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SUMMARY COMMUNICATION

REDUCING EMISSIONS FROM THE ELECTRICITY SECTOR: THE COSTS AND BENEFITS NATIONWIDE AND IN THE EMPIRE STATE

Prepared for the

NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY

Prepared by

RESOURCES FOR THE FUTURE

NYSERDA

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Introduction

The electricity sector is a major source of several air pollutants including sulfur dioxide (SO_2), which contributes to acid rain and fine particle concentrations in the atmosphere, nitrogen oxides (NO_x) which contribute to both of these pollution problems and to ground-level ozone, mercury, which is a toxic substance linked to neurological and other health problems, and carbon dioxide (CO_2), which contributes to global warming. The electricity sector contributes roughly 68 percent of national emissions of SO_2 emissions, 22 percent of NO_x, 40 percent of mercury, and 40 percent of CO_2 (according to EPA's 1999 Emissions Inventory). The environmental effects of the emissions of SO_2 and NO_x are particularly strong in the Northeast, which is downwind of the large number of coal-fired generators located in the Mid-Atlantic States and the Ohio Valley.

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. 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 regulations and for the cost of multipollutant policies aimed at all three pollutants.

In research funded by the New York State Energy Research and Development Authority (NYSERDA), Resources for the Future (RFF) staff analyzed alternatives for federal policy to examine how well they will protect the environment and public health of the nation in general and New York State in particular. RFF analyzed the economic costs and benefits of the EPA's Clean Air Interstate Rule (CAIR) as characterized in the supplemental rule proposed in June 2004, and the Clean Air Mercury Rule (CAMR) as proposed in February 2004. These rules differ in only small ways from the final rules issued in March 2005. The assessment integrates four models including a model of the electricity sector, two models of atmospheric transport of air pollutants, and a model of environmental and public health endpoints affected by pollution. RFF modeled explicitly the emissions of SO_2, NO_x, mercury and CO_2 and the effects of changes in emissions of SO_2 and NOx on environmental and public health. RFF did not model directly the effects of mercury emissions, but did augment the modeling with estimates from other recent studies.

The analysis cannot provide economic advice regarding mercury emission targets because the modeling reflects inadequate links between models of emissions, physical science, public health and social science. Although the costs of mercury reductions were modeled in detail and ancillary changes in particulate matter that results from mercury reductions were accounted for, a direct accounting of the benefits of reduced mercury emissions is not provided. How mercury benefits are accounted for could change the net benefits assessment of the four policy scenarios modeled.

EMEP Program Overview

NYSERDA's Environmental Monitoring, Evaluation and Protection (EMEP) program is funded through the System Benefits Charge (SBC) under the **New York Energy $mart℠** Program. The primary mission of EMEP is to support research to address environmental issues related to the generation of electricity. Since its inception in 1998, EMEP has provided objective and policy-relevant research to:

- Improve the scientific understanding of electricity-related pollutants in the environment;
- Assess the environmental impact of electricity generation relative to other sources of pollution;
- Help develop approaches to mitigate impacts of electricity generation and improve environmental quality.

EMEP has also supported development of advanced environmental instrumentation.

The EMEP program currently supports research in four critical regional environmental issues related to electricity generation: ozone, fine particles, acid deposition, and mercury. Program Opportunity Notices (PONs) are issued periodically to seek proposals which address targeted research areas. Projects are reviewed and selected through this competitive process. The program is guided by a steering committee comprised of representatives from the New York State Departments of Environmental Conservation (DEC), Health (DOH), and Department of Public Service (DPS); the U.S. Environmental Protection Agency (U.S. EPA); a university; two utility associations; and the Adirondack Park Agency. Also, a science advisory committee provides program support and periodic review in critical disciplines.

Under EMEP, NYSERDA sponsors conferences and workshops for policy-makers and scientists to share information. They cover a wide range of topics, from asthma in New York City to mercury in remote regions of the Adirondacks. NYSERDA has also commissioned papers to "translate" scientific results into a form useful for policy-makers. As research reports become available, NYSERDA and its research partners will post information on-line (see: **www.nyserda.org/programs/Environment/EMEP/**). Program Opportunity Notices and information about ongoing projects may also be found on the website.

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 NOx 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.

The 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.

