March 1, 2012

An Economic Impact Analysis of EPA's Mercury and Air Toxics Standards Rule

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Contents

INTRODUCTION

On December 16, 2011, EPA released its final Mercury and Air Toxics Standards (MATS) Rule, accompanied by a Regulatory Impact Analysis (RIA) that reported the incremental cost to the U.S. electricity sector would be $9.6 billion per year in 2015. This is a large cost to the U.S. economy and, therefore, the Rule merits close examination. NERA has the capability to analyze the electric sector impacts and associated macroeconomic impacts of emissions policies. In this paper, we analyze the economic impacts of the MATS Rule. Our analysis is designed to generally match the EPA assumptions in its own analysis, and to offer a broader range of insights about the impacts of that Rule than EPA provided in its RIA. This paper briefly summarizes the approach in our MATS analysis, compares our results to those that EPA has reported, and provides some further results that are available from our own analysis. A particular addition that this paper offers is insight into the overall economy-wide impacts of the Rule that can be expected to result from the costs that the U.S. electric sector is projected to bear under the MATS Rule – EPA did not provide such an economy-wide assessment in its RIA.

NERA's N_{ew}ERA MODEL

NERA's analysis was performed using NERA's N_{ew}ERA model.[1] The N_{ew}ERA model is an economy-wide economic model that includes a detailed representation of the electric sector. It has been designed to assess, on an integrated basis, system costs to the power sector to meet any specified policy scenario as well as the overall macroeconomic impacts of that policy scenario. For the power sector, N_{ew}ERA uses a unit-level representation of the power generation system that considers the actions each generator takes to new policies such as MATS by providing compliance options such as retrofitting, retiring, fuel switching and re-dispatching. The outputs of the model include a variety of electric sector-specific results such as number of retrofits (and types), number of retirements, number and types of new capacity additions, fuel usage, and total sector costs. In addition, because the N_{ew}ERA model includes all sectors of the economy we can also evaluate changes in fuel markets (most importantly, natural gas markets) and macroeconomic indicators such as GDP, consumption and employment measures. Additional information about the N_{ew}ERA model is included in Appendix A.

MATCHING EPA's ANNUAL COST OF $10 BILLION IN 2015

The initial focus of the analysis was to see how closely our own projected electric sector impacts might match the analysis that EPA performed. Note that EPA only considered the impacts of the policy on the electric sector; they did not consider the broader economic effects of the Rule on the economy that arise because of the impacts of the Rule on prices and resources throughout the economy. EPA forecast the impacts of the MATS Rule using the IPM model. EPA analyzed two policy scenarios: 1) a Baseline, which included the Cross-State Air Pollution Rule (CSAPR) that has since been stayed by the court,[2] and 2) MATS, which layers the requirements of the

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[1] For additional technical details on the N_{ew}ERA model see http://www.nera.com/67_7607.htm.

[2] On December 30, 2011, the United States Court of Appeals for the D.C. Circuit issued a ruling to stay CSAPR pending judicial review.

MATS Rule on top of the Baseline; the impacts of the Rule (MATS) are calculated by comparing these two scenarios. The IPM model projected the incremental compliance costs to the electric sector in 2015 would be $9.4 billion (in 2007$).[3] EPA added another $0.2 billion to that cost to reflect monitoring and administrative costs, which accounts for EPA's total cost being reported as $9.6 billion. Our analysis did not include the extra $0.2 billion, so our cost results, when stated as the annual cost in 2015, should be compared to IPM's estimate of $9.4 billion (2007$). Since the N_{ew}ERA model produces results in 2010$, it is useful to convert the IPM cost estimate of $9.4 billion in 2007$ to its value in 2010$: $9.7 billion.

NERA initially analyzed the same two policy scenarios in the N_{ew}ERA model – a Baseline with CSAPR and a scenario with the addition of MATS on top of CSAPR. We also used EPA's assumptions about retrofit options and their costs.[4] Doing so, we projected the incremental compliance costs to the electric sector in 2015 to be $10.4 billion (in 2010$), which is the result that is comparable to EPA's $9.7 billion (in 2010$). Figure 1 compares our cost results to those from IPM with more years, and also stated as present values.[5]

Figure 1: Comparison of Annualized Incremental Compliance Costs for MATS, Relative to CSAPR

