New York as a leader among nations and U.S. states in addressing the urgent issue of climate change. Considering that New York State accounts for one out of every 200 tons of energy-related CO_2 emitted anywhere in the world,[38] the Act's new commitments represent a significant action to address the costly impacts of climate change to New Yorkers and to the state's economy.

Such policy leadership and vision are bold but not altogether unusual in New York. Going back several decades, New York's utility regulators have adopted policies that led to the restructuring of the state's electric industry so that large and small customers may exercise greater choice, and the power system and its consumers may benefit from the effects of competition. These policies involved the unbundling of vertically integrated investor-owned utilities (IOUs) and the separation of electric generation and transmission services (which would be subject to FERC regulation) from retail electric services (which would remain under the supervision of the NY PSC). This restructuring also involved transitioning to reliance on NYISO's wholesale electricity markets as the means to provide consumers with efficient and reliable power supply without burdening consumers with the risk of power plant investments. Such an outcome was acutely important to New York policy makers, consumers, and energy suppliers, given the amount of risk borne by ratepayers for major capital investments in generating capacity, and the painfully expensive lessons learned from the state's experience with "PURPA" obligations during the 1980s/1990s (through long-term contracts that ended up having substantial above-market costs to consumers).[39]

Thus, for several decades, competition has been a foundational policy in support of the efficient economic performance of New York's power system. The state's leadership in establishing RGGI—the multistate market-based program to reduce CO_2 emissions—and adopting a Renewable Portfolio Standard (RPS), and recently the CES, are further reflections of the state's interest in using markets to produce efficient environmental and electric-system outcomes for the benefit of New York consumers.[40] These market-based mechanisms are designed to achieve environmental policy goals in tandem with other state policy mechanisms, and in a manner most compatible with the state's focus on leveraging the forces of competition to minimize consumer costs and investment risks.

In the past decade, New York's public officials have continued to lead clean energy and power market solutions for the benefit of consumers, the state's economy, and its environment. These include, for example:

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https://www.imf.org/external/datamapper/NGDPD@WEO/OEMDC/ADVEC/WEOWORLD; U.S. Bureau of Economic Analysis, "Total Gross Domestic Product for New York," Federal Reserve Bank of St. Louis, available at https://fred.stlouisfed.org/series/NYNGSP.

[38] New York's CO_2 emissions in 2016 were roughly equivalent to the national emissions of Philippines and Portugal combined, per U.S. government and International Energy Agency (IEA) data. IEA, CO_2 Emissions from Fuel Combustion Highlights, 2018, Excel backup file, available at https://webstore.iea.org/Content/Images/uploaded/CO2%20Highlights%202018.xls; EIA, "Energy-Related Carbon Dioxide Emissions by State, 2005-2016," February 27. 2019, page 15, available at https://www.eia.gov/environment/emissions/state/analysis/pdf/stateanalysis.pdf.

[39] PURPA stands for the federal Public Utilities Regulatory Policies Act of 1978.

[40] See the various reports authored by Analysis Group consultants that examine the positive economic benefits that have flowed to New York and the other states involved in the RGGI program, e.g., Paul J. Hibbard et al., "The Economic Impacts of the Regional Greenhouse Gas Initiative on Ten Northeast and Mid-Atlantic States," dated November 15, 2011, July 14, 2015, and April 17, 2018, available at https://www.analysisgroup.com/news-and-events/news/latest-study-from-analysis-group-confirms-that-rggi-program-continues-to-boost-the-economy-and-create-jobs/. See also Paul J. Hibbard, Susan F. Tierney, Pavel G. Darling, and Sarah Cullinan, "An Expanding Carbon Cap-and-Trade Regime? A Decade of Experience with RGGI Charts a Path Forward," *The Electricity Journal*, Vol. 31, No. 5, June 2018, pages 1–8.

- Encouraging retail customers to install energy-saving and energy-producing equipment on their own premises (through programs of the PSC and NYSERDA, as well as the IOUs)[41]
- Participating in a multistate initiative to support the launch of zero-emission vehicle (ZEV) sales in New York's transportation market[42]
- Instituting the Reforming the Electric Vision (REV) process, with various policy decisions by the PSC to help achieve the state's goals through market-based approaches at the distribution-system level and through, among other things, a benefit/cost framework that valued distributed energy resources' ability to avoid CO_2 emissions based on the social cost of carbon[43]
- Publishing the 2015 New York State Energy Plan, with 2030 goals to rely on renewables for 50 percent of electricity sales and to reduce GHG emissions by 40 percent, among others.[44]
- Fostering innovative distribution system solutions from utility and non-utility providers, including through PSC support for procurements of cost-effective non-wires measures [45]
- Supporting innovative clean energy investments and solutions through public financing at NYSERDA's Green Bank
- Adopting (by the PSC in 2016) a CES with stronger goals for introducing new renewables into the market and for retaining renewable and zero-carbon resources that provide value to New York[46]
- Pursuing (by NYSERDA) rounds of competitive solicitations for RECs from a variety of renewable technologies and storage projects, including the landmark announcement of two winning offshore wind projects in July 2019[47]
- Spurring investment in and development of new transmission facilities to support the State's public policy objectives, as part of the NYISO transmission planning process[48]

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[41] Weston Berg, Seth Nowak, Grace Relf, Shruti Vaidyanathan, Eric Junga, Marianne DiMascio, and Emma Cooper, "2018 State Energy Efficiency Scorecard," American Council for an Energy-Efficient Economy, October 2018, available at https://aceee.org/sites/default/files/publications/researchreports/u1808.pdf, pages 93, 159.

[42] Council of State Governments, "State Strategies for Advancing the Electric Vehicle Marketplace," December 2018, available at https://issuu.com/csg.publications/docs/electric_vehicles_online.

[43] DPS, "Reforming the Energy Vision: NYS Department of Public Service Staff Report and Proposal," in case 14-M0101 (Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision), April 25, 2014; NY PSC, "Order Establishing the Benefit Cost Analysis Framework," in case 14-M-0101 (Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision), January 21, 2016 (hereafter PSC Benefit-Cost Analysis Framework), Appendix C.

[44] New York State Energy Planning Board, "The Energy to Lead: 2015 New York State Energy Plan," 2015, available at https://energyplan.ny.gov/Plans/2015. The New York State Energy Planning Board is composed of the agency heads from NYSERDA, the PSC, and the DEC, among others.

[45] See, for instance, NY PSC, "Order Extending Brooklyn/Queens Demand Management Project," in case 14-E-0302 (Petition for Extension of Time to Implement Brooklyn/Queens Demand Management Project), July 13, 2017; NY PSC, "Order Adopting Distributed System Implementation Plan Guidance," in case 14-M-0101 (Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision), April 20, 2016.

[46] NY PSC CES Order.

[47] New York State Governor's Office, "Governor Cuomo Announces Green New Deal Included in 2019 Executive Budget," January 17, 2019, available at https://www.governor.ny.gov/news/governor-cuomo-announces-green-new-deal-included-2019-executive-budget.

[48] NYISO, Power Trends 2019, pages 57–61. See also, for example, "NYISO Board of Directors' Decision on Approval of Western New York Public Policy Transmission Planning Report and Selection of Public Policy Transmission Project," October 17, 2017, available at https://www.nyiso.com/documents/20142/2892590/Western-NY-Board-Decision-Report-20171017.pdf/5c16978f-5040-2acd-0a15-b4247223d2c7.

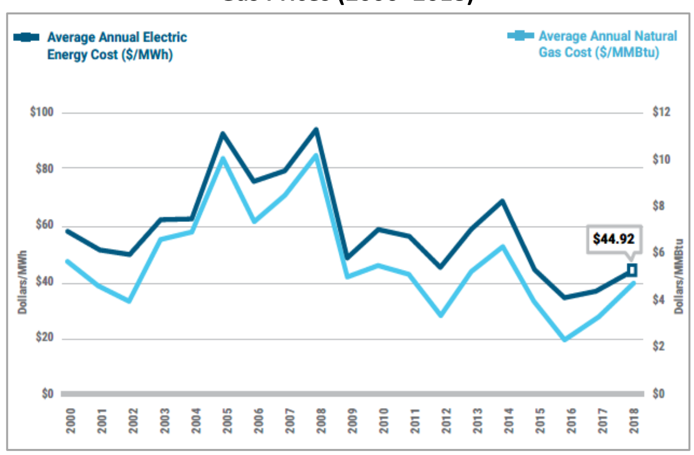
- Advocating (by New York's Attorney General) for clean energy in federal court cases on EPA and FERC policies, in part to protect strong clean energy policies in New York and across the nation, and in part to assure that actions in other states' electric systems would not economically disadvantage New York companies and other energy consumers
- Proposing new regulations to phase out fossil-fired peaking units (announced by Governor Cuomo, and advanced by the DEC in March 2019)
- Adopting, most recently, the Act, one of the most sweeping climate bills adopted in the U.S.

These many strong policy actions, along with other drivers in the market—including low natural gas prices, cost reductions in wind and solar technologies, consumer interest in renewable energy and energy efficiency, and actions by many cities (e.g., New York City) and towns in New York State—have benefited New Yorkers in myriad ways.

New York's environmental and energy profile shows the positive effects of these forces:

- Over the past two decades, private power companies and public power authorities have added nearly 13,000 MW[49] of new power-production capacity—i.e., approximately one-third of the capacity currently on the NYISO system and more than 30 percent of New York's power production.[50] Most of these more modern and more efficient power plants are located in southern and eastern New York, where most of the state's power use occurs.
- During that same period, over 7,300 MW of generating capacity has retired or suspended operation[51] (with most of that capacity being less efficient and higher-emitting fossil-fueled generation), and over 2,700 MW of transmission capability have been added to serve New York's electric system since 2000.[52]
- Demand has been relatively flat, with just a 0.2 percent increase in the past decade.[53]
- Wholesale electric prices have varied over the past two decades, with the average wholesale energy price in 2018 ($44.92/MWh) being around one-fourth lower than the average price in 2000 (nearly $60/MWh). (See Figure 2.) These

Figure 2: NYISO Electric Energy Prices and Average Natural Gas Prices (2000–2018)



Source: NYISO, Power Trends 2019, page 31.

[49] 12,949 MW have been added since 2000. NYISO, Power Trends 2019, page 16.

[50] NYISO, Power Trends 2019, pages 16–18, 26.

[51] 7,343 MW of capacity have retired or suspended operation. NYISO, Power Trends 2019, page 17.

[52] NYISO, Power Trends 2019, page 18.

[53] NYISO, 2019 Gold Book, April 2019 (hereafter 2019 Gold Book), page 15; available at https://www.nyiso.com/documents/20142/2226333/2019-Gold-Book-Final-Public.pdf/; NYISO, 2010 Gold Book, revised May 2016, page 20, available at https://www.nyiso.com/documents/20142/2226467/2010-Load-Capacity-Data-Report-Gold-Book.pdf/b7dca6b1-1b08-64fc-7892-493cffe3319f.

price changes have been driven by a combination of the market forces, market designs, and the public policies described above.[54]

- New York's average electricity prices (in cents/kWh) and average annual electric bills are attractive compared to other states that both have aggressive clean-energy and climate goals and rely on competitive markets for various aspects of electric service provision. (See Table 2.) Also, New York's electricity costs have improved over time. In 2000, for example, New York had the highest average residential retail electricity prices among all of the Lower 48 States, with prices 17 percent higher than in New England and 20 percent higher than in California. By contrast, in 2018 New York prices were 15 percent lower than the average residential retail price in New England and 11 percent lower than California's.[55] Moreover, the average cents/kWh price in New York State was lower in 2018 than it was in 2000, taking inflation into account: in 2018, the average price of electricity in New York was 14.88 cents/kWh (2018$), compared to the average price in 2000, which was 16.59 cents/kWh (2018$) (or 11.38 cents/kWh (2000$)).[56]

Table 2: New York Electricity Costs to Consumers—Rankings Compared to Selected States

Retail Electricity Price: Residential Customers (2017)				Annual Household Electricity Bill (2017)				Electric Bill as % of Income (2017)	
Average Residential Price (c/kWh)		Electric price compared to New York's		Average Residential Electric Bill		Household Electric Bill compared to New York's		Average Annual Electric Bill as % of Household Median Income	
New England	19.41¢	8% higher		New England	$1404	13% higher		U.S. average	2.18%
California	18.31¢	2% higher		U.S. average	$1340	8% higher		New England	2.01%
New York	18.03¢	-		New York	$1239	-		New York	1.98%
U.S. average	12.89¢	29% lower		California	$1218	2% lower		California	1.75%

Sources: EIA Form 861 Data; U.S. Census Bureau, Table H-8: Median Household Income by State: 1984 to 2017, available at https://www2.census.gov/programs-surveys/cps/tables/time-series/historical-income-households/h08.xls.

Note: New England metrics reflect weighted average information across the six New England states, with the c/kWh and average electric bill weighted by individual states' kWh usage sales, and with electric bills as a percentage of household median income weighted by number of residential customers.

- As a result of the changing supply portfolio (e.g., retirements of plants that burned fossil fuels, addition of renewables, improved efficiency of the state's power plants, gas prices being more attractive than coal prices), flat demand, and various public policies focused on power plant emissions, emissions from New York's electric system have declined substantially. Over the past two decades, emissions of sulfur dioxide (SO_2) dropped 98 percent, NO_x emissions declined 89 percent, and CO_2 emissions were cut in half. (Figure 3 shows the decline in

[54] NYISO, Power Trends 2019, pages 31 and 33.

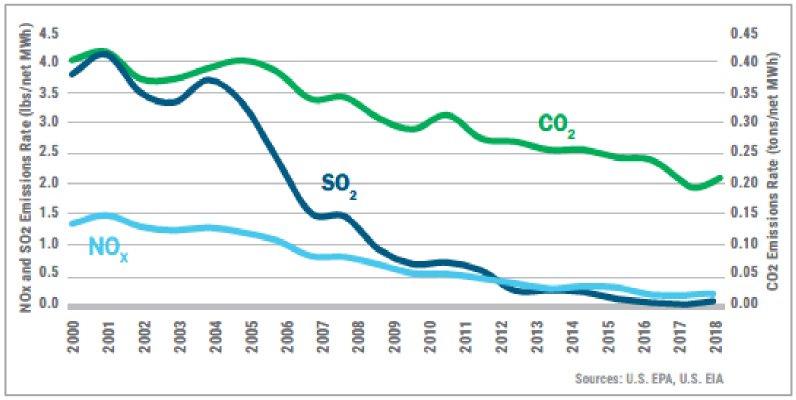
[55] EIA, Form 861 annual survey data (hereafter EIA Form 861 Data), available at https://www.eia.gov/electricity/data.php#sales.

[56] EIA Form 861 Data; Bureau of Labor Statistics, "Consumer Price Index: Total All Items for the United States;" Federal Reserve Bank of St. Louis, available at https://fred.stlouisfed.org/series/CPALTT01USQ661S.

rates of air pollutants for each type of emission, noted in terms of units of emissions per MWh of electricity produced by the entire set of power plants on the NYISO system.)

- On top of a variety of public health and other outcomes in New York, these changes have also led to a shift in the dominant carbon-emitting sectors of New York's economy. As of 2018, the most CO_2 emissions from New York's economy overall (46 percent) came from combustion of fossil fuels in the transportation sector; another 32 percent came from residential and commercial buildings; and power sector emissions accounted for 17 percent of total CO_2 emissions.[57]

Figure 3: Emission Rates for Electricity Generation in New York (2000–2018)



Source: NYISO, Power Trends 2019, page 33

- Throughout these changes, NYISO and market participants have maintained highly reliable service on the bulk power system.

D. FERC regulation of wholesale electricity markets

FERC, as the regulator of the NYISO markets, has supported changes in market rules and other transitions in New York's wholesale markets over many years. That said, in recent years, FERC has raised two countervailing issues:

- On the one hand, FERC has recognized that different states and regions have their own preferences not only for the design of their organized wholesale markets (where such markets exist) but also for the ability of states to exercise their preferences for public policies that affect, directly or indirectly, those wholesale markets. In recent years, FERC has shown an interest in accommodating state environmental policies that affect the entry, exit, and performance of power plants in an electric system. As noted above in Section 1, in 2017 FERC signaled a willingness to receive proposals from Regional Transmission Organizations (RTOs), like NYISO, that would attempt to harmonize the design of wholesale market rules with states' preferences for certain types of power supply resources. FERC has determined, for example, that, pursuant to state action on renewable energy standards, where there is a market for RECs that are unbundled from a wholesale electric-energy transaction, transactions involving the purchase and sale of RECs do not affect wholesale electricity rates.[58] The courts have upheld the ability of states (and notably New York) to adopt ZEC programs.[59]

[57] NYISO, Power Trends 2019, page 34.