Policy Background

Significant reductions in emissions from power plants have been achieved under the 1990 Clean Air Act Amendments and under various other state and federal regulations. However, it is widely recognized that further emission reductions are necessary in order to achieve 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 reduce emissions of mercury.

For several years Congress has weighed proposals suggesting a coordinated environmental policy to reduce emissions of multiple pollutants from the electricity sector. It makes sense to coordinate policies for multiple pollutants because of the interaction of compliance investments at power plants. Efforts to reduce one pollutant have an effect on the cost of reducing other pollutants. However, with the inability of Congress to reach agreement, the EPA initiated a regulatory process that culminated in two new rules issued in March 2005 that together address SO_2, NO_x, and mercury emissions from the electricity sector.

In its Clean Air Interstate Rule, or CAIR, EPA caps emissions of SO_2 and NO_x in a large multistate region mostly east of the Mississippi. This regulation allows for emissions trading, and emission reductions are imposed in two phases with the first beginning in 2010 and the second beginning in 2015. In the first phase, CAIR 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 currently before Congress, except they happen on a somewhat accelerated schedule. The final regulation also preserves a cap on seasonal summertime emissions of NO_x in a region with a slightly different boundary.

In the second new rule known as the Clean Air Mercury Rule (CAMR), 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 allowance banking. According to the EPA actual emissions are expected to exceed 15 tons for many years beyond 2018 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.

Scenarios Analyzed

Four different multipollutant policy scenarios that coincide with recent proposals were analyzed. 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] One variation considers seasonal controls in addition to national controls on NO_x emissions, a feature that was missing in the proposed rule but included in the final rule. Other variations focus on different approaches to regulation of mercury, an issue that is important not only for mercury emission levels but also because of the interaction of controls for mercury with controls for other pollutants. In all of these scenarios, emission allowances are distributed initially based on historic emissions levels.

1. **CAIR plus EPA Mercury:** CAIR as originally proposed coupled with a companion national mercury cap, based on EPA's mercury cap in the proposed and final mercury rule (CAMR), with unrestricted trading of mercury emission allowances. Under this scenario, as in the proposed rule but different from the final rule, 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.

[1] The proposed version of the rules differ slightly form the final version. In particular, the CAIR region was modified to drop Kansas and the annual caps were adjusted accordingly. Two somewhat offsetting changes in the mercury rule are that the initial cap under the mercury rule was raised from 34 tons to 38 tons and the safety valve feature was removed.

Conclusion

In conclusion, the four policies regulating multiple pollutants from the electricity sector investigated all would deliver substantial benefits to residents of New York State and the nation. The benefits exceed the costs of those policies by a significant factor even under cautious assumptions about inputs to the benefits calculation that are expected to yield relatively low estimates of benefits. Moreover, the analysis of important sources of uncertainty indicates the finding of benefits in excess of costs holds up in virtually every scenario considered. Contrary to EPA's findings, CAIR as originally proposed would not keep summer emission 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 results show that CAIR with the seasonal NO_x cap produces higher net benefits. However, this finding does not translate into an endorsement of the EPA rules. The modeling indicates that additional SO_2 emissions reductions beyond those called for by the EPA rules would yield benefits that substantially exceed the additional cost. Further, a more precise accounting of the benefits of reduced mercury emissions could sway the recommendation in favor of more stringent mercury controls. The evaluation of scenarios with tighter mercury emissions controls shows that the net benefits of a maximum achievable control technology approach exceed the net benefits of a cap and trade approach. Moreover, if preserving a role for coal is an important policy goal, then a maximum achievable control technology 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. The overarching finding, however, is that the reductions in emissions that would be achieved under the EPA final rules or any of the alternatives investigated offer important economic benefits far in excess of costs to the Empire State.

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For more information about this project, including the full report, visit the EMEP webpage at: **www.nyserda.org/programs/Environment/EMEP/**

Fuel Mix

The effect of the different policies on the mix of fuels used to supply electricity is fairly modest for the scenarios that combine CAIR with the EPA Mercury Cap. Switching among types of coal accounts for about 45 percent of the reduction in SO_2 emissions, but there is only a slight switch away from coal to natural gas, which accounts for just 4 percent of the reduction in SO_2 emissions. The effect on fuel mix is also modest under the Tighter Mercury with MACT scenario, where fuel switching from coal to gas accounts for only 4 percent of the mercury reductions.

