Reducing Emissions from the Electricity Sector: The Costs and Benefits
Nationwide and in the Empire State

Executive Summary

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EXECUTIVE SUMMARY

Recent federal policy proposals to reduce emissions of SO$_2$, NO$_x$, and mercury from the electricity sector promise important improvements in air quality and reductions in acid deposition in New York State and across the nation. The cost of achieving these reductions depends on the form and stringency of the regulation. In particular, the fact that technologies designed to reduce SO$_2$ and NO$_x$ can reduce mercury emissions as well has important implications for how producers respond to different types of mercury regulation and for the cost of multipollutant policies aimed at all three pollutants.

Using four models, this study looks at EPA’s Clean Air Interstate Rule (CAIR) as originally proposed, which differs in only small ways from the final rule issued in March 2005, coupled with several approaches to reducing emissions of mercury including one that differs in only small ways from the final rule also issued in March 2005. This study analyzes what costs and benefits each would incur to New York State and to the nation at large.

EPA has taken steps toward requiring greater reductions in emissions of SO$_2$ and NO$_x$ than mandated under current law from electricity generators. To facilitate compliance with the 8-hour ozone standard and with new air quality standards for fine particulates with a size of 2.5 micrometers in diameter and smaller (PM$_{2.5}$) and to meet statutory requirements for reducing emissions of hazardous air pollutants such as mercury, the EPA adopted two new rules early in 2005 that together address SO$_2$, NO$_x$, and mercury emissions from the electric sector. In its Clean Air Interstate Rule, or CAIR, EPA caps emissions of SO$_2$ and/or NO$_x$ in a large region covering more than 20 states, mostly east of the Mississippi, and the District of Columbia.

Summary of Main Findings

Benefits to the nation and to New York State significantly outweigh the costs associated with reductions in SO$_2$, NO$_x$, and mercury, and all policies show dramatic net benefits.

The manner in which mercury emissions are regulated will have important implications not only for the cost of the regulation, but also for emission levels for SO$_2$ and NO$_x$ and where those emissions are located.

Contrary to EPA’s findings, CAIR as originally proposed by itself would not keep summer emissions of NO$_x$ from electricity generators in the SIP region below the current SIP seasonal NO$_x$ cap. In the final CAIR, EPA added a seasonal NO$_x$ cap to address seasonal ozone problems. The CAIR with the seasonal NO$_x$ cap produces higher net benefits.

The effect of the different policies on the mix of fuels used to supply electricity is fairly modest under scenarios similar to the EPA’s final rules.

A maximum achievable control technology (MACT) approach, compared to a trading approach as the way to achieve tighter mercury targets (beyond EPA’s proposal), would preserve the role of coal in electricity generation.

Our evaluation of scenarios with tighter mercury emission controls shows that the net benefits of a maximum achievable control technology (MACT) approach exceed the net benefits of a cap and trade approach.
This regulation allows for emissions trading, and restrictions are imposed in two phases with the first beginning in 2010 and the second beginning in 2015. In the first phase, the program allocates 3.7 million tons of SO$_2$ allowances and 1.6 million tons of NO$_x$ allowances to electricity generators within 25 states and the District of Columbia. In 2015, the total allocations for annual emissions drop to 2.6 million tons for SO$_2$ and 1.3 million tons for NO$_x$. Actual emissions are expected to exceed these targets for some years beyond 2015 due to the opportunity to bank emission allowances distributed in earlier years for use in later years. The percent reductions in emissions within the CAIR region are comparable to those that would be required nationwide under the Clear Skies Initiative, except they happen on a somewhat accelerated schedule. The regulation also institutes a cap on seasonal summertime emissions of NO$_x$ in a region with a slightly different boundary.

In the second new rule, EPA adopts a national plan to reduce emissions of mercury from electricity generators using a cap-and-trade approach applied to all coal-fired generating units in the nation. The rule distributes allowances for 38 tons of emissions from all coal and oil-fired electricity generators beginning in 2010 and 15 tons beginning in 2018. The rule allows for emission banking. According to the EPA actual emissions are expected to exceed 15 tons for many years beyond 2015 due to the role of banking. In the final rule, the cap-and-trade approach to reducing mercury was selected over a maximum achievable control technology (MACT) approach, which was also included as an option for consideration in the proposed rule.

We analyze four different multipollutant policy scenarios that coincide with recent proposals. All of these scenarios include EPA’s Clean Air Interstate Rule for SO$_2$ and NO$_x$ in its original proposed form in combination with different approaches to reducing mercury emissions from electricity generators nationwide.