[58] FERC, "Order Conditionally Accepting Service Schedule R," WSPP Inc., 139 FERC ¶ 61,061, Docket No. ER12-1144-000, issued April 20, 2012, page 9, available at https://statepowerproject.files.wordpress.com/2017/07/ferc_schedule_r_order_042012.pdf.

[59] See the description of litigation related to the New York case, *Coalition For Competitive Electricity et al v. Zibelman, et al.*, at Harvard University Law School's State Power Project website at https://statepowerproject.org/new-york/#nyces.

- On the other hand, FERC has also been a staunch defender of competitive markets and its jurisdiction over wholesale electricity prices. In a number of court cases involving the Federal Power Act (FPA) and state policies that favor one type of electric resource over another, limits have been imposed on state action. In *Hughes v. Talen Energy Marketing*, the U.S. Supreme Court held that the particular design of Maryland's program involving a contract with an independent power company to build a new natural gas facility in the state was preempted by the FPA, which gives FERC exclusive jurisdiction over wholesale rates.[60]

Particular to its interest in market competition, FERC has recently taken steps to regulate the terms and conditions under which state actions regarding out-of-market contracts affect the performance of capacity markets in organized markets such as PJM, ISO-New England (ISO-NE), and NYISO. FERC raised questions in 2018, for example, about the designs of PJM's and ISO-NE's capacity markets, in light of concerns about the adverse impacts of state-sponsored out-of-market procurements on the efficiency and competitiveness of capacity markets.

FERC concluded that PJM's tariff was, in its current form, "unjust and unreasonable and unduly discriminatory," saying that "the evidence put forward by PJM and the intervenors demonstrate[s] that the price-distorting effects on wholesale capacity prices caused by resources that receive out-of-market support reach far beyond new natural gas-fired resources."[61] It cited "laws passed in a number of PJM states that provide or require out-of-market support for nuclear, solar, and wind resources," as well as "data showing that existing state RPS programs will continue to require significant support in the future."[62] FERC also noted that an increasing array of "older, uneconomic resources in PJM, which may not be able to clear the market based on their costs alone, are increasingly receiving out-of-market support."[63] PJM has proposed changes to its tariff, although FERC has not yet ruled on them as of this writing.

Although ISO-NE's approach was different—with FERC having recently approved ISO-NE's Competitive Auction with Sponsored Policy Resources (CASPR) approach, in which the timing of state-sponsored resources would be coordinated with the retirement of existing resources with capacity obligations—FERC nonetheless made similar observations to those in its 2018 PJM order:

> [This] raises a potential conflict with the Commission's interest in maintaining efficient and competitive wholesale electric markets. Specifically, out-of-market state support can result in the region building more capacity than it needs. … Absent market mechanisms to limit the impact on FCM [forward capacity market] prices, which serve as both a revenue stream and a price signal for investors, those state actions can erode the investor confidence on which the FCM relies to meet its objective. Erosion of investor confidence can prevent the FCM from attracting investment in new and existing non-state-supported resources when investment is needed, or can lead to excessive costs for consumers as capacity sellers include significant risk premiums in their offers. … The Commission has previously found

[60] *Hughes, Chairman, Maryland Public Service Commission et al. v. Talen Energy Marketing, LLC, , FKA PPL Energyplus, LLC, et al.*, 578 U.S. __ (2016), available at https://statepowerproject.files.wordpress.com/2014/03/hughes-v-talen-supreme-court-opinion.pdf.

[61] FERC, "Order Rejecting Proposed Tariff Revisions, Granting in Part and Denying in Part Complaint, and Instituting Proceeding under Section 206 of the Federal Power Act," 163 FERC ¶ 61,236, Docket Nos. EL16-49-000. June 29, 2018 (FERC June 2018 Order), pages 64–65, available at https://www.ferc.gov/CalendarFiles/20180629212349-EL16-49-000.pdf.

[62] FERC June 2018 Order, pages 65, 66.

[63] FERC June 2018 Order, page 67.

> that ISO-NE's current MOPR [minimum offer-price-rule] construct, including a limited exemption for a set quantity of renewable resources each year (RTR exemption), would adequately limit the impact of out-of-market state actions on FCM prices, and thus yield just and reasonable rates. *However, as ISO-NE indicates, the New England states recently have significantly increased both their targets and their efforts to promote the development of specific state-supported resources in the region*.[64] [emphasis added]

NYISO's current buyer-side mitigation (BSM) approach is yet different from PJM's and ISO-NE's. NYISO's BSM process seeks to prevent uneconomic offers by new out-of-market resources that will artificially reduce capacity prices. NYISO's BSM involves a series of tests to determine whether a resource is eligible to offer into capacity markets at a price level below a certain "Offer Floor" price.[65] These tests—currently applied in particular "mitigation capacity zones" (i.e., NYC (Zone J) or in the Lower Hudson Valley (Zones G–J)), and with an exemption of 1,000 MW of renewables in each "class year" in the capacity market—aim to mitigate resources that would, as price-takers, end up selling at uneconomic prices and to subject them to an Offer Floor price.

In this framework, new state-sponsored resources in other parts of the NYISO footprint (sometimes called the "Rest of State") do not trigger the application of BSM actions. There are, however, several open complaints pending at FERC specifically questioning the design and application of the BSM in the NYISO market, with those complaints aimed at eliminating the 1,000-MW renewables exemption and at modifying BSM so that it applies in the Rest of State.

In light of the approach that could be applied in PJM—which would apply mitigation to both new and existing state-sponsored resources—and the language adopted in ISO-NE's tariff approval—which foreshadows increasing concerns about the impact of out-of-market state actions on wholesale markets as the states significantly increase their clean energy targets and their efforts to promote the development of specific state-supported resources in the region—it is uncertain whether FERC will find that changes are needed in the NYISO BSM approaches as New York State transitions to increasing amounts of clean energy resources that enter the market with NYSERDA REC/ZEC contracts. This risk will be heightened in light of the state's need to meet the mandates under the recently passed Act.

E. Economic and public policy literature on carbon pricing

There is an extensive academic literature[66] on the economic and policy considerations relating to the design, performance, and outcomes of addressing technical "market failures" (such as the occurrence of environmental externalities related to CO_2 emissions) through emissions pricing mechanisms. Without repeating that literature here, it is useful to highlight several insights from it:

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[64] FERC, "Order on Tariff Filing" re: ISO-New England Inc., Docket No. ER18-619-000, 162 FERC ¶ 61,205, March 9, 2018, pages 10–11, available at https://www.ferc.gov/CalendarFiles/20180309230225-ER18-619-000.pdf.

[65] NYISO MST Tariff Section 23.4.5.7, Attachment H, available at https://www.nyiso.com/regulatory-viewer.

[66] See, for example, William Nordhaus, "How Fast Should We Graze the Global Commons?" *The American Economic Review*, May 1982, 72(2): pages 242–246; Marc Hafstead, "Carbon Pricing 101: An introduction to carbon pricing," Resources for the Future, June 6, 2019, available at https://www.rff.org/publications/explainers/carbon-pricing-101/; Lawrence Goulder, "Addressing the Urgency of More Stringent Climate Change Policy," Resources for the Future Working Paper 19-12, May 30, 2019, available at https://www.rff.org/publications/working-papers/addressing-urgency-more-stringent-climate-change-policy/; Kenneth Gillingham and James H. Stock, "The Cost of Reducing Greenhouse Gas Emissions," *Journal of Economic Perspectives*, Fall 2018, 32 (4): pages 53–72, available at https://www.aeaweb.org/articles?id=10.1257/jep.32.4.53; Christopher R. Knittel, "Diary of a Wimpy Carbon Tax: Carbon Taxes as Federal Climate Policy," MIT Center for Energy and Environmental Policy Research, Working Paper Series, CEEPR WP 2019-013, August 2019, available at http://ceepr.mit.edu/files/papers/2019-013.pdf.

- Where negative environmental externalities arise from the ways in which markets are organized, the price at which suppliers and consumers transact for a product or service does not appropriately reflect the full costs to produce that good or service, with costs shifted to third parties not otherwise involved in the transaction. Finding a way to internalize such externality costs into prices sends more accurate signals to suppliers and consumers of such a product.
- A carbon price may be imposed partially or fully through one or more mechanisms in the power sector, including through direct or indirect means such as:
  - adoption of technology-specific standards (e.g., New York's ZEC standard applicable to nuclear plants, or through RECs for renewable resources without emissions of CO_2)
  - a cap-and-trade program (such as RGGI)
  - policies (e.g., tax incentives, research and development (R&D), financial support for entry of early-stage technologies that have the potential to produce electricity with zero-carbon resources) that help with innovation and commercialization of carbon-free energy systems (such as are supported by NYSERDA R&D grants)
  - a sector-specific or economy-wide carbon tax
  - an externality value (e.g., a shadow price associated with a technology's carbon emissions), sometimes used in integrated resource planning contexts and in establishing the benefits and costs of energy efficiency programs
  - a carbon adder introduced into the dispatch algorithm of a wholesale energy market (such as has been under consideration by NYISO)

Clearly, carbon emissions do impose costs and risks on society—including on peoples' health and wellbeing, on economic systems, on infrastructure, and on the natural environment, among other things—as has been revealed in the scientific literature on climate change[67] and climate impacts,[68] and in the literature on the social cost of carbon.[69] Therefore, any policies to address those technical market imperfections will improve the performance of markets for the benefit of society. Allowing producers to emit CO_2 for free (or at a low price relative to its costs) distorts the market in ways that have been explicitly called out in the findings and declarations of the CLCPA.

Use of one or more policy instruments to correct technical market failures tends to involve some combination of administrative decisions (e.g., determining an allowed cap on emissions, establishing the price level for ZECs under New York's CES program) and market forces (e.g., the RGGI auction that establishes a price on CO_2 allowances, NYSERDA solicitations that set the price at which successful offshore wind developers will be paid for their RECs, a carbon price in NYISO energy markets).

Although various advocates for different policy instruments hold diverse views about the extent to which these various policy approaches may operate constructively and efficiently in combination with each other, the practical reality is that in most of the settings in which policy makers have addressed environmental externalities associated with carbon emissions, an array of policy tools has been adopted over time, with each policy tool explicitly or implicitly placing a value on emissions of CO_2.

[67] In its section on findings and declarations, the Act describes the scientific conclusions of the Intergovernmental Panel on Climate Change.

[68] See the Act's findings and declarations, and the 2018 National Climate Assessment, available at https://nca2018.globalchange.gov.

[69] See, for example, National Academies of Sciences, Engineering, and Medicine, "Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide," The National Academies Press, 2017, available at https://doi.org/10.17226/24651.

The many diverse provisions of New York's CLCPA exemplify this reality. There are multiple collateral objectives of policy makers when they set out to address carbon emissions (e.g., environmental goals, jobs and other economic considerations, equity). The ability to address both the carbon externality and those other goals may involve a portfolio of policies. Indeed, the Act calls for the state's new Climate Action Council to develop a scoping plan by 2021 that "[identifies] and [makes] recommendations on regulatory measures and other state actions that will ensure the attainment of the statewide greenhouse gas emissions limits … The measures, actions [and other considerations taken into account] in such scoping plan shall at a minimum include, among other things":

- "measures to reduce emissions from the electricity sector by displacing fossil-fuel fired electricity with renewable electricity"
- measures leading to the installation of 6,000 MW of distributed solar, 9,000 MW of offshore wind capacity, 3,000 MW of storage, and significant amounts of energy efficiency
- "mechanisms to limit emission leakage"
- "the total potential costs and potential economic and non-economic benefits" of the plan, "taking into account the value of carbon" as determined by the DEC, and the environmental, economic, and public health co-benefits
- "measures to maximize reductions of GHG and co-pollutants in disadvantaged communities"

The Act invites these multiple mechanisms to operate in tandem. Although not specifically called out in the language of the Act, a price on carbon, in conjunction with the other named policy instruments, can help to reduce GHG emissions efficiently, address leakage, and reduce emissions in areas affecting disadvantaged communities.

The sheer scope, scale, and urgency of actions that will be needed to accomplish New York's aggressive goals in a timely way call for using every effective means possible to position the state for success. As Stanford University environmental economist Professor Lawrence Goulder has recently written:

> For decades, economists have identified the climate change problem as an externality problem that leads to a market failure and a potential role for government intervention. Their analyses have influenced policy debates and helped support climate policy action in the U.S. and elsewhere. Yet economists can expand their influence in important ways by giving greater attention to the urgency of more stringent climate action policy and the associated costs of delay.[70]

[70] Lawrence Goulder, "Addressing the Urgency of More Stringent Climate Change Policy," Resources for the Future Working Paper 19-12, May 30, 2019, available at https://www.rff.org/publications/working-papers/addressing-urgency-more-stringent-climate-change-policy/.

III. Implications of a NYISO carbon pricing mechanism for assisting New York in accomplishing its CLCPA goals

A. Introduction

The context discussion in Section II sets the stage for considering the value proposition afforded by the introduction of a carbon pricing policy in NYISO markets for New York's ability to accomplish the important and challenging goals of the Act. Several insights emerge from that context:

- New York's policy leadership has made a meaningful difference in achieving the state's multiple goals for the state's electric system. Policies affecting competitive markets, clean energy, and environmental improvements have resulted in a system that provides efficient and reliable supply to consumers at a lower cost than they paid two decades ago (in inflation-adjusted terms).
- In the power sector, New York has relied upon a diverse set of policies to accomplish these affordability, reliability, environmental, clean energy, and infrastructure investment goals.
- The power sector's CO_2 emissions have been cut by approximately one-third since 2000,[71] through a combination of market forces, environmental policy, and administrative actions. Much of that progress has been accomplished through myriad actions in the market: adopting the multistate RGGI program to reduce regional CO_2 through market forces; switching from reliance on carbon-intensive fossil fuels (i.e., coal, oil) to less carbon-intensive fuels (i.e., natural gas); improving power-production efficiencies as newer fossil units have entered the market; increasing output at existing nuclear plants; and increasing investment in energy efficiency and renewable projects over the years.
- Although wind and solar renewables have increased significantly from their levels a decade ago—with wind generation, for example, nearly doubling from 2,108 GWh in 2009 to 3,985 GWh in 2018—these renewables still represent a very small share of total electrical supply in New York. Wind's share of total generation rose from 1 percent in 2009 to 3 percent in 2018. [72]
- This offers an important perspective on what is to come. The Act calls for unprecedented increases in renewable generation in 11 years, so that renewables provide 70 percent of consumers' needs. The Act requires that only zero-carbon generation sources remain in the electric system 21 years from now (which is essentially the same amount of time that NYISO has been in business (since 1999),[73] in which time new, non-hydroelectric renewables have increased by only 3 percentage points, from 2 percent of supply in 2005[74] to 5 percent of supply as of 2018[75]).

[71] EIA, "Emissions from the U.S. electric power sector projected to remain mostly flat through 2050," February 11, 2019, available at https://www.eia.gov/todayinenergy/detail.php?id=38293.

[72] NYISO, Power Trends 2019, page 60.

[73] NYISO, "What We Do," available at https://www.nyiso.com/what-we-do.

[74] NYISO, 2006 Gold Book, revised May 2016, page 51, available at https://www.nyiso.com/documents/20142/2226467/2006-Load-Capacity-Data-Report-Gold-Book.pdf/89ab7fc7-a228-2ed9-e201-8efcc482ba85.

[75] NYISO, Power Trends 2019, page 27.