However, the switch from coal to natural gas is much larger under the Tighter Mercury with Trading Policy, accounting for roughly 19 percent of the reduction in mercury relative to the baseline. This policy also produces large ancillary reductions in emissions of CO_2, which fall by 11 percent of baseline levels nationally and 26 percent in New York State in 2020. These results suggest that if preserving a role for coal is an important policy goal, then a technology approach (MACT) may be preferred to a trading approach as the way to achieve tight mercury targets (beyond the cap in EPA's mercury rule).

Distribution of Costs

A key factor in the design of environmental policy is the incidence of burden – e.g. who bears the cost of the policy. The incidence varies for consumers and for producers depending on whether a trading approach is used. Nationally, consumers bear all of the cost of EPA's proposed policies in 2010, and in New York producers actually benefit from the policies. By 2020, nationwide 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, and producers bear this cost.

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 percent of the cost of the Tighter Mercury with MACT policy in 2010 and over 70 percent 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. The price of emission allowances is very high and the internalization of the opportunity cost of mercury emissions allowance prices into electricity price raises electricity price and has a large effect on electricity demand. Also, the high allowance price yields a corresponding change in resource use including fuel switching from coal 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.

2. **CAIR plus EPA Mercury and Seasonal SIP NOx 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 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 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.

All of these scenarios are compared to a baseline scenario that assumes electricity generators face no requirements to reduce mercury or CO_2 emissions, but must comply with the Title IV SO_2 emissions caps from the 1990 Clean Air Act Amendments and the summer seasonal NO_x cap-and-trade program in the NO_x SIP Call region. This project focused on the simulated effects of the four policies for the years 2010 and 2020.

Emissions, Costs, and Prices

The analysis shows that benefits to the nation and to New York State significantly outweigh the costs associated with reductions in SO_2, NO_x, and mercury. This is found to be true even under cautious assumptions about the valuation of the expected health effects and other model parameters that yield lower estimates of benefits than would result from values typically used by EPA.

Depending on the policy, between 10 and 13 percent of the total national health benefits associated with reduced emissions of SO_2 and 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 significant quantifiable benefits. The health benefits of reducing particulate matter were found to be nearly two orders of magnitude greater than the health benefits of reducing ozone. Other types of benefits include visibility effects, reduced acidification and other ecological improvements, and the effects of mercury on human health and the environment. Recent unpublished estimates of the benefits of ecological improvements in the Adirondack Park and for reduction of mercury emissions, suggest that accounting for these additional benefits would increase the calculated net benefits even further. The potential sizes of these effects are explored in an uncertainty analysis discussed on page 11.

The EPA's new rules will have fairly small impacts on the average price of electricity nationwide and in New York. Moreover, the alternative policy modeled including the stringent Tighter Mercury MACT policy has little impact on average electricity price. The exception is the policy which uses a trading approach to achieve the same stringent mercury emission target. This policy leads to a 10 percent higher electricity price in 2010 and a 5 percent higher electricity price in 2020 relative to the baseline scenario.

The stringent mercury cap-with-trading policy has important implications not only for the cost of the regulation within the electricity sector, but also for emission levels for SO_2 and NO_x and where those emissions are located. Under this scenario, the CAIR SO_2 cap is no longer binding by 2010 as generators rely more on installation of flue gas desulfurization (FGD) units (known as SO_2 scrubbers) to reduce mercury and less on activated carbon injection (ACI). Despite the fact that trading allows generators to lower the costs of reducing mercury, relative to a technology standard, allowing for mercury trading introduces an opportunity cost associated with mercury emission allowances that stimulates switching from coal-fired to gas-fired generation. This opportunity cost is more than an order of magnitude (factor of ten) greater than under the EPA's proposed mercury cap. Even though the trading scenario produces greater ancillary reductions in SO_2 and larger associated health benefits than the MACT approach, the large increase in electricity price more than offset that difference.