1. **CAIR plus EPA Mercury Cap**: The Clean Air Interstate Rule (CAIR) as originally proposed coupled with a companion national mercury cap, based on EPA’s mercury cap in the proposed and final mercury rule, with unrestricted trading of mercury emission allowances. Under this scenario, the seasonal cap-and-trade program for NO$_x$ for electricity generating units in the State Implementation Plan (SIP) seasonal NO$_x$ trading program is no longer in effect. In all of the CAIR and national allowance trading programs, allowances are distributed initially based on historic emissions.

2. **CAIR plus EPA Mercury and Seasonal SIP NO$_x$ Policy**: This scenario combines scenario 1 with the continuation of the seasonal cap-and-trade program for NO$_x$ emissions from electricity generating units in the NO$_x$ SIP Call region. Although the originally proposed CAIR rule would have suspended the current seasonal NO$_x$ policy, in the final rule a seasonal program is reconstituted.

3. **CAIR plus Tighter Mercury with MACT**: This scenario includes the CAIR as represented in scenario 1 coupled with a national requirement that all coal-fired generators achieve either
a 90% reduction in mercury emissions or a target emission rate of 0.6 lbs of mercury per trillion Btu of heat input, whichever is less expensive at the particular facility.

4. **CAIR plus Tighter Mercury with Trading**: This scenario models the CAIR coupled with a national cap-and-trade program for mercury where the national annual emission cap for mercury in each year is set at the mercury emission level realized under the version of the Tighter Mercury with MACT rule modeled in scenario 3.

Our analysis shows that benefits to the nation and to New York State significantly outweigh the costs associated with reductions in \( \text{SO}_2 \), \( \text{NO}_x \), and mercury, even under cautious assumptions about the valuation of the expected health effects. Depending on the policy, between 10 and 13% of the total national health benefits associated with reduced emissions of \( \text{SO}_2 \) and \( \text{NO}_x \) occurs in New York State, a function of the state’s population and its location downwind of major emission sources. This estimate is based on a calculation of expected improvements in human health resulting from changes in particulate matter and ozone concentrations, which are thought to capture the most important benefits. We find the health benefits of reducing particulate matter are nearly two orders of magnitude greater than the health benefits of reducing ozone. Several benefit categories including visibility effects, reduced acidification and other ecological improvements and the effects of mercury on human health and the environment would increase the calculated net benefits even further. The magnitude of benefits for ecological improvement in the Adirondack Park and for reduction of mercury emissions, based on recent unpublished estimates, is discussed in the analysis.

We find that, with one exception, the set of policies will have fairly small impacts on the average price of electricity nationwide and in New York. However, the manner in which mercury emissions are regulated will have important implications not only for the cost of the regulation, but also for emission levels for \( \text{SO}_2 \) and \( \text{NO}_x \) and where those emissions are located.

Our research also shows that contrary to EPA’s findings, the CAIR rule, as originally proposed, by itself would not keep summer emissions of \( \text{NO}_x \) from electricity generators in the SIP region below the current SIP seasonal \( \text{NO}_x \) cap. As a result, average summertime 8-hour and 24-hour ozone concentrations in New York and elsewhere are higher under the originally proposed version of the CAIR policy than under the baseline. The remedy to this could include either tighter annual caps or continuation of seasonal controls.

We find combining a continuation of the SIP seasonal \( \text{NO}_x \) cap with the CAIR plus EPA Mercury scenario corrects this situation and does so at relatively low cost to firms and virtually no cost to electricity consumers nationwide. In the final version of the CAIR rule, EPA reconstitutes a seasonal cap-and-trade program for \( \text{NO}_x \) in a subset of the region to address this concern.

As an alternative to the EPA schedule of caps, we model a more stringent set of mercury policies that lead to about 67% further reductions in mercury emissions. An important environmental effect of the tighter mercury cap is that it brings about substantial ancillary reductions in emissions of \( \text{SO}_2 \). Under Tighter Mercury with Trading, the \( \text{SO}_2 \) cap is no longer binding by 2010 as generators rely more on installation of
flue gas desulfurization (FGD) units (known as SO\textsubscript{2} scrubbers) to reduce mercury and less on activated carbon injection (ACI).