- For the electric sector to assist in decarbonizing New York's other economic sectors (where 83 percent of the carbon emissions now occur[76]) on the aggressive time frames in the Act, New York's power system will need to adjust to vastly different levels and shapes of electricity demand while simultaneously adding clean energy resources on a scale and pace unseen in recent years in the state (and perhaps not since the mid-20th century, when NYPA's massive hydropower projects came on line). Even considering the amount of existing renewables in New York and new renewables that have entered into long-term REC contracts with NYSERDA (or have been announced as successful offshore wind projects) in recent years (which will total approximately 50,000 GWh, or one-third of the generation that will be in the system by 2025[77]), New York will still need to add more incremental renewables than have ever been added in the state's history.
- Between now and 2040, when all of the state's power must come from zero-carbon supplies, all but one of New York's existing, zero-emitting nuclear units are set to end operations. In 2019, nuclear plants provided approximately a quarter of New York consumers' needs. If the plants operate until the end of their agreed-upon lives (in the case of Indian Point 2 and 3) or the end of the current operating licenses (in the case of Ginna, FitzPatrick, and Nine Mile Point 1 and 2), the percentage of nuclear generation is estimated to drop to 11 percent by 2030 and to 6 percent by 2040 (or even lower, in a high-electrification case). Looking just at 2030, it will take essentially all of the specifically named resources committed in the Act—i.e., 6,000 MW of solar, 3,000 MW of storage, and half of the 9,000 MW of offshore wind due by 2035—*simply to replace the carbon-free generation that has been provided by the four units that will retire by then*.[78] Doing so will help meet the 70 percent renewable target by 2030 but it would not advance the state's ultimate target of 100 percent zero-carbon generation by 2040.
- The Act envisions early action and invites multiple carbon reduction mechanisms to operate in tandem. Although not specifically called out in the Act, a price on carbon in the NYISO market, in conjunction with the state's other policy instruments, can serve as a consistent foundational CO_2 pricing overlay for spurring innovation and creativity in the pursuit of least-cost GHG reductions in the electric sector; it can help to efficiently reduce GHG emissions, address leakage, and reduce air pollution affecting disadvantaged communities. A carbon price can serve as a market-based foundation, helping to guide and normalize the pushes and pulls of the implementation of the other administrative policies targeted at specific resources.
- Although FERC has sent signals that it wants to accommodate states' public policies affecting electric system portfolios, it is possible that new state action (e.g., in New York) that results in significant increases in out-of-

[76] NYISO, Power Trends 2019, page 34.

[77] See Technical Appendix, Table A.1.

[78] This is based on the following assumptions:

- Indian Point 2 and 3, Ginna, and Nine Mile Point 1 together produced approximately 26 million MWh a year on average in recent years. Replacing that zero-carbon output would require an equivalent amount of generation. (Indian Point 2 and 3 will retire in 2020 and 2021, respectively; Ginna and Nine Mile Point 1 each have an operating license that expires in 2029.)
- Adding output from 6,000 MW of community distributed solar PV (at 14 percent capacity factor) equals 7.36 million MWh.
- Adding output from 4,500 MW of offshore wind (at 44 percent capacity factor) equals 17.34 million MWh.
- Together, those additions of community-distributed solar PV and offshore wind would generate 24.7 million MWh (compared to the 26 million MWh produced at the four nuclear units).
- The storage would be needed to provide greater capability value for the combined installed capacity of the offshore wind and solar projects, and potentially to avoid some curtailment of renewables generation.

See the Technical Appendix for the sources of these capacity factors.

market contracts to support entry of new resources into the RTO market may provoke FERC to take further market mitigation action to protect the fundamental structure of the competitive market. FERC has shown the inclination to consider not only what resources exist due to state policy, but also those resources in the pipeline as a result of state legislative and/or regulatory action. It will be no secret to FERC that the magnitude of resources stemming from the Act will overwhelm market operations over the next 5–15 years, unless they are made harmonious with markets through an internal market mechanism.

- The sheer scope, scale, and urgency of actions that will be needed to accomplish New York's aggressive reductions in GHG emissions in a timely fashion call for using every effective means possible to position the state for success, and to do so at the lowest possible cost. A price on carbon in wholesale markets can provide a signpost to low-cost compliance pathways and preserve the fundamental wholesale electricity-market structure that encourages operational efficiency and minimizes consumers' investment risks.

The bottom line is that New York's electric industry transition will not be easy. Achieving the GHG emission reductions and other requirements called for in the Act will involve a significant, focused, and historic effort by policy makers and private actors, as soon as possible.[79] Even considering the many inventive regulatory and other policy instruments and approaches that have occurred in New York,[80] it will take even further innovation in a combination of policy, R&D, technology, business models, financing, service-delivery mechanisms, workforce training, and social support systems. Just as the DPS staff considered it important for the Commission to adopt the CES program to meet four principal policy objectives—(1) to increase renewable electricity supply to meet the state's goal (which was "50 by 30" at the time); (2) to support construction of new renewable generation in New York; (3) to prevent premature closure of upstate nuclear facilities; and (4) to promote the progress of REV market objectives (e.g., to "support the development of a vibrant clean energy market and provide the scale and certainty necessary for broad competition that encourages private investment and reduces cost" and "encourages innovative, market-based solutions")[81]—the addition of a carbon pricing mechanism would amplify these same objectives of the CES.

B. New York's upcoming clean energy challenge: The numbers

Table 3 shows the magnitude of New York's upcoming clean energy challenge relative to the state's portfolio mix as of 2018. That year, renewable resources provided 20 percent of the state's consumers' demand (with 80 percent of current renewables coming from hydroelectric resources).[82] The Act requires an increase in renewable energy projects by 2030 such that they provide 70 percent of LSEs' demand.

[79] This point about the urgency of action is well understood by New York's policy makers, but it is worth repeating here in the context of a discussion of the role of a carbon pricing mechanism in the NYISO market. The PSC made a similar observation—"the imminent need to move as quickly as is feasible to build a low-carbon energy system, as provided in the State Energy Plan"—in its "Order Establishing Offshore Wind Standard and Framework for Phase 1 Procurement," Case 18-E-0071, July 12, 2018 (hereafter Offshore Wind Order), page 17.

[80] Such innovations include the REV process; RGGI; the Clean Energy Standard and the Offshore Wind Standard and related procurements of RECs, ZECs and ORECs; Green Bank; and NYISO itself.

[81] DPS Staff White Paper on Clean Energy Standard, Case 15-E-0302, January 25, 2016, page 3 (for the reference to the quoted statements) and, more generally, pages 2–3 for a description of the REV goals.

[82] In the 2019 Gold Book (page 78) and the Power Trends 2019 (page 27) documents, NYISO reports that renewables provided 26 percent of generation in the NYISO control area. The difference between that percentage and the 20 percent figure reported here is that the latter refers to renewables as a percentage of total in-state generation, while the former represents the percentage of total New Yorkers' demand that was met by in-state renewables

Progress toward these targets is already underway, of course. If one starts with the baseline NYISO demand forecast (shown in Table 3) and assumes that (a) all of NYSERDA's existing and anticipated contracted-for CES resources in 2017, 2018, and 2019 come into commercial operation[83] (including the offshore wind projects announced in July 2019); and (b) the RECs associated with clean energy technology targets specifically enumerated in the Act[84] also end up being procured through future NYSERDA contracts, then an estimated 22 percentage points of incremental renewable supply needed by 2030 would be in the pipeline, accounted for, and presumably coming on line by 2030. This is shown on the "known/planned resources" line for renewables on Table 3, which indicates that New York has identified renewables amounting to 42 percent of baseline supply needed by 2030 (even if the specific projects associated with all of the Act's offshore wind, solar photovoltaic (PV), and storage capacity goals have neither been identified nor procured as yet).[85]

Table 3:
Clean Energy Resources in NYISO System vs. New York State Targets for the Power Sector[86]
(Baseline Demand Outlook)

	2018		2030		2040	
	%	GWh	%	GWh	%	GWh
Baseline demand forecast	-	158,445	-	153,400	-	165,200
Renewable resources						
CLCPA Target[2]	-	-	70%	107,380	-	-
Known/planned resources[1]	20%	32,338	42%	63,700	52%	85,300
Additional resources to be identified	-	-	28%	43,680	18%	30,340
Zero-carbon resources						
CLCPA Target[2]	-	-	-	-	100%	165,200
Known/planned resources[1]	60%	94,744	70%	108,000	75%	123,400
Additional resources to be identified	-	-	-	-	25%	41,800

Notes:
[1] Reflects all existing, procured, and planned resources in New York State including those forecasted by NYISO in the 2019 Gold Book, procured through New York's Clean Energy Standard in 2017-2019, or announced as part of the concrete targets in New York's Climate Leadership and Community Protection Act.
[2] The CLCPA targets seek 70% renewable energy by 2030 and 100% carbon free energy by 2040. A smooth transition to renewable and carbon free energy targets is assumed between 2018 and the target years.

in 2018. The Act focuses on renewables as a share of the supply provided to end-use customers by LSEs (defined as entities that are jurisdictional to the PSC). For the purposes of this report, we are reporting renewables as a share of total electricity sold at retail, in light of the larger context in which the Act calls for the eventual elimination of GHG emissions from the entire electric sector and New York's entire economy.

83 NYSERDA procurements of renewable attributes to date include: (a) more than 11 RPS "Main Tier" solicitations in which NYSERDA contracted for RECs from 2,241 MW of new renewable capacity between January 2005 and May 2016; and (b) two CES solicitations in 2017 and 2018, through which NYSERDA contracted for RECs from an additional 2,748 MW of onshore wind (1,040 MW), utility-scale solar (1,687 MW), and hydro (3 MW), to be operational by 2023. A third CES solicitation is underway, with awards expected to be announced in November 2019. In July 2019, Governor Cuomo announced that New York had selected two offshore wind projects (totaling 1,696 MW of capacity) to proceed to contract negotiations with NYSERDA. See Technical Appendix.

84 The Act calls for the PSC to establish programs to require LSEs to produce at least 9,000 MW of offshore wind (by 2035), 6,000 MW of solar PV generation (by 2025), and 3,000 MW of statewide storage capacity (by 2030). See the Technical Appendix for the assumptions we used to convert these capacity-related numbers into generation output by technology type.

85 The 14 percent figure comes from the anticipated amount of "known/planned resources" in 2030 (i.e., 34 percent) minus the amount that already existed in 2018 (i.e., 20 percent).

86 As explained in more detail in the Technical Appendix, sources include: NYISO Gold Book (2017, 2018, 2019); NYSERDA Fact Sheets regarding renewable energy procurements; the Act; and Governor Cuomo's Green New Deal targets.

But given the Act's target of 70 percent renewables by 2030, that would leave a need for additional projects to supply another 28 percent of renewable resources, and for those projects to be built and enter the market by 11 years from now. This is *127 percent*[87] more than the amount already contracted for (or expected to soon be under contract) by NYSERDA and already identified in the Act's technology-specific targets. Given that the last decade witnessed the addition of renewables equivalent to 5 percentage points of total supply, this will be an unprecedented and significant task.

Another dimension of New York's clean energy challenge relates to the entry of zero-carbon-emitting resources (which, of course, many types of renewable energy can provide). As shown in Table 3, if New York were to satisfy its 2030 renewable targets with mainly wind and solar capacity, the state would be well on its way toward meeting its 2040 zero-carbon goals for the state's electric sector. But if existing nuclear generating units retire over the next 11 years, their output will need to be fully replaced by zero-carbon-emitting generation if New York is to avoid backtracking on its 2040 goal. This situation will significantly magnify the work that New York's policy makers, market participants, and others will need to do put New York's carbon emissions reductions on track with the Act's requirements. As noted previously, it will take essentially all of the specifically named resources committed in the Act—i.e., 6,000 MW of solar PV, 3,000 MW of storage, and half of the 9,000 MW of offshore wind due by 2035—simply to replace the zero-carbon generation that has been provided by the four nuclear units that either must or might retire by then. Doing so will help meet the 70 percent renewable target by 2030, but it will not advance the state's target of 100 percent zero-carbon generation by 2040.

New York's existing and needed new renewable and zero-carbon resources are shown in Table 4, which builds out the information in Table 3 to show changes in the technology portfolio as New York's nuclear units shut down or retire. (Note again that the percentages indicated on this table reflect generation as a percentage of New York's total baseline demand.)

[87] This figure is based on the following: (a) between 2018 and 2030, we calculate that the incremental resources associated with NYSERDA contracting through 2019, plus the technology-specific resources identified by the Act (i.e., offshore wind, solar PV), would together add generation able to serve 22 percent more of the demand than was available in 2018; and (b) an additional 28 percent of demand needs to enter the market by 2030, and 28 percent is 1.27 times higher than 22 percent.

Table 4:
Clean Energy Resources (by Technology Type) in NYISO System vs. New York Targets for the Power Sector[88]
(Baseline Demand Outlook)

	2018		2030		2040	
	%	GWh	%	GWh	%	GWh
Baseline demand forecast	-	158,445	-	153,400	-	165,200
Known/planned resources[1]						
Nuclear	27%	43,003	11%	16,600	6%	10,400
Hydro	18%	28,304	18%	28,300	17%	28,300
Wind	3%	3,985	16%	24,000	28%	45,600
Solar	0%	49	7%	11,400	7%	11,400
Clean Imports	12%	19,402	18%	27,700	17%	27,700
Renewable resources						
CLCPA Target[2]	-	-	70%	107,380	-	-
Known/planned resources[1]	20%	32,338	42%	63,700	52%	85,300
Additional resources to be identified	-	-	28%	43,680	18%	30,340
Zero-carbon resources						
CLCPA Target[2]	-	-	-	-	100%	165,200
Known/planned resources[1]	60%	94,744	70%	108,000	75%	123,400
Additional resources to be identified	-	-	-	-	25%	41,800

Notes:
[1] Reflects all existing, procured, and planned resources in New York State including those forecasted by NYISO in the 2019 Gold Book, procured through New York's Clean Energy Standard in 2017-2019, or announced as part of the concrete targets in New York's Climate Leadership and Community Protection Act.
[2] The CLCPA targets seek 70% renewable energy by 2030 and 100% carbon free energy by 2040. A smooth transition to renewable and carbon free energy targets is assumed between 2018 and the target years.

The task before the state, NYISO, and electricity market stakeholders is significantly magnified when considering the Act's requirements for reducing GHG emissions from *all* energy sectors. If the state's electric system performs the broader role of decarbonizing elements of transportation and building end-uses, as anticipated in the Act, the challenges associated with adding more renewables *plus* adding and/or retaining zero-carbon supply are far larger. Table 5 provides the results of a "higher electrification" scenario, which assumes that end-use electricity demand rises precipitously, much faster than in NYISO's baseline forecast. This is an illustrative example of the changes in demand and the requirements for clean resource additions generated by the assumption that New York households switch to electric vehicles and owners of residential buildings in New York switch their heating systems

[88] See the Technical Appendix for sources of information for this table's information.

to electricity.[89] Compared to the baseline forecast (in Table 4), Table 5's "forecasted energy demand" is 20 percent higher in 2030 and 45 percent higher in 2040.

Table 5:
Illustrative Higher Electrification Scenario:
Clean Energy Resources (by Technology Type) in NYISO System vs. New York State Targets for the Power Sector[90]

	2018		2030		2040	
	%	GWh	%	GWh	%	GWh
Baseline demand forecast	-	158,445	-	184,300	-	240,100
Known/planned resources[1]						
Nuclear	27%	43,003	9%	16,600	4%	10,400
Hydro	18%	28,304	15%	28,300	12%	28,300
Wind	3%	3,985	13%	24,000	19%	45,600
Solar	0%	49	6%	11,400	5%	11,400
Clean Imports	12%	19,402	15%	27,700	12%	27,700
Renewable resources						
CLCPA target[2]	-	-	70%	129,010	-	-
Known/planned resources[1]	20%	32,338	35%	63,700	36%	85,300
Additional resources to be identified	-	-	35%	65,310	34%	82,770
Zero-carbon resources						
CLCPA target[2]	-	-	-	-	100%	240,100
Known/planned resources[1]	60%	94,744	70%	108,000	51%	123,400
Additional resources to be identified	-	-	-	-	49%	116,700

Notes:
[1] Reflects all existing, procured, and planned resources in New York State including those forecasted by NYISO in the 2019 Gold Book, procured through New York's Clean Energy Standard in 2017-2019, or announced as part of the concrete targets in New York's Climate Leadership and Community Protection Act.
[2] The CLCPA targets seek 70% renewable energy by 2030 and 100% carbon free energy by 2040. A smooth transition to renewable and carbon free energy targets is assumed between 2018 and the target years.

This illustrative case *greatly understates* the magnitude of the build-out of clean power supplies that would be required to fully satisfy the Act's expectation of switching much of the New York economy's energy use to electricity. Even assuming that large investments in energy efficiency will be made in future years, electrification of energy uses in commercial vehicle fleets, buses, trucks, airplanes, ships, commercial and government buildings, industrial uses, and other residential equipment will mean significantly higher electricity requirements on the New York system, perhaps doubling the energy use anticipated in the baseline outlook for demand shown in Tables 3 and 4.

[89] Many of the elements of the Act are still under development, and will be for at least several years. On the one hand, the degree of electrification we select for this *illustrative calculation* seems well beyond any feasible electrification target based on current actions, policies, markets, or economics. On the other hand, the illustrative electrification percentages actually *fall short* of what is likely to be needed to meet the economy-wide GHG reduction targets in the Act. Therefore, it is difficult for us to conclude whether our example is an optimistic or pessimistic view of the magnitude of electrification-related changes to the electricity market.

[90] The sources are the same as those for Table 4, except that the baseline demand forecast is increased as described in the Technical Appendix.