Seasonal Ozone

The research shows that contrary to EPA's findings, annual controls on SO_2 and NO_x under the proposed version of the CAIR rule would not keep summer emissions of NO_x from electricity generators in the SIP region below the current SIP seasonal NO_x cap. As a result, average summertime 8-hour and 24-hour ozone concentrations in New York and elsewhere would be higher under the originally proposed version of the CAIR policy than under the baseline scenario. The remedy to this could include either tighter annual caps or continuation of seasonal controls. In the final version of the CAIR rule, EPA reconstituted a seasonal cap-and-trade program for NO_x in a subset of the region to address this concern. The continuation of the seasonal 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. CAIR with the seasonal NO_x cap produces higher net benefits relative to the originally proposed CAIR.

Uncertainty Analysis

RFF examines the uncertainty of its findings by varying the most important parameters in its estimations–the atmospheric model and value of a statistical life–and by varying somewhat more speculative estimates of the human health benefits of reduced mercury emissions and a partial analysis of ecological benefits. Three sets of benefit estimates are considered. The Low value represents net benefits under the lowest defensible values for each uncertain item. This case uses an estimate of $1 million for the value of a statistical life, the low end of the range of values surveyed by the EPA (EPA 2004). This case also uses only IQ-related benefits for mercury and a low value of the ecological benefit of acid rain reductions in the Adirondack Park (Banzhaf et al. 2004). The Preferred value case uses a $2.25 million value of a statistical life, which is less than half of the $6.1 million estimate used by EPA. The Preferred value case also uses cautious values for mercury and ecological benefits, which were not included in the benefit values reported in Table 1. The High value case uses alternative source-receptor coefficients for particulates and includes a value of statistical life of $10 million, the high end of the range of values surveyed by the EPA. The High value case also incorporates the high end of mercury-health related benefits, including cardiovascular effects and premature mortality, and the high end of ecological benefits. The addition of mercury benefits in both the Preferred and High value cases make comparisons across the four policy scenarios more relevant than they are in Tables 1 and 2.

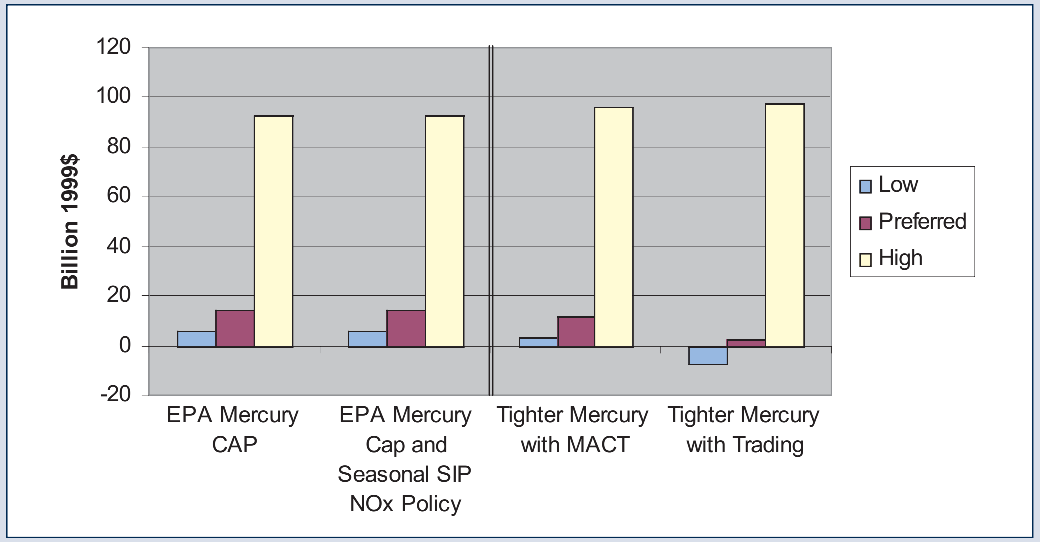
The results of the uncertainty analysis are presented in Figure 1. For the Low values case the CAIR policy coupled with EPA Mercury Cap and the continuation of the NOx SIP Call remains the policy with the greatest net benefits among those analyzed. As noted previously, this was also the policy that would capture the greatest net benefits under the Preferred value case. Under the High value case, however, although all policies show dramatic net benefits, the policies with the Tighter Mercury standard have the greatest net benefits resulting primarily from the combination of the high value of statistical life and the inclusion of mortality benefits from reduced mercury exposures.