Despite showing positive and significant net benefits, we hasten to add two important qualifications that preclude an endorsement of the CAIR policy coupled with EPA Mercury Cap and the continuation of the NO\textsubscript{x} SIP Call - the policy that comes closest to the one embodied in the EPA’s final CAIR and mercury rules. First, this calculation does not include benefits from mercury reductions, which would increase the benefit estimates of the tighter mercury standard. In a discussion of potential benefits we draw on recent research by Rice and Hammitt (2005) on the benefits of mercury emissions reductions associated with the Clear Skies Initiative to infer estimates of potential benefits of different levels of mercury control. This information suggests that inclusion of benefits from the tighter mercury standard would reduce the gap in net benefits between the Tighter Mercury policies and the policies with the EPA Mercury Cap. Second, our study indicates the benefits of additional tons of SO\textsubscript{2} reduction beyond the CAIR rule far exceed the costs. We do not investigate alternative levels of SO\textsubscript{2} control.

We provide an uncertainty analysis that varies the most important parameters in our estimations—the atmospheric model and value of a statistical life—and that includes somewhat more speculative estimates of the human health benefits of reduced mercury emissions and a partial analysis of ecological benefits. For the Low values in the uncertainty analysis, the CAIR policy coupled with EPA Mercury Cap and the continuation of the NO\textsubscript{x} SIP Call remains the policy with the greatest net benefits. However, under the High value cases, although all policies show dramatic net benefits, the policies with the Tighter Mercury standard have the greatest net benefits.

The effect of the different policies on the mix of fuels used to supply electricity is also fairly modest. The scenarios that combine CAIR with the EPA Mercury Cap see a significant switch among types of coal, accounting for about 45% of the reduction in SO\textsubscript{2} emissions, but there is only a slight switch away from coal to natural gas, which accounts for just 4% of the reduction in SO\textsubscript{2} emissions. The switch from coal to natural gas tends to be much larger under the Tighter Mercury with Trading Policy, and this switch accounts for roughly 19% of the reduction in mercury relative to the baseline. The policy also produces large ancillary reductions in emissions of CO\textsubscript{2}, which fall by 11% of baseline levels nationally and 26% in New York State in 2020. Since it is often stated by the current federal administration that it is not the purpose of environmental regulation to force fuel switching away from coal, then a maximum achievable control technology (MACT) approach may be preferred to a trading approach as the way to achieve tight mercury targets (beyond the cap in EPA’s mercury rule) because it preserves the role of coal in electricity generation.

A key factor in the design of environmental policy is the incidence of burden, which varies for consumers and for producers depending on whether a trading approach is used. Consumers bear all of the cost of EPA’s proposed policies in 2010. In New York, producers benefit from the policies. By 2020, nationwide we find the burden is shared fairly equally between consumers and producers. In 2020 the cost in New
York State is very small, due in part to the implementation of New York’s multipollutant rule that is included in the baseline.

Replacing the EPA mercury rule with the tighter mercury standards yields additional costs for both consumers and producers in 2010, when consumers bear an additional cost of about $1.3 billion nationwide and producers bear an additional cost of $2.2 billion. In 2020 the additional cost of the Tighter Mercury with MACT policy falls entirely on consumers, who bear an additional cost of $2.8 billion, while producers bear no additional cost. Overall, consumers bear over 75% of the cost of the Tighter Mercury with MACT policy in 2010 and over 70% in 2020. There is no additional cost of the tighter mercury standard using a MACT approach in New York State in 2010 or 2020.

Implementing tighter mercury standards using a trading approach imposes significantly more cost on the electricity sector than using a MACT standard to achieve the same emission target due to the internalization of the opportunity cost of mercury emissions allowance prices and the corresponding change in resources use including fuel switching to natural gas. Consumers bear the entire burden from tight mercury controls with trading. In the aggregate producers actually benefit substantially due to higher electricity prices, but the effect on individual firms is likely to vary greatly, depending on the portfolio of generation assets they operate.

In conclusion, we find that all four policies we investigated which would regulate multiple pollutants from the electricity sector, including policies with the tighter mercury controls, would deliver substantial benefits to residents of New York State and the nation. Contrary to EPA’s findings, CAIR as originally proposed by itself would not keep summer emissions of NO\textsubscript{x} from electricity generators in the SIP region below the current SIP seasonal NO\textsubscript{x} cap. In the final CAIR, EPA added a seasonal NO\textsubscript{x} cap to address seasonal ozone problems. The final CAIR with the seasonal NO\textsubscript{x} cap produces higher net benefits relative to the originally proposed CAIR. Our modeling indicates that additional SO\textsubscript{2} emissions reductions beyond those called for by the EPA rules would yield benefits that substantially exceed the additional cost. Our evaluation of scenarios with tighter mercury emission controls shows that the net benefits of a maximum achievable control technology (MACT) approach exceed the net benefits of a cap and trade approach. It is important to note that we do not include estimates of the benefits of mercury reductions, which if included, would improve the net benefits of more stringent mercury controls.