In this illustrative high-electrification scenario, vastly more renewable resources will need to enter the market much faster than in the baseline case in order to meet the 2030 deadlines. That pace will need to continue during the 2030s to meet the 2040 targets, as owners of upstate nuclear plants decide whether to retire their units at the end of their operating licenses or to seek extensions of them.

C. New York's clean energy challenge: Framing the issue of the costs

The cost implications of these massive and urgent build-outs are large. If one were to assume that no carbon price was implemented in the NYISO markets, then there would likely be "above-market" costs for many renewable and storage projects because wholesale market prices would not reflect the attribute value of such resources. The Act has found, in effect, that those above-market costs to electricity consumers are worth it, in light of the climate, economic development, workforce, public health, infrastructure protection, social, and other benefits associated with transitioning the state's economy to a lower carbon footprint.

Although such costs would need to be absorbed in New York's economy as part of what it will take to develop, finance, and operate sufficient renewable resources to meet state statutory requirements, these costs would also show up as above-market costs in in a NYISO market without a carbon price. If New York's electric system did not value the renewable or zero-carbon attributes of certain power resources, then the system would likely not see the same pace and degree of new capital investment, because the NYISO system is currently relatively sufficient with supply resources. The Act therefore anticipates a pace of entry and significantly new and large investment in capacity and other infrastructure well beyond what would otherwise be needed to meet reliability and energy requirements alone, because New York may not otherwise need to add new generating capacity.

Therefore, if the NYISO market design does not account for the renewable or zero-carbon attributes of such supply, then there will be relatively weak price signals for the retirement of the least-efficient and highest-emitting fossil power plants, and for the addition of low- or zero-carbon generation and of potentially unprecedented levels of high-voltage transmission needed to better connect upstate and downstate electrical regions within NYISO and to move offshore wind onshore. There will also be relatively weak price signals for *early* additions of renewables, storage, energy efficiency, and demand response at the scale and timing necessitated by the Act.

Indeed, if energy prices (without a carbon price) remain relatively low in the future—and even lower in a market with deep penetration of zero-variable-cost resources—then REC and/or ZEC prices (if not also capacity prices) will have to rise over time to continue to pull these resources into the system. It is not hard to imagine that under such conditions, some of the early renewable project entrants into the NYISO market will also ask for higher REC prices to make it worthwhile to continue to maintain their projects and remain in the market.

Introducing a carbon price in NYISO's wholesale market will align the market with state policy, and will signal to market participants (including consumers) the value of relying on renewable and zero-carbon supply. It will internalize into locational price signals the importance of resources valued by the state. It will provide price signals so that the right type of resources are available where and when consumers demand supply. The discipline of a carbon price will help chart the path to the most efficient set of resources, infrastructure additions, and demand-side reductions over time, in ways that cannot necessarily be accomplished through the disparate actions of multiple state agencies, industry stakeholders, and market participants.

For example, assume that onshore wind resources are cost-competitive at prices that do not reflect a carbon pricing mechanism. They are likely to seek to locate in upstate New York, where the valuable land-based wind resources are located in the state. If that occurs, then it will likely lead to oversupply and curtailment of precious zero-carbon electricity supply at times when transmission constraints prevent access to downstate loads. In that sense, then, even if the wind resources are cost-competitive, their value to the New York system is undermined unless there are investments made in transmission.

Even if onshore wind projects could enter the market competitively through price signals in NYISO's energy and capacity markets, it is not likely that offshore wind, storage at scale, or abundant solar projects can do so, at least for many years. This means that without aligning the wholesale market design with the renewable and zero-carbon attributes these resources provide, the Act's anticipated build-out will require compensation in the form of RECs or some other way to value those attributes. And it is not likely that upstate nuclear units would seek to extend their operating licenses without a forward-looking expectation of further compensation for their zero-carbon-emissions attributes, either through additional ZEC contracts or some other means.

The above-market costs are very large in a market that does not value these attributes. There are a number of ways that these costs can, and likely will, be collected. They could be supported through contracts for RECs and/or ZECs, which would be paid by consumers in the prices charged by LSEs. They could be supported through the addition of a carbon price in NYISO markets. They could also be supported through some combination of these policy mechanisms (and others identified in the future, as well). As discussed further in the section below, given the urgency and unprecedented nature of the challenge, New York would benefit from exploiting as many policy mechanisms as possible, with reliance on ones that integrate seamlessly and helpfully with the operation of competitive markets, and are likely to minimize the overall cost of meeting the Act's requirements.

Wholesale markets have demonstrated their ability to direct electric-industry operations and investment so as to extract efficiencies relative to what would have occurred absent competitive markets. This is demonstrated by comparing, for example, wholesale market operations with the operation of vertically integrated utilities, states or regions, or unit performance and costs with and without competition. Experience with the demonstrated efficiency savings that have occurred in organized competitive wholesale electricity markets suggests that it is reasonable to expect similar savings in achieving the requirements of the Act through price signals in the NYISO market. If so, then the literature[91] suggests that at least 1 percent and potentially as high as 3 percent of potential costs to satisfy the Act could be reduced simply by harnessing market forces and aligning the design and

[91] The figure here is a conservative estimate based on a review of literature that quantifies the cost savings associated with the introduction of market mechanisms in the electricity sector in the United States over the past three decades. The sources reviewed were the following: Matthew Barmack, Edward Kahn, and Susan Tierney, "A Cost-Benefit Assessment of Wholesale Electricity Restructuring and Competition in New England," *Journal of Regulatory Economics*, April 2007, Vol. 31:2, pages 151–184, available at https://link.springer.com/article/10.1007/s11149-006-9022-8; James Bushnell, Erin T. Mansur, and Kevin Novan, "Review of the Economics Literature on US Electricity Restructuring," working paper, February 23, 2017, available at http://bushnell.ucdavis.edu/uploads/7/6/9/5/76951361/economics-literature.pdf; James B. Bushnell and Catherine Wolfram, "Ownership Change, Incentives, and Plant Efficiency: The Divestiture of U.S. Electric Generation Plants," University of California Energy Institute Center for the Study of Energy Markets Working Paper Series, March 2005, available at http://faculty.haas.berkeley.edu/wolfram/Papers/Divest_0331.pdf; Steve Cicala, "Imperfect Markets versus Imperfect Regulation in U.S. Electricity Generation," working paper, May 9, 2019 , available at http://home.uchicago.edu/~scicala/papers/elec_gov_v_mkt/elec_gov_v_mkt_draft_2.pdf; Lucas W. Davis and Catherine Wolfram, "Deregulation, Consolidation, and Efficiency: Evidence from US Nuclear Power," *American Economic Journal: Applied Economics*, October 2012, Vol. 4:4, pages 194–225; Kira R. Fabrizio et al., "Do Markets Reduce Costs? Assessing the Impact of Regulatory Restructuring on U.S. Electric Generation Efficiency," *The American Economic Review*, September 2007, Vol. 97:4, pages 1250–1277; Erin T. Mansur and Matthew W. White, "Market Organization and Efficiency in Electricity Markets," working paper, January 13, 2012, available at http://www.dartmouth.edu/~mansur/papers/mansur_white_pjmaep.pdf; PJM Interconnection, "Resource Investment in Competitive Markets," May 5, 2016, available at https://www.pjm.com/~/media/library/reports-notices/special-reports/20160505-resource-investment-in-competitive-markets-paper.ashx; The Brattle Group, "Electricity Market Restructuring: Where Are We Now?" presentation at the National Conference of State Legislators Energy Forum, December 6, 2016, available at http://www.ncsl.org/Portals/1/Documents/energy/Energy_Pfeifenberger_Johannes_present.pdf; Frank A. Wolak, "Measuring the Benefits of Greater Spatial Granularity in Short-Term Pricing in Wholesale Electricity Markets," *The American Economic Review*, May 2011, Vol. 101:3, pages 247–252; Yiyuan Zhang, *Three Essays on the Impacts of Energy and Environmental Policies,* PhD thesis at the University of Michigan, 2017.

operations of the NYISO market with New York's goals through introducing a carbon price into NYISO's energy market.

Given NYISO's experience over the past two decades, we estimate such market-efficiency savings (net present value, or NPV) on the order of $280–850 million between 2022 and 2040 (2019$, 3 percent discount rate). This estimate is likely conservative, based on the unrealistically low assumption—given the decarbonization and electrification aspirations under the CLCPA—of a business-as-usual outlook for electricity demand. The full build-out of a zero-carbon economy over the next two decades will require significant investment in incremental low- and zero-carbon resources to accommodate decarbonization through electrification of buildings' and vehicles' energy use.

Thus, the savings that can flow from an efficient carbon pricing mechanism in the electric sector will be vital in helping New York manage the costs of the clean energy transition. Consumers will benefit from a market that relies as much as possible on the discipline of competition that a price on carbon within NYISO's markets can support.

D. A carbon price: Its value as an arrow in New York's policy quiver

We are aware that, over the past decade, New York policy makers have clearly shown a preference for relying on NYSERDA to conduct competitive solicitations and long-term contracting for RECs from new renewable resources.

But we are also cognizant that if New York were to rely on that approach for all of the incremental resources that have been called out specifically in the Act *and* for the additional ones that will be needed to meet the Act's goals (i.e., 70 percent renewable supply by 11 years from now and eliminating all carbon emissions in the next two decades), then the NYISO wholesale market would see a vast and rapidly increasing percentage of its generation resources assisted by out-of-market contracts. Moreover, the wholesale market would witness a pace of change—in types, quantities, and location of the generating resources needed to meet economic and reliability mandates—greater than ever experienced in its history.

While contracts for RECs and ZECs currently account for approximately 20 percent of generation in the NYISO market, by 2030 that share would be between 50 and 60 percent if all needed new renewable generation entered with REC contracts and if ZEC contracts were extended for the two existing nuclear units—Nine Mile Point 2 and FitzPatrick—that have operating licenses ending after 2030.

When the PSC adopted its CES order in 2016, the Commission made a number of statements that seem relevant for consideration of the policy tools that will be needed to meet the Act's very aggressive clean energy targets. In the CES order, the Commission stated that:

> The volume of new development that will be needed to achieve 50 by 30 [the renewables target then in place in 2016] is much greater than the annual pace the RPS program has achieved to date. Analysis of this issue is driven by the Commission's fundamental responsibility to consumers to achieve the SEP goal at a reasonable cost. For this it is apparent that some form of long-term procurement will be needed.
>
> Investors simply will not look to build renewable generation facilities without sufficient certainty that they will successfully earn a return on their investment. In the case of the type of long-lived capital investment necessary to construct and operate a generation facility, a long-term contract *or other durable mechanism* [emphasis added] providing reasonably certain terms will be necessary to induce

> such investment. Without the assurances that a long-term contract provides, the renewable generation projects that the State requires will not come to fruition. …
>
> The potential for federal preemption creates a risk that could slow the implementation of the RES. The U.S. Supreme Court decision in *Hughes v. Talen Energy Marketing, LLC*, 136 S. Ct. 1288 (2016) does not directly bar power purchase agreements. It does, however, cast uncertainty over state-mandated contracts that parties may argue interfere with federally supervised wholesale markets.
>
> An additional concern is a practice of FERC which places constraints on the Commission's ability to mandate PPAs in a cost-effective manner. FERC's current policy of imposing "buyer-side mitigation measures" upon various resources participating in the downstate installed capacity markets creates significant risk that a PPA backed by a public resource (including utility ratepayers) could fail to clear the capacity market thereby forcing ratepayers to purchase capacity from other resources that would not otherwise be needed. Although exemptions for certain renewable resources or other policy-driven procurements have been discussed in various orders, no clear policy delineations exist at this time. [92]

The language in the CES Order suggests that the PSC might be open to alternative policies to create incentives for entry of renewables if there were some "*other durable mechanism*" besides (or perhaps in addition to) long-term contracting for RECs to provide the "reasonably certain terms … to induce such capital investment."

A carbon pricing mechanism—relying on a relatively stable and durable social cost of carbon to reflect the value of the generation that provides electricity supply without emitting carbon—can provide the type of forward-wholesale-market revenue visibility and level of compensation needed to create incentives for investing in clean energy resources in the absence of, or even in tandem with, a long-term contract. Moreover, a stable carbon pricing mechanism can provide a steady hand on the rudder of change in New York State—one that can guide the transition toward the most efficient and lowest-cost path to decarbonization in full coordination with other state-driven policies.

Lenders place significant reliance on electric-market revenue streams (as opposed to also taking into account the expected revenues associated with RECs that are not under contract) in their determinations about whether to invest capital in support of a renewable project. This has made it important for many renewable project developers to gain financing during periods with low energy-market prices. But with wholesale energy market values reflecting a price on carbon (pegged to the social cost of carbon), lenders and investors will have transparency into that attribute's valuation and will likely be more willing to provide capital for many commercially ready renewable technologies, especially with the cost reductions in onshore wind and solar technologies that have been seen in commercial installations in recent years. This can husband the state's REC procurement bandwidth for the purpose of entering into contracts with newly emerging technologies, or technologies (like offshore wind or innovative technologies) that may require long-term RECs or other contracts to instill confidence among investors.

Additionally, carbon pricing in NYISO's wholesale markets would have a strong advantage of signaling *where* new resources should be located for the highest value to the system and its consumers. With a carbon price in place in NYISO's energy market, there would be a visible financial incentive for identifying an efficient way to address carbon-reduction requirements for downstate loads. For example, a carbon price can transparently place appropriate value on adding transmission or other means to increase transfer capability for flows from upstate to

[92] PSC, CES Order (with footnotes in the original left out of the quoted text), pages 99-101.

downstate New York, providing a signal for growth in upstate renewable investments to the extent that that option represents a low-cost (or the lowest-cost) pathway to reducing GHG emissions associated with downstate load. It would also provide incentives for owners of upstate nuclear units to make investments to keep those units operating for as long as possible, postponing the need to replace their high-capacity-factor output with resources requiring some combination of capital-intensive clean energy resources and storage facilities.

Because the current contracts for up to 27,618,000 ZECs per year from the four upstate units (i.e., FitzPatrick, Ginna, and Nine Mile Point 1 and 2)[93] end on March 31, 2029, there is no visibility beyond then with respect to whether those units would be compensated for their zero-carbon attribute. Ginna and Nine Mile Point 1 have operating licenses that end in 2029, while FitzPatrick's goes to 2034 and Nine Mile Point 2's extends beyond 2030. An energy price environment that reflects the social cost of carbon during the 2020s and beyond can provide that forward-looking visibility in the years leading up to 2029, and can create efficient and transparent market incentives for the owner to continue to invest in those projects, including potentially deciding whether to seek the ability to extend the lives of the units beyond 2029.

By contrast, if the nuclear units retire, and their high-capacity-factor generation goes away, the replacement cost for the zero-carbon energy output (needed for addressing the Act's goals) will be significantly higher than the cost of ZECs. We calculate roughly that given the difference in capacity factors for onshore and offshore wind and for solar resources, New York will need to add between 6,000 and 9,000 MW of renewable project capacity to replace the 3,267 MW of nuclear capacity anticipated to retire in New York State by 2030, just to replace the zero-carbon generation.[94] Much more renewable and/or storage capacity will be required to backfill the lost capacity from such nuclear retirements (not to mention the potential increase in installed reserve margins that will be required with the introduction of increasing amounts of variable resources[95]). Any contribution that a NYISO carbon price can make to postponing such retirements may avoid significant unnecessary additional costs to consumers.

Furthermore, the useful project lives of many clean energy technologies are currently estimated to be relatively short, compared to some of the thermal-steam generating technologies that have traditionally been on the electric system for decades. Lazard estimates the following facility lives for different clean energy technologies: 20 years for onshore wind turbines and for offshore wind projects; 25 years for rooftop solar PV systems; and 30 years for utility-scale solar projects.[96] By contrast, the equipment lives of nuclear facilities have been 40–60 years under licenses issued by federal regulators.

One implication of these potentially shorter life spans is that as various public and private actors in New York's electric market add the new facilities that will be needed to help transition the state to its clean energy targets over the next decades, the system will also need to replace these projects as they get closer to the end of their useful lives. A carbon price will not only help provide market revenues to facilitate such replacements as economically efficiently as possible, but it will also create incentives for owners of facilities in operation to make the ongoing investments needed to keep the facilities in good working order and to increase the chance of extending their useful lives.

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[93] CES Order, page 145.

[94] This is based on 3,267 MW (summer capability) for the four units that will retire or have operating licenses that end before 2030: Ginna (581 MW); Nine Mile Point 1 (632 MW); Indian Point 2 (1,016 MW); and Indian Point 3 (1,038 MW). See NYISO, 2019 Gold Book, Table III-2.