The preferred approach is to use cautious assumptions about benefit estimates. The motivation for doing so is that even with cautious assumptions, the annual net benefits of the proposed policies are found to be significant. Given the important uncertainties that surround these estimates, it is useful for policymakers to know that estimates are not likely to overstate the benefits of the policy.

Finally, it is noted that there are many other sources of uncertainties and omissions on the benefit side, as well as the cost side, that extend beyond the current capability to model in a quantitative manner at the same level of confidence as human health benefits are modeled. For instance, benefits from improved visibility and from improved ecological health for the entire nation (outside Adirondack Park) are not included in the uncertainty analysis. On the other hand, costs incurred outside the electricity sector due to the interaction of environmental policy with preexisting regulations and taxes tend to increase the overall cost of environmental policy to the nation (Goulder et al., 1999). It is believed that the sources of benefits and costs included are the most important and most relevant to policymakers and their constituencies, given current knowledge and modeling capability.

Figure 1. The Effect of Uncertainties on Annual Net Benefits, 2020

(Ecological benefits to New York State residents for reduced acidification in the Adirondack Park and the health benefits of reduced mercury emissions are included in the uncertainty analysis.)



First, the results are consistent with previous studies that find the efficient level of control of SO_2 is significantly tighter than in CAIR, but the set of options investigated does not vary along this dimension. This project calculated a lower bound on average benefits of SO_2 emission reductions of approximately $2,900 per ton in 2010 and $3,100 per ton in 2020. Other authors (Banzhaf et al., 2004) find the average and marginal benefits of particulate-health related SO_2 reductions are approximately equal and fairly constant over an extended range of emissions, which implies that the average benefit per ton of the emission reductions modeled would apply to further emission reductions. In contrast, the marginal cost of further SO_2 reductions, which is the allowance price for SO_2, is identified here to be about $350 per ton in 2010 and $1,300 per ton in 2020. Hence, although alternative levels of SO_2 control are not investigated, there is compelling evidence that marginal benefits of further reductions in SO_2 emissions exceed the marginal costs and further reductions beyond those in CAIR would be justified on economic grounds.

Second, as noted above, the net benefit calculations in Table 1 do not include benefits from mercury reductions, which makes comparison of net benefits across the two sides of the table in appropriate. Including these benefits would increase the benefit estimates of the tighter mercury standard. In a discussion of potential benefits this report draws on recent research by Rice and Hammitt (2005) on the benefits of mercury emissions reductions associated with the Clear Skies Initiative to infer 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. This issue is explored further in uncertainty analysis.

Net Benefits

This report compares findings with respect to health benefits and economic costs of the different policy scenarios at the national level in Table 1. The phrase "net benefits" summarizes the difference between benefits and costs. Benefits are incomplete as they do not include ecological or visibility benefits or those associated with mercury reductions. On the cost side, only costs in the electricity sector are included. Nonetheless, the included categories of benefits and costs are thought to constitute the significant majority of quantifiable measures, and these are the measures that are the most significant in recent Regulatory Impact Assessments by the EPA.

A double line divides Table 1 into two halves and separates those scenarios involving the EPA mercury cap from those involving more stringent restrictions on mercury emissions. In the first two columns are the measurable net benefits under two versions of the CAIR policy with the EPA mercury cap. The last two columns include CAIR with the two policies that impose tighter restrictions on mercury emissions. The relevant comparisons are those within each side of the table as total national mercury emissions are constant within each of the grouped scenarios.

Table 1. Summary of Modeled National Benefits and Costs (Billions of 1999$)

	CAIR plus		*CAIR plus*	
	EPA Mercury CAP	*EPA Mercury CAP and Seasonal SIP NO_x Policy*	*Tighter Mercury with MACT*	*Tighter Mercury with Trading*
2010				
Benefits				
Ozone Health Benefits	0.16	0.16	0.17	0.08
Particulate Health Benefits	13.31	13.61	13.75	20.40
Costs				
Electricity Sector	-2.89	-3.00	-6.46	-16.15
Measured Net Benefits	10.58	10.77	7.46	4.33
2020				
Benefits				
Ozone Health Benefits	0.25	0.27	0.27	0.20
Particulate Health Benefits	19.21	19.03	19.14	21.71
Costs				
Electricity Sector	-5.60	-5.20	-8.23	-20.91
Measured Net Benefits	13.38	14.10	11.18	1.00