[95] NYISO, Comments submitted to the NY PSC in Case 15-E-0302 (Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard), July 8, 2016, page 9.

[96] Lazard, "Levelized Cost of Energy Analysis - Version 12.0," November 2018, pages 16–17.

This latter point is also relevant for owners of existing fossil generating units in the NYISO market today. The Act sends a loud and clear signal to those owners that without some way to address their carbon emissions, their assets' future years are numbered. It would be economically rational under such circumstances for those owners to consider this fact as they decide whether to make investments (and if so, which ones) to keep their facilities in good working order, or to potentially increase generation efficiency and lower the carbon intensity of operations. In a world in which all new renewables and existing nuclear plants receive contracts that provide revenue streams for the renewable or zero-carbon attributes, and in which compensation in the NYISO markets is greatly affected by the combination of low natural gas prices and by the entry and operation of plants with very low operating costs, the owners of such fossil units may be disinclined to spend more than the minimal amount on operations and maintenance. And yet, for the near term and until there are sufficient storage or other resources at scale on the system to allow for reliable operations around the clock and over long periods without sunshine or robust wind, such fossil units will be needed to integrate renewables and balance the electric system. A carbon price can provide the financial incentives needed to keep the best, most efficient, and lowest-carbon fossil units on the system in safe and efficient form, and provide the locational price signal needed for retention of the right fossil resources in the right locations to support reliable operations.

In conjunction with the NYISO wholesale markets, a carbon price will also transfer investment and performance incentives and risks to those most capable of managing such risks—investors—and away from consumers. A principal reason why New York restructured its electric industry two decades ago was to shift such risks, and those decisions reflected the lessons learned from decades of experience with PURPA and large capital-cost investments by utilities.

The proposed NYISO carbon pricing mechanism also has the ability to explicitly address the issue of leakage of CO_2 emissions, which the Act identifies as an important problem to prevent. The proposed design includes a border adjustment for flows of power into New York, thus protecting against the shifting of carbon from inside of New York's electric system to other regions outside of it.

Finally, a carbon price in the NYISO market can further position New York state as a policy innovator and a steadfast supporter of clean energy, competition, and reliable and affordable electricity supply. Other states and regions with strong climate policies may adopt a similar approach, or become more willing to increase the stringency of current policies such as RGGI.

There is a strong potential synergy between New York's wholesale electric markets and the Act's GHG emissions reduction targets. Adoption of a carbon price into the operations of NYISO-administered markets would help to send efficient price signals to market participants about the value of clean energy resources, and would establish an electric system strongly aligned with the goals of the Act. A carbon price can work hand in hand with other clean energy, innovation, air pollution control, and public health policies, rather than in conflict with them. And the policy can be in place in a timely fashion, responsive to and supportive of the aggressive timelines contained in the Act. New York has the opportunity to use a new lever—i.e., a carbon price—in an existing platform—i.e., NYISO wholesale markets—to help the state move quickly to align the incentives in its electric system with the broader low-carbon economy, economic efficiency, and community protection goals of the state. It would help to unleash private sector action for the benefit of New York's energy consumers and citizens.

IV. Impacts related to the risk that FERC will impose broader mitigation of policy-driven resources in NYISO markets

A. Introduction

An important consequence of the adoption of a NYISO carbon price is its role in aligning the state's climate policy with wholesale market design and, in so doing, providing an economic basis for reducing the risk that FERC will impose stricter mitigation of actions resulting from state preferences for certain types of power generation resources.

A key motivator for NYISO's stakeholder process to consider the design and possible implementation of a carbon price in the NYISO market was FERC's concerns around how to better ensure that state public policies favoring the entry and operations of certain types of supply resources over others are compatible with the efficient functioning of organized wholesale capacity markets administered by three RTOs (NYISO, ISO-NE, and PJM). At its technical conference in May 2017, FERC raised questions about ways that federally regulated RTOs could accommodate state policies while also avoiding the need for FERC to require mitigation of the adverse effects of certain state policies for maintaining the vitality of capacity markets in those regions. FERC made clear its interest in maintaining the integrity of the capacity markets it regulates, in ensuring that capacity prices are competitive and sufficient to provide the financial incentives for new entry, and in protecting energy and capacity markets from the adverse impacts of over-supply of resources added primarily for state public policy purposes.

Before and after that FERC conference, the three RTOs have responded to FERC's concerns in different ways. ISO-NE has adopted a program it calls CASPR (Capacity Auctions with Sponsored Policy Resources) to coordinate the timing of the entry of new "Sponsored Policy Resources" with the timing of retirements of existing resources.[97] In June of 2018, FERC ordered PJM to modify its capacity market rules (specifically its Minimum Offer Price Rule (MOPR)) in response to concerns raised by certain traditional generators that state policies (e.g., RECs and ZECs) were leading to the suppression of prices in the PJM capacity market. FERC directed PJM to remove the exemptions of many resources (e.g., existing nuclear plants, renewables) from the operations of the MOPR.[98]

NYISO took a different approach. It already had the Buyer-Side Mitigation (BSM) rule in place to address the out-of-market entry of certain resources in the New York City and Lower Hudson Valley capacity zones (i.e., zones G, H, I, and J), with an exemption for mitigation of the first 1,000 MW of renewables entering those zones each year that it has begun applying for new resources as of August 2019.[99] NYISO began the IPPTF process in 2017 as a way to consider how a carbon price in NYISO's energy market might help integrate new policy resources in a manner more consistent with the functioning of New York's wholesale markets. These actions not only responded to FERC's indication of interest in better aligning state and federal policies affecting RTO-administered capacity markets, but also sought a mechanism to accomplish this alignment without triggering changes to NYISO's current BSM rules.

[97] For a description of ISO-NE's CASPR project, see ISO-NE, "Competitive Auctions with Sponsored Policy Resources (CASPR) Project," available at https://www.iso-ne.com/participate/support/customer-readiness-outlook/caspr-project.

[98] June 2018 Order. (As of this writing, FERC has not acted upon PJM's proposal in response to FERC's June 2018 order.)

[99] NYISO, "Motion Requesting Commission Action on Compliance Filing, Notice of Implementation Plans, and Conditional Request for Tariff Waivers of the New York Independent System Operator, Inc.," Docket No. ER16-1404-000, July 19, 2019.

In recent years, several parties have asked FERC to order changes in NYISO's BSM approach in ways that might (a) dramatically reduce, on a going-forward basis, the 1,000-MW renewables exemption that exists in the currently mitigated capacity zones of New York City and the Lower Hudson Valley; and/or (b) broaden the geographic scope of the BSM tariff provision so that it would also apply in the "Rest of State," thus making it a NYISO-wide mitigation rule.[100]

Also in recent years, FERC has ordered that PJM modify its MOPR to apply it both retroactively and prospectively to all out-of-market resources anywhere on the PJM system.[101] This has understandably raised questions in the minds of some stakeholders in New York about the potential risk of mitigation of out-of-market resources that already exist on the system in parts of the state not now subject to BSM rules (e.g., power plants with existing ZEC and REC contracts anywhere in the state).

The fact that FERC (as of this writing) has not made a final determination about the protests before it—or even on PJM's proposed MOPR revisions—leaves unsettled many questions about what steps FERC might take in the future to assure the integrity of organized wholesale markets. This open question will become more compelling and concerning as the level of resources driven by long-term contracts increases in the NYISO market. (In making this observation, we are aware of the PSC's new proceeding to review the state's resource adequacy approach.[102])

B. Potential impacts of hypothetical FERC mitigation of NYISO markets

No one knows how FERC will respond to the complaints it has received regarding NYISO's existing BSM rules. But with an increasing share of generating resources operating in the NYISO market having ZEC and REC contracts with NYSERDA, and with the potential that state-driven resource contracts may increase significantly over the next decade and beyond, it may be more difficult for FERC to avoid taking actions to protect the integrity of the NYISO wholesale electricity market.

As noted above in Section III, power plants with NYSERDA contracts for RECs and ZECs now represent approximately 20 percent of the generation that supplies customers' loads. New renewables that were (or will be) successful in the NYSERDA CES solicitations in 2017, 2018, and 2019 will enter the market in the next few years, and they will raise this percentage. If NYSERDA were to accelerate and deepen the level of contracting at a pace consistent with the entry of renewable resources needed by 2030, then generating assets under NYSERDA contracts would account for 50–60 percent of total generation as of 2030.

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[100] See, for example, FERC Dockets EL15-65 and ER16-1404-000.

[101] FERC June 2018 Order.

[102] PSC, "Order Instituting Proceeding and Soliciting Comments," in Case 19-E-0530 (Proceeding on Motion of the Commission to Consider Resource Adequacy Matters), August 8, 2019. The Order states on pages 3–4 that: "ICAP, as currently designed, is an incomplete resource adequacy instrument because it fails to recognize and provide compensation for many important factors, such as environmental and local reliability benefits. Because of this, there is no guarantee that the resources that clear the ICAP auctions are the same ones needed to meet the State's clean energy and other mandates. Further, the NYISO may impose 'mitigation' on resources that are the subject of state policy support by intervening to raise their minimum bid levels into the NYISO-administered auctions and thereby potentially causing them to not "clear" the auction, and therefore to not be counted as eligible capacity resources. As a result, consumers may pay higher costs than necessary, and that increase could grow substantially over time as the State's clean energy goals expand. Accordingly, this Order commences a proceeding for the Commission to consider how to reconcile resource adequacy programs with the State's renewable energy and environmental emission reduction goals. This inquiry is necessitated by the Commission's statutory obligations to ensure the provision of safe and adequate service at just and reasonable rates. Costs to consumers are a primary and ultimate consideration, recognizing that the necessary investments in resources must have sound economics. However, New York is ideally situated, being within a single state Independent System Operator, to speak clearly and coherently to its environmental, economic, and energy service policy interests, and thus to the services and outcomes it looks to electricity markets and providers to deliver. As identified below, the Commission is seeking comments from all interested entities and individuals on a wide range of questions regarding resource adequacy matters."

FERC has already demonstrated unease over the impact of *existing* levels of out-of-market resources on wholesale market pricing. The potential for an increasing level of state-sponsored resources directly compensated through out-of-market mechanisms will be hard for FERC to ignore going forward. Without attempting to forecast what NYSERDA *will* do with regard to future contracting or what FERC *will* do with regard to mitigation of resources with out-of-market contracts, it is nonetheless informative to understand the potential cost to New York consumers of hypothetical actions that FERC *might* take to protect the competitiveness of the NYISO market.

The goal of this particular discussion and analysis is to examine potential impacts of a carbon price on reducing the risk of and/or avoiding costs associated with BSM that, in theory, could be assessed if FERC were to decide that the clean energy resources procured by New York State (through long-term REC or ZEC contracts with NYSERDA) were out-of-market resources that warranted mitigation. Our discussion and analysis do not express an opinion about whether FERC *will* or *will not* take steps in future decisions on NYISO market rules to implement changes in the BSM penalties. (Similarly, we do not express an opinion on the changes, if any, the PSC will adopt with regard to its required resource-adequacy construct for New York's electric system.) Rather, we frame the discussion by addressing the question of what costs might arise, in terms of BSM effects on capacity payments by New York consumers, if FERC were to modify its BSM policies in light of and/or in anticipation of a growing level of resources entering the market through out-of-market contracts. Examination of this "what if" question is prompted by the potential for New York State officials to decide whether to procure most, if not all, future renewables and clean energy resources only through long-term contracts, rather than through and/or in combination with NYISO markets.

Using several hypothetical premises, we examined various circumstances in which NYISO's current framework for BSM were expanded by FERC. For example, we explored a situation in which FERC were to adopt a mitigation policy that applied retroactively to resources already having ZEC and REC contracts with NYSERDA. We also assessed situations in which FERC were to prospectively mitigate resources that enter the market to comply with the state's CES and/or that receive REC contracts as a means of support—with a hypothetical situation in which FERC were to remove the 1,000-MW renewable energy exemption to BSM and/or expand the BSM tariff provision to all parts of New York state.

Considering only the first-order effects[103] of such actions by FERC, the potential for expanded BSM could lead to significant cost exposure for New York consumers. Although the risk is difficult to estimate, and recognizing that NYISO is working actively with stakeholders and policy makers in New York to reduce the risk, we conclude that consumers' potential cost exposure if FERC were to expand BSM in the NYISO markets would be very large.[104]

A carbon pricing policy as proposed through the NYISO stakeholder process represents a fair and transparent, competitive, market-based mechanism to compensate resources based on generating resource attributes (i.e., zero-emissions or renewable resource attributes). Administration of a carbon pricing mechanism would help to align state policy with the state's wholesale markets, and reduce the potential for FERC to impose further BSM

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[103] We consider "first-order effects" to include the direct impacts of changing the rules for application of BSM in New York. We consider "second-order effects" to track the impact on changes in NYISO capacity market prices (which affect all capacity resources in the state) as a result of the entry of out-of-market resources.

[104] Without intending to suggest that the circumstances in New York and in PJM or in ISO-NE are comparable to those in the NYISO market, we note here for illustrative purposes the results of a recent study of the "potential cost of imposing a broad MOPR policy" in PJM, which estimated that "the total cost of the MOPR to PJM consumers could reach $5.7 billion per year, a 60% increase in cost compared to the current capacity market. The average residential customer in PJM could see their electric bill increase by over $6 per month." Michael Goggin and Rob Gramlich, Grid Strategies LLC, "Consumer Impacts of FERC Interference with State Policies: An Analysis of the PJM Region," August 2019, available at https://gridprogress.files.wordpress.com/2019/08/consumer-impacts-of-ferc-interference-with-state-policies-an-analysis-of-the-pjm-region.pdf.

actions by guiding the development of new clean energy resources substantially through pricing in competitive wholesale markets. This is a benefit that would not be captured through a traditional production cost modeling exercise.

To reiterate, we do not conclude either that NYSERDA will enter into REC contracts for all of the renewables that will need to enter the market to satisfy the goals of the Act, or that FERC will mitigate the NYISO market in any of these ways. We present this hypothetical analysis because (1) the potential magnitude of costs to New York consumers is too large to ignore; (2) FERC mitigation would be consistent with its principles for the design and operation of competitive wholesale markets, and with recent precedent on out-of-market contracting in other RTO regions; (3) FERC mitigation can compromise or interfere with New York's administration and implementation of its carbon-reduction policy objectives; and (4) the policy under review—the pricing of carbon emissions in wholesale markets—would likely reduce if not eliminate the need for FERC to impose BSM in the NYISO markets.

In short, we view the implementation of a carbon price in the NYISO market as a means to increase the probability that renewable projects could enter the market without sole or significant dependence on long-term contracts; that such entry would be "in-market" entry based on prices and revenue streams in the combined NYISO markets; and that such entry would lessen the need for NYSERDA to increase the amount of resources under contract. All of those same factors would reduce the risk that FERC would take action to expand BSM mitigation in the NYISO market and, in so doing, serve as an economic basis to avoid consumer cost increases that would flow from such action.

V. Impacts on potential repowering of generating units (and/or repurposing of sites)

A price on carbon in NYISO markets will also change incentives for certain asset owners to retire and/or repower older, inefficient, higher-emitting generating units. In the latter instance, sites now used for inefficient fossil generating units that hold transmission access may opt for installation of new storage facilities and/or the siting of more-efficient and more-responsive generating resources. This is particularly true in the New York City area, which such options would provide additional emissions reductions and other benefits to the electric power system.

Repowering involves replacing older, less-efficient power generation technology (e.g., older steam turbines) at an existing facility with newer, more-efficient technology (e.g., fast-start gas-fired combustion turbine or combined-cycle units). Repowering provides a number of benefits, including increased power generation efficiency with lower costs and lower emissions. Generally, a power plant owner will choose to repower a unit if the owner anticipates that market conditions in the future will support making investments that lower a unit's power production costs (including emission costs such as NYISO's proposed carbon pricing mechanism), thereby improving its position on the dispatch curve and increasing its potential to be dispatched (and receive revenues) in the energy and/or ancillary services markets.

Currently, there are a number of relatively inefficient and higher-emitting generating units in New York City and Long Island. These tend to be steam turbines and other peaking units, and are frequently located near environmental justice (EJ) areas. Among the recent policy efforts that have focused on them are the following:

- NYISO is considering new rules to encourage repowering of these units.[105]
- In February 2019, Governor Cuomo proposed more stringent regulations on fossil-fueled units.[106]
- The CLCPA proposes that new energy storage projects be deployed to reduce the use of peaking facilities located near disadvantaged communities.[107]

By reducing the profitability of inefficient steam turbines and peaking units relative to newer, more-efficient capacity, a carbon price can help harmonize these goals and policies with the operation of existing wholesale markets. Indeed, many analyses have explored the potential effects of a carbon price on creating incentives for repowering and on the potential impact of repowering on emissions. In a set of analyses conducted by Potomac[108] as supplements to the Brattle/IPPTF study, the analysts modeled the repowering of two 360-MW steam units with fast-start combined-cycle units in Zone J (New York City), while also taking into account the practical effects of

[105] See Jonathan Newton, "Repowering: Update and Proposal," presentation to NYISO ICAP Working Group, May 9, 2019, page 5 ("New rules should be considered to improve market efficiency in recognition of the effects of barriers to entry in NYC, including encouraging and facilitating private investment in the repowering and preplacement of existing assets."), available at https://www.nyiso.com/documents/20142/6474763/Repowering_For%20Posting_05092019.pdf.

[106] See New York State, "Governor Cuomo Announces Proposed Regulations to Improve Air Quality and Reduce Harmful Ozone Caused by Power Plant Emissions," February 28, 2019, available at https://www.governor.ny.gov/news/governor-cuomo-announces-proposed-regulations-improve-air-quality-and-reduce-harmful-ozone.

[107] See the Act.

[108] See Technical Appendix for a description of the analyses.

local reliability requirements in the analysis.[109] Potomac found that the carbon price would decrease the profitability of the existing steam turbine(s) and increase the profitability of a repowered unit.[110]

As mentioned above, repowering provides emissions and other benefits to the electric system. At present, local reliability requirements mandate continued operation of older, existing, and inefficient steam turbines in New York City.[111] Because these units have limited operational flexibility but are nonetheless needed to provide local operating reserves, they tend to run at least at a minimum load around the clock so that they can be ready to produce power during peak-demand conditions. Potomac's repowering scenario analysis indicates that replacing these resources with more flexible units would provide emissions benefits,[112] because replacement units will run for fewer hours to provide the same electricity service, and will generate lower emissions per unit of generation when doing so.[113] Similarly, the more flexible repowered units would help to integrate intermittent renewables more effectively and more efficiently than less-responsive units.[114] This is particularly important given the level of renewables that the Act envisions for the near future, and the potential for connection of thousands of MW of offshore wind into the downstate grid.

These results are illustrative and help to provide insight into potential impacts. They do not, however, account for a number of other factors. For example, there may in fact be additional repowering projects that are prompted by the implementation of a carbon price. Carbon pricing may also have the effect of increasing reserve prices, which will provide additional repowering investment incentives. Finally, there may be additional benefits above and beyond system reliability, renewable integration, and emission reduction benefits, since repowering projects can also provide a substantial economic benefit to a region. For example, a 2013 proposal for an approximately 500-MW repowering project in New York, replacing seven oil-fired Westinghouse units with two fast-start combined-cycle gas turbine (CCGT) units, was estimated to provide over $300 million per year in gross regional product over the first 10 years of operation, and over 3,000 jobs.[115]

[109] Potomac models LRRs in New York City only (not Long Island) by using least-cost units as a "must-run list" in the Base Case and the Carbon Case. For additional detail about the analysis, see Potomac Economics, MMU Evaluation of Impacts of Carbon Pricing, May 9, 2019 (hereafter Potomac Carbon Pricing Evaluation), available at https://www.nyiso.com/documents/20142/6474763/MMU%20Study%20re%20Carbon%20Pricing__5092019.pdf/40b832a6-b1f7-f973-9f60-4aaf4e9ab22f.

[110] Potomac compared estimated revenues from energy, ancillary services, and capacity payments for older steam turbines and potential replacement technologies (new frame combustion turbines, fast-start combined-cycle units, and battery storage) with and without a carbon charge. See Potomac Carbon Pricing Evaluation, page 23.

[111] Potomac Carbon Pricing Evaluation, page 10.

[112] See Potomac Carbon Pricing Evaluation, page 24.

[113] Since this scenario modeled the effects of both repowering and local reliability requirements, some of the decrease in prices may be attributable to the latter. For instance, it may be that the original Brattle/IPPTF Scenario base case has artificially low emissions from steam units downstate because it does not consider such local reliability requirements, which in turn leads to underestimating the effect of the carbon prices.

[114] See Potomac Carbon Pricing Evaluation, pages 12, 24.

[115] See NRG Astoria Repowering Project Proposal to the New York Power Authority, May 20, 2013, available at http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B4988DCA8-D9AC-46ED-BF55-81DDD092F0DF%7D.

VI. Impacts on public health from air emission reductions

Many of the potential benefits discussed in this report focus on the significant potential for carbon pricing in wholesale markets to produce "ancillary" benefits— e.g., fostering improvements in generating efficiency and investment, lowering the risk of costly federal market mitigation, and reducing consumer costs through more efficient operations and lower-cost implementation of state energy and carbon policy goals.

However, carbon pricing can also generate important primary and ancillary environmental benefits. This is because a carbon price will introduce changes in the dispatch of resources on the electric system and in turn—in combination with other public policies—will reduce emissions of CO_2 and other air pollutants. Reducing these other local pollutants can generate positive public health benefits, and is important for the communities surrounding affected power plants. The Act places prominent attention on reducing adverse pollution and other impacts on vulnerable populations, many of which are in the New York City area.

We attempted to explore the changes in emissions that would result from a carbon price by examining the unit-specific emissions data that resulted from modeling performed by the Brattle/IPPTF and Potomac teams. In the end, obtaining reliable results related to the impact of a carbon price on local air pollutants was challenging for several reasons: the world has changed dramatically since issuance of those studies as a result of passage of the CLCPA; the baseline case in the analyses assumed that all renewables needed to satisfy the then-current CES requirements would have already entered the market (rather than accounting for the likelihood that a carbon price will hasten the entry and affect the location of renewables); the analyses rely on different assumptions with respect to inclusion of the impacts of the newly proposed Peaker Rule (which will affect certain fossil units in New York City with associated local emission impacts); and the analyses differ in terms of how they model operations of fossil steam units in New York City for local reliability purposes.[116] Consequently, it is not clear whether they underestimate or overestimate the impact of a carbon price on air emissions.

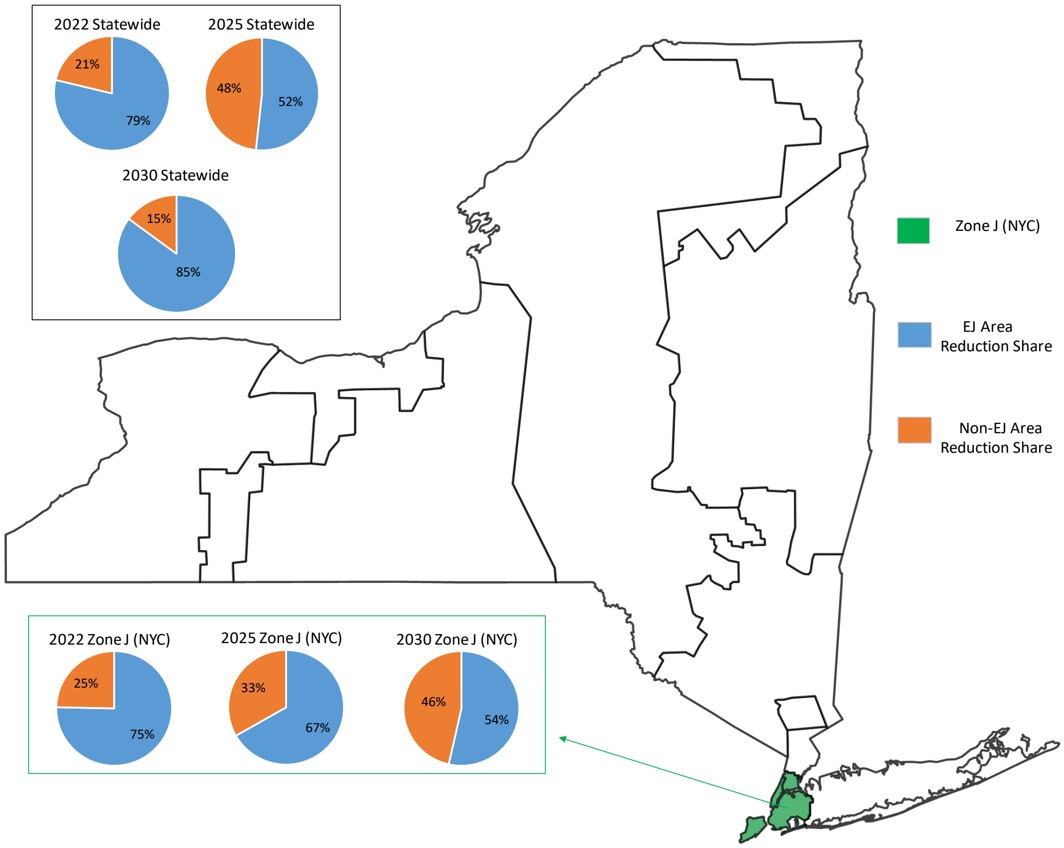
Nevertheless, based on review of these analyses and consideration of factors that either emerged since then or were not addressed, it is reasonable to take away from these studies that directionally, a carbon price will reduce CO_2, NO_x, and SO_2 emissions, especially in downstate areas, with benefits for communities made up of at-risk demographic groups. As shown in Figure 4 and in more detail in the Technical Appendix, NO_x emissions reductions are concentrated in potential EJ areas.[117] Depending on the year and the scenario modeled by Brattle/IPPTF and Potomac, between 40 and 85 percent of the NO_x emissions reductions occur in EJ areas. Similarly, depending on the year and scenario, between 45 and 100 percent of the SO_2 emissions reductions occur in EJ areas.[118]

[116] The Brattle/IPPTF analyses were performed ahead of the proposed Peaker Rule, whereas the Potomac analysis captured it; and the modeling performed by Brattle/IPPTF did not account for the operations of fossil units in the base case that would need to operate at minimum load for local reliability functions, whereas the Potomac analysis did.

[117] EJ areas were established by the New York State DEC in 1999 based on the following thresholds are: 1. At least 15.1 percent of the population in an urban area reported themselves to be members of a minority group; or 2. At least 33.8 percent of the population in rural areas reported themselves to be members of minority groups; or 3. At least 23.95 percent of the population in an urban or rural area had household incomes below the federal poverty level. See Technical Appendix for additional information.

[118] In 2022, there are small emissions increase in EJ zones. This is attributed to the American Refuse Fuel plant in Zone A.

Figure 4:
Impact of Carbon Price on NO_x Emissions in Environmental Justice Areas in Zone J (NYC) and New York State: Brattle/IPPTF Study Share of NO_x Emissions Reductions Occurring in EJ Areas[119]



In most years, changes in emissions from the carbon price have a modest economic benefit to the state in the form of improved public health. Directionally, the emissions reductions captured in the Brattle/IPPTF and Potomac modeling indicate such public health benefits. As described further in the Technical Appendix, we used EPA's public health impact tools to determine the economic value of the estimated changes in NO_x and SO_2 emissions as a result of the carbon price. Across the three sets of results available from the Brattle/IPPTF and Potomac modeling runs, the largest estimated annual public health benefits statewide amount to between approximately \$0.66 million and \$1.5 million in 2025, and between approximately \$0.23 million and \$0.52 million in 2030.[120]

These analyses only account for emissions benefits related to particulate matter (PM), and therefore may be conservative in that they do not account for the public health or other economic impacts of reduced amounts of other pollutants (e.g., ozone) in estimating health impacts. While both NO_x and SO_2 are precursors to $PM_{2.5}$, SO_2

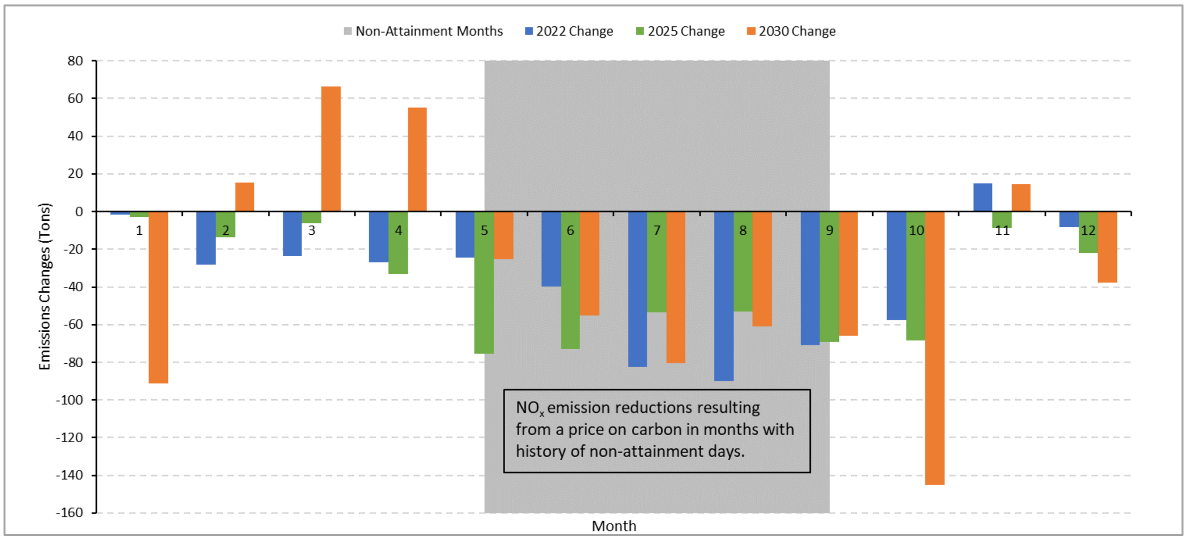
[119] See the Technical Appendix for sources of the data and the methodology used to identify the location and public health benefits of these emissions.

[120] Dollar values are reported in 2015\$, using a 3% discount rate for any benefit incurred beyond the year of exposure; we have adjusted these for inflation and report the numbers in 2018\$. The Potomac scenarios show more moderate public health benefits in these years due to smaller SO_2 emissions deltas between the base and carbon cases. Results indicating negative health benefits in 2022 are due to a state-wide increases of SO_2 emissions in the carbon case relative to the base case in that year.

emissions changes between the baseline and carbon cases have more of an impact on the resulting public health impact values.

The timing of the air emissions reductions is also important and may provide an additional benefit. The carbon price's impacts on NO_x reductions tend to occur during months in the summer ozone season, when NO_x emissions otherwise contribute to unhealthy levels of smog. (See Figure 5.) Certain New York State counties are currently in non-attainment of the 2015 eight-hour ozone National Ambient Air Quality Standard (NAAQS).[121] These NO_x emissions reductions during ozone season would assist New York State in achieving its goal of achieving ozone NAAQS attainment.[122]

Figure 5:
Impacts of a Carbon Price on New York State NO_x Emissions During Months with a History of Ozone Non-Attainment Days: IPPTF Study of the Impact of a Carbon Price[123]



These modeling runs thus identify relatively small impacts on public health benefits and progress toward lowering air pollution to meet NAAQS targets. Nevertheless, it is useful to recognize that a carbon price will accelerate the transition away from fossil fuels, especially in downstate regions of the state where most of that fossil generation occurs. This suggests that greater public health benefits will occur sooner with that policy in place in NYISO's market design.

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121 "Additional Air Quality Designations for the 2015 Ozone National Ambient Air Quality Standards," Final Rule, published June 4, 2018. 83 FR 25776. See the Technical Appendix for additional information.

122 To the extent that reduced NO_x emissions lead to lower ozone levels and improve New York's status with regard to national air quality standards (e.g., ozone attainment), there may be other economic development benefits for New York beyond public health benefits.

123 Notes: [1] A day is considered in non-attainment if the daily maximum 8-hour ozone concentration is greater than 0.070 ppm in 2018 EPA daily air quality air monitoring data. See the Technical Appendix. [2] Results for 2022 reflect changes in emissions between the simple baseline case and the simple carbon case. Results for 2025 reflect changes between the simple baseline case (D2) and simple carbon case (D3). Results for 2030 reflect changes between the simple baseline case (D5) and a carbon case, including all dynamic adjustments. Sources for this figure can be found in the Technical Appendix.

Finally, with the Act's expectation of relying substantially upon the electric system to help lower carbon emissions in other sectors, a carbon price will help to speed up the ability of the state's power system to contribute to and drive the energy-system transitions across all sectors of the economy.