All of the policies have positive annual net benefits that in most cases increase over time. The net benefits of the policies that include the EPA mercury cap are greater than $10 billion per year in 2010 and roughly $14 billion per year in 2020. (All values are reported in 1999 dollars.) Furthermore, maintaining a seasonal NO_X program with the CAIR plus EPA Mercury Cap will produce positive incremental net benefits from a national perspective in both 2010 and 2020, compared to the CAIR plus EPA Mercury Cap but without a seasonal NO_X program.

The latter two columns show the effects of the costs of controlling mercury emissions to a much more stringent standard. Between 2010 and 2020, net benefits under the Tighter Mercury with MACT policy rise from $7.5 billion to $11.2 billion. Net benefit values for both years are somewhat lower than scenarios that involve the less stringent EPA mercury cap because the direct benefits of mercury emission reductions are unmeasured, while mercury control costs are increased. This is a methodological limitation of the study. Under the Tighter Mercury with Trading policy net benefits of $4.3 billion in 2010 fall to $1.0 billion in 2020. In this case particulate health benefits are higher due to the ancillary reductions in SO_2 and NO_X emissions. However, costs in the electricity sector are also higher because tradable mercury emission allowances internalize into electricity price the opportunity cost of emission reductions. When these effects are combined, the measured net benefits of CAIR coupled with Tighter Mercury with Trading are one-tenth those of CAIR coupled with Tighter Mercury with MACT.

The benefits and costs of the different policies in New York State are reported in Table 2, which is structured analogously to Table 1. When looking at this table it is important to keep in mind that the benefits and the costs in New York State are not directly linked. Actions to reduce emissions from electricity generators in New York State will yield environmental benefits in New York, which are included in Table 2, but they will also yield environmental benefits outside of New York, which are not included. Likewise, some of the benefits obtained in New York under the various policies reported in Table 2 will be the result of a mixture of actions taken at generating units in New York and those undertaken in upwind states. Nevertheless, the net benefits estimates are relevant for New York residents and businesses and therefore are included.

The results show that in 2010 all of the policies generate net benefits in New York. The net benefits in New York State are highest under the Tighter Mercury with Trading scenario and lowest under the EPA Mercury Cap scenario even though the mercury benefits are not included. This happens because the particulate health benefits for the former scenario in 2010 are nearly 40 percent higher than under any other scenario, substantially outweighing the $300 million in additional cost within the state. In 2020, the net benefits in New York are virtually identical under all four scenarios, although this would change if the mercury benefits were accounted for.

Table 2. Summary of Modeled New York Benefits and Costs (Billions of 1999$)

	CAIR plus		*CAIR plus*	
	EPA Mercury CAP	*EPA Mercury CAP and Seasonal SIP NO_X Policy*	*Tighter Mercury with MACT*	*Tighter Mercury with Trading*
2010				
Benefits				
Ozone Health Benefits	.02	.02	.02	.02
Particulate Health Benefits	1.66	1.78	1.83	2.51
Costs				
Electricity Sector	.03	-.02	.06	-.25
Measured Net Benefits	1.71	1.79	1.90	2.27
2020				
Benefits				
Ozone Health Benefits	.03	.03	.03	.03
Particulate Health Benefits	2.60	2.63	2.60	2.75
Costs				
Electricity Sector	-.07	-.02	.11	-.17
Measured Net Benefits	2.56	2.63	2.73	2.61

A Comparison of Policy Options

Table 1 indicates that the combination of the CAIR policy, the EPA Mercury Cap and the continuation of the NO_X SIP Call has higher net benefits than the combination of CAIR and the EPA Mercury Cap alone. As noted, this calculation considers just the benefits and costs from reduced concentrations of ozone and particulates. Figure 1 suggests that the same finding holds if modest values for mercury and ecological benefits of acid rain reductions are added to the mix, labeled as the Preferred case in Figure 1. This is the policy that comes closest to the one embodied in the EPA's final CAIR and CAMR. However, two important qualifications that preclude an endorsement of the final rules are included here.