To consider the role of a carbon price in contributing to overall CO_2 emissions reductions in New York's economy through electrification, we developed an illustrative example in which we assumed that over the next two decades, increasing percentages of New York households would switch their vehicles from gasoline to electricity and their heating systems from natural gas or oil to electricity. Using this illustrative high-electrification example (with the electricity shares of residential vehicles and heating uses set at 10 percent in 2025 and rising to 35 percent in 2030, to 60 percent in 2035, and to 85 percent in 2040), we explored the impact of shifting these energy uses to electricity on net CO_2 emissions (i.e., taking into account increased demand for electricity relative to a baseline demand outlook, and decreased use of fossil fuels in vehicles and homes). We estimate that in that particular high-electrification scenario, there would be a net *decrease* in CO_2-equivalent (CO_2e) emissions in New York on the order of 82.8 MMT of CO_2 in the year 2040,[124] even taking into account an increase in electricity generation by over 74.9 TWh as of that year. Given that the CLCPA calls for net-zero emissions in all sectors of the economy by 2050 (and not just in residential buildings and vehicles), our illustrative example understates the net GHG (CO_2e) emissions reductions that will result from electrification and zero-carbon electricity supply.

Because we conclude that a carbon pricing mechanism in NYISO markets will accelerate the retirement of fossil generation and hasten the entry of renewables into the electric system (as described in Sections III.B and III.C), we think it is appropriate to attribute some (although unknown) portion of the illustrative net reductions to the introduction of a carbon price in the NYISO market. The anticipated GHG-emissions reductions in New York's economy will require faster, deeper, and sustained growth in renewable supply to meet the electric sector and economy-wide targets. A carbon price can help to accelerate the transition to lower GHG emissions in the state while also preventing leakage of emissions into neighboring regions.

[124] The estimated net reductions in CO_2e emissions for other years are: 8.1 MMT in 2025; 30.8 MMT in 2030; 55.0 MMT in 2035. For context, energy-related CO_2e emissions in New York State in 2015 were 183.8 MMT, with most (72.8 MMT) occurring in the transportation sector (where residential and other vehicles are counted), and with 48.3 MMT in the residential sector, 41.1 MMT in the commercial sector, 15.4 MMT in the industrial sector, and the remaining 6.3 MMT from sources such as natural gas pipelines and waste incineration. NYSERDA, "New York State Greenhouse Gas Inventory: 1990-2015," September 2018, pages 1–23, available at https://www.nyserda.ny.gov/-/media/Files/EDPPP/Energy-Prices/Energy-Statistics/greenhouse-gas-inventory.pdf.

VII. Impacts on use of fossil fuels in New York State

New York currently depends upon natural gas for a variety of purposes. In the power sector in 2018, for example, 41 percent of in-state generation came from power plants that predominately burn natural gas.[125] But most of the natural gas consumed in New York State occurs in buildings: 35 percent occurs in residential buildings, and another 25 percent is consumed in commercial buildings.[126] Compared to the 60 percent of gas used in buildings in New York State, the power sector uses approximately half of that amount.[127]

There are at least two reasons why reduced use of natural gas in the power sector can provide benefits to the state. First, New York has in many instances opposed the siting of new natural gas pipelines to deliver gas into the New York market.[128] In general terms, such developments have been proposed in order to provide greater supplies into the regional energy market to satisfy increased demand for natural gas. There are examples where the constraints on natural gas delivery into New York have meant that New York utilities have not been able to add new natural gas customers.[129]

Second, as the state moves to reduce GHG emissions from the power sector and from the economy at large, reductions in natural gas use lead directly to lowering GHG emissions (including both CO_2 and methane emissions), consistent with the direction envisioned by the Act.

The introduction of a carbon price in the NYISO markets will hasten these reductions in use of natural gas in the power sector and, in turn, with respect to uses of natural gas for end-uses in other sectors that transition to relying on electricity. (Our high-electrification example in the prior section of this report illustrated the net GHG-emissions reductions that would result from New Yorkers switching their heating systems from gas or oil to electricity. Note that 58 percent of homes and apartments in New York use natural gas for heating.[130])

Based on our review of the results of the Brattle/IPPTF and Potomac studies, we expect that carbon pricing in the NYISO market will reduce gas use in the power system in each of the three years analyzed in the Brattle/IPPTF and Potomac analyses. Recognizing that these are indicative and directional results (in light of the somewhat outdated assumptions in those studies), statewide gas use in the power sector would drop in the range from 2.4 percent to 7.8 percent, depending on the study year. These impacts are illustrated in Figure 6. These gas use reductions vary by zone, with most reductions occurring in downstate areas of New York. Gas use changes in the largest downstate zones (F, G, J, and K, comprising more than 99 percent of New York downstate gas demand) range from a 7 percent

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[125] NYISO, Gold Book 2019, page 78, which indicates that 6 percent of 2018 generation took place at New York power plants that only burn natural gas, and another 35 percent occurred at dual-fuel power plants that use natural gas (as the primary fuel) and oil (as the secondary fuel).

[126] EIA, "Table F18: Natural Gas Consumption Estimates, 2017," State Energy Data System, available at https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_fuel/html/fuel_use_ng.html&sid=US (hereafter 2017 SEDS Data).

[127] Power sector use of natural gas in New York accounted for 31 percent of gas consumed in the state. EIA, 2017 SEDS Data.

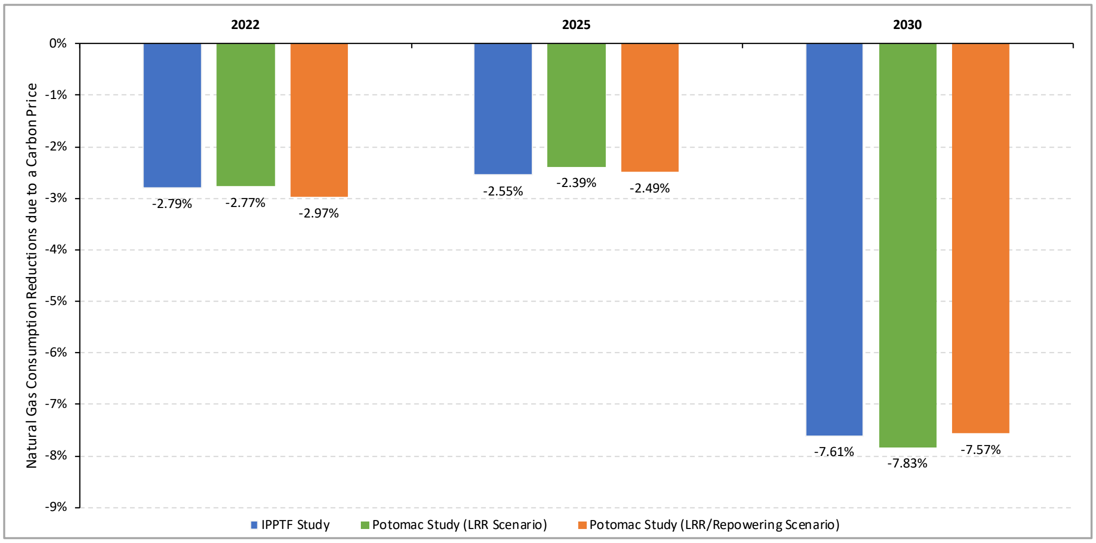
[128] See Vivian Wang and Michale Adno, "New York Rejects Keystone-Like Pipeline in Fierce Battle Over the State's Energy Future," *The New York Times*, May 15, 2019, available at https://www.nytimes.com/2019/05/15/nyregion/williams-pipeline-gas-energy.html; Phil McKenna, "New York Rejects a Natural Gas Pipeline, and Federal Regulators Say That's Ok," *Inside Climate News*, January 16, 2018, available at https://insideclimatenews.org/news/16012018/new-york-rejects-natural-gas-permit-constitution-pipeline-ferc-water-quality; and Nicholas Kusnetz, "Another Pipeline Blocked for Failure to Consider Climate Emissions," *Inside Climate News,* September 7, 2018, available at https://insideclimatenews.org/news/07092017/new-york-pipeline-permit-rejected-natural-gas-valley-lateral-ferc-climate-change.

[129] Consolidated Edison Company of New York, "About the Westchester Natural Gas Moratorium," available at https://www.coned.com/en/save-money/convert-to-natural-gas/westchester-natural-gas-moratorium/about-the-westchester-natural-gas-moratorium; Iulia Gheorghiu, "National Grid Says No New NYC Gas Customers Until State Approves Pipeline," May 22, 2019, *Utility Dive,* available at https://www.utilitydive.com/news/national-grid-says-no-new-nyc-gas-customers-until-state-approves-pipeline/555283/.

[130] U.S. Census Bureau, "Physical Housing Characteristics for Occupied Housing Units," 2013-2017 American Community Survey 5-Year Estimates, Table S2504.

increase to a 10 percent decrease, depending on the zone and the year. (These impacts are presented in more detail in the Technical Appendix.)

Figure 6:
Impact of a Carbon Price on Use of Natural Gas in New York's Electric System: NYISO-wide Reductions as Modeled by Brattle/IPPTF and Potomac [131]



The Brattle/IPPTF and Potomac modeling of the carbon prices indicates that reduced demand for gas will occur at generating units in New York City (Zone J), as shown in Figure 7. Again, these should be interpreted as indicative of directional change in gas use, given the assumptions in those studies. In addition, it is not possible to determine the direction or magnitude of changes in natural gas use at different or specific times of the year (e.g., in summer and shoulder months as opposed to winter); thus we have not tried to analyze how these changes may affect system operations during severe winter conditions. Notably, the Potomac analysis assumed that the Peaker Unit regulations would be in place in its analyses; the Brattle/IPPTF did not assume the implementation of the Peaker Rule, but understated the local-reliability requirements for must-run fossil units in Zone J.

Although a small impact relative to total gas consumption in New York State, these impacts help New York move in the direction of lowering GHG emissions from the power sector and the state's economy, consistent with the goals envisioned in the Act. A price on carbon will help to accelerate these reductions, both directly in the power sector and indirectly by supporting New York's electrification of fossil energy use in other sectors. It will also create incentives for repowering fossil units in Zone J, as reflected in the Potomac analyses (described in Section V, above).

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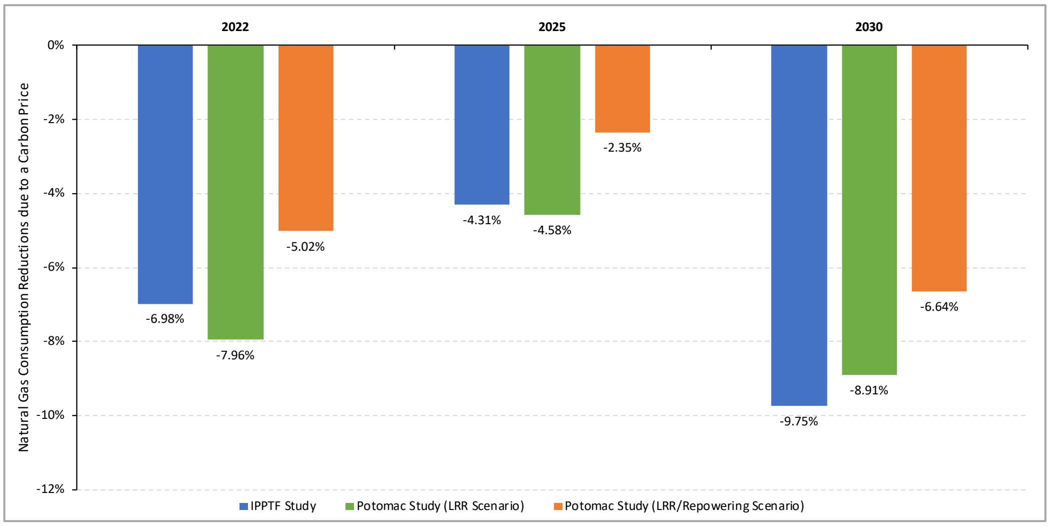
[131] Assumptions and sources are provided in the Technical Appendix.

Figure 7:
Impact of a Carbon Price on Consumption of Natural Gas in New York's Electric System: Zone J (NYC) Reductions as Modeled by Brattle/IPPTF and Potomac[132]



132 Assumptions and sources are provided in the Technical Appendix.

VIII. Impacts on consumers' electricity costs and social welfare

A. Framing the consumer cost and social welfare issue

As noted previously, the CLCPA was enacted after most of the assumptions were adopted by the groups that performed quantitative modeling of a carbon price's cost impacts (and, in turn, retail customer cost impacts): Brattle/IPPTF, Potomac, and RFF.

Analysis of consumer cost impacts of the Act has not been published (as of this writing). Because the Act requires more aggressive adoption of renewable and zero-carbon supply than was assumed in those studies, and because Brattle/IPPTF and Potomac assumed that all clean energy resources would enter the New York market in a frictionless or costless way, relying on these studies as predictors of the impact of a carbon price on consumer costs is problematic. The Brattle/IPPTF and Potomac studies' results leave the false impression that a carbon pricing mechanism in NYISO markets will lead to near-term negative impacts on consumers,[133] whereas other policy instruments will not.

Further exacerbating this situation is the fact that neither study provides an indication of social welfare benefits as context for considering the estimated cost impacts on consumers. By contrast, the new RFF study (which, like the others, was performed without the benefit of knowing that the Act would accelerate and deepen the renewable energy and decarbonization targets) indicates modest increases (1 percent or less) in electricity consumers' costs in the year modeled (2025), while also estimating positive impacts on societal welfare on the order of between $118 million and $755 million per year.[134] Notably, when the PSC has evaluated whether to adopt new policies (e.g., CES, Offshore Wind Standard), it has done so by considering consumer costs in the context of societal benefits, many of which were not estimated quantitatively.[135]

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[133] Both the Brattle/IPPTF and Potomac studies indicate modest price increases to consumers in the year 2022 as a result of introducing a carbon price, with both studies indicating longer-term positive benefits to consumers.

[134] RFF estimates these societal welfare benefits in the range of $108–691 million, expressed in 2013$. The estimates reported above reflect adjustment for inflation from 2013–2019, using the Bureau of Labor Statistics CPI Inflation Calculator. RFF 2019 Study, pages 8–9; as of 8-27-2019, Bureau of Labor Statistics, CPI Inflation Calculator, available at https://data.bls.gov/cgi-bin/cpicalc.pl.

[135] Note, for example, that the PSC's Offshore Wind Order found that it was beneficial to adopt the Offshore Wind Standard in light of various findings, including that the program would have net cost impacts on electricity consumers while also leading to other benefits to New York:

- "NYSERDA's estimate for the overall cost of the 2.4 GW program (net of carbon benefits) would be approximately $200 million over the life of the program, at NPV. This estimate does not account for economic development and other benefits. Expenditures in New York resulting from this initiative have the potential to total over $6 billion. Typical bill impacts for a 400 MW project in 2024 (the first year of operation) are estimated by NYSERDA to be between 0.11% and 0.41% depending on procurement methods." (page 18, with footnotes in the original text omitted here)
- There is an "imminent need to move as quickly as is feasible to build a low-carbon energy system, as provided in the State Energy Plan." (page 17)
- "[T]he potential economic development benefits of developing the supply chain in New York are large." (page 17)
- "Offshore wind can result in direct benefits in the form of economic development, workforce employment, and the avoidance of adverse health outcomes, and can lead to secondary benefits in the form of development of emerging technologies, a new source of coastal tourism, indirect jobs associated with construction and operation, purchases of local products and services, and new and increased tax payments by employees and facilities." (page 19)
- "Socioeconomic benefits, such as employment opportunities and improved port facilities, can begin before construction and carry through operations." (page 21)

PSC, "Order Establishing Offshore Wind Standard and Framework for Phase 1 Procurement," in case 18-E-0071 (In the Matter of Offshore Wind Energy), July 12, 2018. See also CES Order, pages 3–7, 70–71.

Any estimates of consumer cost impacts from a carbon price thus require some form of context. Certainly, it will be difficult to achieve the goals of the Act without introducing new costs into the electric system and for its consumers. New York policy makers have decided—at least implicitly through the findings, declarations, and explicit provisions of the Act—that the monetary and non-monetary costs of climate change are significant enough to warrant urgent and aggressive action to transition the state's electricity and other energy-using sectors away from fossil fuels. The costs that are being experienced and will be borne by people and institutions in New York justify action, and New York is well positioned to take such actions in efficient and cost-effective ways.

The Act anticipates that new clean power-supply resources will need to enter the market even when there is already enough generating capacity to satisfy the state's resource adequacy needs. Without a carbon price in NYISO markets, the combination of currently low natural gas prices and capacity prices reflecting surplus conditions will put pressure on NYSERDA to rely upon competitive solicitations for RECs to help move those new resources into the market, and, in so doing, to help enable the state to reduce its GHG footprint and the costs associated with climate change.

A carbon pricing mechanism tied to the actual cost of climate-related impacts (i.e., the social cost of carbon) would be an efficient signaling mechanism to indicate the value that New York State places on renewable energy and zero-carbon attributes of various projects, and would help support early entry through the wholesale market design. It would provide incentives for efficient investment in transmission, energy efficiency, and existing clean energy facilities (to keep them operating safely and economically as long as possible, and, in so doing, avoid the costs of replacing their output with other zero-carbon supply). It would harness the market to drive innovation. It would provide insurance against FERC action to mitigate New York's market and avoid consumer cost impacts of such mitigation policies. These are all part of the value proposition afforded by a carbon price in the NYISO energy market.

Just as we are unable to quantify the actual costs to consumers of New York's transition to a lower-carbon electricity system and lower-carbon economy, we are unable to quantify the actual costs (or net benefits) of adding a carbon price into NYISO's market. What is likely to be the case is that New York's economy and consumers will benefit both from the operation of a carbon price that internalizes into market prices the costs of carbon emissions, *and* from the deployment of myriad other public policies aimed at improving the efficiency of energy production and use, and the carbon footprint of those activities.

B. Brattle/IPPTF and Potomac estimates of consumer costs

The studies conducted by Brattle/IPPTF and Potomac provide very granular estimates of the implications of adding a carbon price into the New York market. Each builds off of technically strong modeling foundations, with careful attention to such things as the interactions of market design, cost parameters for fuels and technologies, and so forth.

That said, in some respects these highly technical, granular, and carefully constructed modeling efforts serve to point a flashlight on these costs while ignoring—by virtue of assuming that all clean energy resources enter the market in a costless way in the base case—the overall challenges and costs that will need to be addressed as the state quickly transitions toward its clean energy goals.

Nonetheless, we report here NPVs for the introduction of a carbon pricing mechanism based on the results of these studies, because they indicate strongly and directionally—if not precisely—the potential cost implications of adding a carbon price in the NYISO markets. Specifically, we report NPVs for the impacts between 2022 and 2036, generated from the results of three cases: (1) the Brattle/IPPTF "dynamic case"; (2) the Potomac carbon price case that makes technical adjustments to the Brattle/IPPTF assumptions about how plants operate for reliability purposes in Zone J (New York City); and (3) the Potomac case that examines the effects of the potential repowering of two relatively inefficient fossil units in Zone J. These studies modeled impacts in three years: 2022, 2025, and 2030 (as described above in Section I of this report).[136]

To develop these NPVs for each case, we followed the method of the Brattle/IPPTF study—a combination of linear interpolation and adjustments for inflation—to generate estimates for the years not modeled by Brattle and Potomac so that we would have estimates of annual impacts from 2022–2036.[137] These annual impacts were translated into NPVs using two different discount rates, as presented in Table 6: a 3 percent "public" discount rate, and a 7 percent "private" discount rate.[138]

The results show that a carbon price delivers savings to consumers regardless of discount rate assumption or case, even in analyses that understate the value of a carbon price in the context of aggressive GHG emissions reductions policies. As seen in Table 6, these savings range from $0.12–0.61 billion in the Brattle/IPPTF case, to $1.72–3.25 billion in the Potomac cases, depending upon the discount rate and scenario. The Brattle/IPPTF and Potomac studies suggest that the introduction of a carbon price would produce savings in electricity costs to consumers.

Table 6:
Net Present Value of Customer Bill Impacts from a NYISO Carbon Pricing Mechanism (2022–2036): Estimates Based on the Results of the Brattle/IPPTF and Potomac Studies

	Net Present Value ($mm)	
Model	NPV @ 7%	NPV @ 3%
Brattle/IPPTF Study	-$119	-$605
Potomac LRR Scenario	-$1,715	-$2,646
Potomac LRR/Repowering Scenario	-$2,215	-$3,253

[1] All impacts given in millions of dollars (2019$).
[2] Bill impacts for 2022, 2025, and 2030 for each model are taken directly from annual impact estimates for these years from the Brattle/IPPTF Study and Potomac analyses. Annual impacts for other years follow the methodology of the Brattle/IPPTF Study. Impacts for 2023–2024 and 2026–2029 are calculated via linear interpolation. Impacts for 2031–2036 are calculated by applying a 2 percent annual inflation factor to the 2030 estimated bill impact figure.

As noted above, beyond these estimates of savings to consumers, the 2019 RFF Study also suggests that an NYISO carbon price would produce net positive social welfare benefits in the year analyzed in the study (2025). RFF reports these positive benefits as $108–691 million per year in 2025, expressed in 2013$.[139] These equate to annual benefits of $118–755 million in 2019$.

These results support a conclusion that a carbon price will provide net economic benefits to New York.

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[136] Brattle/IPPTF Study; Potomac Carbon Pricing Assessment. Both studies provide considerable detail in terms of describing their inputs, their calculation methods, and their results, including by zone.

[137] See Brattle/IPPTF Study, pages 10–11.

[138] As explained further in the Technical Appendix, we have chosen to use these two discount rates because of policy guidance recommending this approach in situations where an analysis involves money flows to various entities in society over different periods of time, especially when "there is a significant difference in the timing of costs and benefits, such as with policies that require large initial outlays or that have long delays before benefits are realized." U.S. EPA, National Center for Environmental Economics, Office of Policy, "Guidelines for Preparing Economic Analyses," EPA 240-R-10-001, December 17, 2010 (updated May 2014), page 6-4, available at https://www.epa.gov/environmental-economics/guidelines-preparing-economic-analyses.

[139] 2019 RFF Study, page 31.

IX. Impacts on revenues to New York's public power entities

The introduction of a carbon price will change wholesale prices to serve customer loads. It will also affect the revenues to different types of power plants in the NYISO markets, especially for power plants with low GHG emissions (e.g., hydroelectric, wind, and solar resources).

Because, in the event of a carbon price in the NYISO energy market, the carbon charges included in suppliers' offer prices into NYISO's energy market would increase the costs of carbon-emitting generation dispatched by NYISO, a carbon charge would raise the energy market clearing prices whenever carbon-emitting resources are on the margin. All suppliers, including clean energy resources, would receive the higher energy price.

One of the largest suppliers of power with zero or low CO_2 emissions is the NYPA. Assuming that this state public power authority would be treated the same as all other generators on the NYISO system, its energy market revenues would increase as a result of the introduction of a carbon price (given its portfolio of generating assets). The Brattle/IPPTF study calculated that NYPA would receive an additional $306 million in 2025 in market revenues as a result of introducing a carbon price in NYISO energy markets.[140] (In its 2017 comments to the PSC on the Brattle report, Nucor Steel estimated that based "on 2015 production, if all of the NYPA St. Lawrence, Niagara and Blenheim-Gilboa (pumped storage) facilities' production were sold into the energy market, NYPA would realize an additional $411 million annually."[141]) The recent RFF study estimates that increased annual NYPA revenues in 2025 would be in the range of $326–400 million (in 2019$).[142]

Without knowing—or even speculating about—what NYPA would do with such additional revenues, it is still logical to assume that this revenue can be viewed as a public benefit to New York's economy. NYPA's mission is to "power the economic growth and competitiveness of New York State by providing customers with low-cost, clean, reliable power and the innovative energy infrastructure and services they value."[143] Few investor-owned power plant owners have that same public service mission. It is not hard to imagine that NYPA would put those revenues to use for public purposes. NYPA provides a number of services, including sales of electricity, customer-energy services, R&D, investment in economic development, and provision of low-cost financing to eligible entities (e.g., public entities in New York State, not-for-profit colleges and universities, recipients of NYPA's economic-development rates) for energy efficiency and other energy projects.

[140] Brattle Group, 2018-11-28 Carbon Charge Customer Cost Impact Analysis.xlsx (hereafter Brattle Cost Impact Analysis), available at https://www.nyiso.com/documents/20142/3760282/2018-11-28 percent20Carbon percent20Charge percent20Customer percent20Cost percent20Impact percent20Analysis.zip/6310b3bb-0ebf-2c27-6288-663441d2707f.

[141] Nucor Steel Auburn, Inc., "Comments on the Brattle Group Report and Suggested Analyses to be Incorporated in the Integrating Public Policy Task Force Workplan," PSC (In the Matter of Carbon Pricing in New York), Matter 17-01821, footnote 70.

[142] RFF 2019 Study, page 31. RFF reports that the range would be from $298–366 million in 2013$. The estimates reported above reflect adjustment for inflation from 2013 to 2019 using the Bureau of Labor Statistics CPI Inflation Calculator. As of 8-27-2019, Bureau of Labor Statistics, CPI Inflation Calculator, available at https://data.bls.gov/cgi-bin/cpicalc.pl.

[143] NYPA Webpage, "About," available at https://www.nypa.gov/about.

X. A NYISO carbon pricing mechanism: Its overall value proposition

In considering the economic impacts of a carbon pricing proposal in NYISO markets, policy makers may be informed by the qualitative and quantitative considerations described in this report and elsewhere. But there are many missing pieces of information and too many fast-moving parts in the state's changing policy environment to have the luxury of being informed in the near term by a fully fleshed-out benefit/cost analysis.

New York's utility regulators have set forth a benefit/cost framework[144] in the context of determining whether utility investments in distributed energy resources (funded through customer revenues), for example, are in the public interest. That framework includes direct monetary costs and benefits from the point of view of the performance of the electric system with and without the assets and/or programs being assessed. It also includes many difficult-to-quantify considerations as well as externality impacts that accrue to society more broadly. Such an approach has similarly been adopted in recent years in the context of the CES and the Offshore Wind Standard.[145]

We do not attempt to apply this precise type of conceptual framework. Any such effort would be hampered in numerous ways that limit the ability to provide refined quantitative estimates of benefits and costs, in part because of the many uncertainties about future conditions in New York's energy markets that have arisen since New York adopted the Act.

Nevertheless, we provide a list of elements that are part of the incremental value proposition afforded by the introduction of a carbon pricing mechanism into the NYISO energy market. The results of our analyses are summarized in Table 7 below.

[144] PSC Benefit-Cost Analysis Framework.

[145] See, e.g., DPS CES Cost Study.

Table 7: Summary for Policy Makers: Incremental Value Proposition of Adding a Carbon Pricing Mechanism in NYISO Markets In Conjunction with Reliance on Administrative Actions by New York State Agencies		
Outcome	**Impact of a Carbon Pricing Mechanism in NYISO Markets**	**Other Observations**
State policy leadership	A carbon price can be exported to other states and regions, supporting New York's market approach.	Support for a carbon price will further position New York State as a national policy innovator and leader, and encourage other states to act.
Speed of adoption	A NYISO carbon pricing mechanism can be implemented relatively quickly.	NYISO and its stakeholders have already done a great deal of work to explore this proposal, which can shorten the lead time for filing at/approval by FERC.
Accelerated entry of renewable projects	A price on carbon will increase the opportunity for financing of clean energy resources to enter the market in the absence of a long-term REC contract.	Some clean energy technologies (e.g., offshore wind) will likely require support through long-term REC contracts in order to get financing. But a price on carbon in wholesale prices will help some renewable projects (e.g., onshore wind, some solar projects) gain financing without a contract.
Incentives for innovation	A carbon price in the NYISO energy market will increase incentives for entrepreneurs and others to develop new supply-side and demand-side technologies, products, and services.	Although Clean Energy Standard (CES) procurements may elicit innovative and valuable proposals, a carbon price can produce solutions not anticipated in administrative procurements, and spur or accelerate research and development (R&D) and commercialization activities for emerging clean energy technologies.
Incentives for energy efficiency and other customer-based actions	A carbon price has the potential to improve price signals over time to consumers reflecting the full costs of using electricity, and influence consumer access to and use of demand-management technology and practices.	The wholesale market's ability to influence consumers' behavior will be affected by retail pricing approaches adopted by utilities, the NY PSC, and Load Serving Entities. Nevertheless, carbon pricing at the wholesale level will likely contribute to societally efficient consumption decisions.
Incentives for efficient transmission investments	A location-based carbon price will create strong incentives for cost-effective investment in increased transfer capability between upstate and downstate.	Given the Act's goals to decarbonize the electric system and to electrify much of the energy used in New York's buildings and vehicles, additional transmission capability will be needed to provide downstate population centers with improved access to distant zero-carbon resources.
Acceleration of fossil retirements and reduced use of natural gas	The NYISO carbon price will put financial pressure on existing inefficient fossil units to retire and reduce use of fossil fuels, especially in downstate New York areas. It will also drive increased efficiencies in remaining fossil generation.	A price on carbon can accelerate retirements and/or efficient repowering of fossil units above and beyond policy requirements to retire peaking units, with positive impacts on air quality in downstate disadvantaged communities.
Compatibility with other policy instruments	A carbon price can be a seamless complement to other state policies (e.g., energy efficiency, REC and ZEC contracting) by providing a means to value low-carbon investment and operations in the electric system.	The pace and depth of New York's electric-system transition will require simultaneous reliance on multiple policies. A carbon price is not duplicative; instead, it efficiently and transparently reduces reliance on and the cost of meeting administrative clean energy policies.
Ability to harmonize policy and markets	The NYISO carbon price will internalize the cost of GHG emissions into the electric markets, and improve the performance of the wholesale market.	With the Act, New York's electric system's needs are now firmly linked to a lower-carbon footprint. NYISO's market design should similarly incorporate this price signal and introduce the cost of carbon into electricity decisions.
Alignment with wholesale market design	A NYISO carbon pricing mechanism will support the efficient operation of the NYISO markets.	The carbon pricing mechanism will dovetail seamlessly into the operation of NYISO wholesale markets.
Consumer cost impacts	The NYISO market's two-decade track record of extracting efficiencies out of the electric system's operations can provide confidence that an improved market design, aligned with the state's carbon reduction goals, will produce savings to consumers.	In light of the Act's recent and much more aggressive decarbonization targets, the results of prior modeling of the impacts of a carbon price do not shed light on (and likely underestimate) the relative value of a carbon price in producing consumer savings compared to exclusive reliance on CES procurements and administrative actions.
Public health impacts	Given the location of fossil generation in downstate New York, a carbon price will reduce local air pollution there.	A carbon price will dovetail with other state policies (e.g., the Peaker Rule) to encourage retirements and repowering.
Impacts on disadvantaged communities	Given the location of fossil generation in downstate New York, a carbon price will reduce emissions in downstate environmental justice areas.	A carbon price will dovetail with other state policies (e.g., the Peaker Rule) to encourage retirements and repowering.
Limitation of CO_2 emissions leakage to other regions	A carbon pricing mechanism will limit leakage due to the proposal's treatment of emissions related to cross-boundary electricity flows.	The Act identifies leakage as an issue the state should address and avoid; relying on CES procurements alone will not be as effective as a carbon price for this issue.
Revenue streams to public entities	Given the portfolio of zero-carbon supplies owned/ controlled by the New York Power Authority (NYPA), the carbon pricing mechanism will increase revenues to NYPA as a power provider in the NYISO markets.	These incremental additional revenues to NYPA can be used in a variety of net-positive ways to New York (e.g., investment in infrastructure to support clean energy, low-cost financings, discounted service offerings, R&D, and innovation that would otherwise be paid for in NYPA rates).

XI. Conclusion

New York has a home-grown tool—a proposed carbon pricing mechanism in the state's wholesale market administered by NYISO—that can provide a number of benefits, including support for New York policy makers' goals to reduce carbon emissions as quickly and as economically as possible. Introducing a carbon price in the state's wholesale electric market administered by NYISO can lead to a number important outcomes, including that it:

- can be implemented fairly soon (consistent with the Act's encouragement of early action)
- has the potential to address locational issues relating to air pollution, especially in vulnerable EJ neighborhoods (consistent with some elements of the Act's intent)
- has the ability to address leakage issues relating to power flows across New York's electricity borders with neighboring regions (consistent with the Act's directives for state policy makers to mitigate potential leakage of carbon emissions)
- can send signals to investors about the value of adding certain types of commercially ready renewable and zero-emissions power sources, even without a long-term contract
- can create incentives for the state to take further steps to add transmission or other capability to provide greater access to upstate clean energy resources for downstate electricity consumers
- can help to provide energy-price visibility to owners of existing non-carbon-emitting resources to remain in the market after their current contracts are over
- can help to grow the electric supply system with zero- and low-carbon resources, thus helping to support the "beneficial electrification" objectives of the Act
- can provide demonstrated benefits to other states that might consider adopting such an approach in order to accomplish their own carbon reduction goals
- can save money for New York's consumers and its economy, in terms of meeting the CLCPA goals more cost-effectively and efficiently than without such a carbon price in the NYISO market

Without the carbon price, New York policy makers may be inadvertently tying one hand behind the market's back, at a time when New York's aspirations for a clean energy economy call for all hands to be clapping together in unison.

Technical Appendix:
Methodological Issues, Data, and Assumptions

Under separate cover