Annualized and Present Value Incremental Compliance Costs (Billions of 2010$)				
	2015	2020	2030	PV (2014-2034)
EPA (IPM)	$9.7	$9.0	$7.7	$89.9
NERA (N_{ew}ERA)	$10.4	$10.8	$11.9	$94.8

CAPITAL COST REQUIREMENTS ARE ATTRIBUTABLE TO BOTH RETROFITS AND REPLACEMENT CAPACITY

The U.S. electric sector must not only comply with the MATS Rule, but will likely also need to comply with CSAPR, which has been stayed by the U.S. Court of Appeals. Given the investments that will need to be made to comply with CSAPR (if the stay is removed) as utilities also work towards complying with MATS, it is useful to also compare the costs to comply with the MATS Rule and with CSAPR, relative to a Baseline that includes the Clean Air Interstate Rule (CAIR), which specifies the current SO_2 and NO_X limits that generators must meet.

We addressed this issue by evaluating a scenario that did not include CSAPR in the Baseline and instead had only CAIR, which is presently the actual existing regulation. CAIR is assumed to continue into its second phase starting in 2015. Thus, we are able to make comparisons of a scenario that includes both the MATS Rule and CSAPR with one that includes CAIR, but does not include either the MATS Rule or CSAPR. The remaining results presented in this paper are based on this comparison, unless otherwise stated.

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3 Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards, December 2011, p. 3-13.

4 The only difference in assumptions about retrofit options in the N_{ew}ERA runs was to limit Dry Sorbent Injection (DSI) to units burning subbituminous coals and that have capacity less than 300 MW.

5 In calculating the net present value, we used a real discount rate of 5%.

There are some important details about costs that EPA did not report, but that we can report from our own analysis based on the N_{ew}ERA model. One of these is the level of total capital that electric companies will need to raise within the implementation period. EPA only reports the annual capital payments that companies incur over time to "pay back" the upfront spending. Annualized costs have relevance because they may affect electricity rates. However, the level of spending that must occur upfront is of relevance for other reasons. For example, it indicates how leveraged companies may have to become, which can affect their borrowing costs and their stock valuate.

The capital costs are associated with both pollution control retrofits and new capacity to replace capacity retired as a result of the Rule. Reporting only the annualized costs masks the significant increase in capital that would be required in order to comply with the MATS Rule. We thus turn to the key drivers of capital spending prior to 2015.

Retrofits

EPA's analysis shows that in 2015 the MATS Rule (incremental to CSAPR being fully implemented first) will entail 60 GW of scrubber retrofits (wet scrubbers, dry scrubbers and dry sorbent injection combined), 63 GW of scrubber upgrades, 99 GW of activated carbon injection (ACI) and at least 102 GW of fabric filters.[6] In contrast, our analysis shows an incremental 64 GW of scrubbers, 70 GW of ACI and 124 GW of fabric filters (the scrubber retrofit numbers are 70 GW if compared relative to CAIR). The details on the retrofits are in Figure 2.

Figure 2: Summary of 2015 Retrofit Additions

Scenario	WFGD	DFGD	DSI	Total Scrub	SCR	ACI	FF
EPA Results (IPM)							
Base (CSAPR)	55	6	9	70	0	0	0
CSAPR/MATS	52	26	52	130	0	99	102
Delta	***-3***	***19***	***44***	***60***	***0***	***99***	***102***
NERA Results (N_{ew}ERA)							
CAIR	18	0	0	18	15	7	4
CSAPR	18	6	0	24	15	7	9
CSAPR/MATS	19	47	22	88	16	78	128
Delta from CSAPR	***1***	***41***	***22***	***64***	***2***	***70***	***124***
Delta from CAIR	***1***	***47***	***22***	***70***	***2***	***70***	***124***

Note: Deltas may not add up due to rounding.

[6] Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards, p. 3-15.

Retirements

The other component of the capital spending relates to new capacity to replace coal-fired generators that economically retire due to the compliance requirements of the MATS Rule. EPA projects that the MATS Rule will result in an incremental 5 GW of coal-fired capacity retiring by 2015 relative to CSAPR. Our analysis of the MATS Rule has an incremental 19 GW of coal-fired capacity retiring as a result of the MATS Rule relative to CSAPR. We project 23 GW of retirements relative the Baseline without CSAPR. We note, however, that the Baseline without CSAPR has 15 GW of retirements in it, so that the total capacity retired through 2015, once both CSAPR and MATS are applied, is 38 GW. (It is about the same even if only the MATS Rule is imposed on top of the CAIR-only Baseline.) Almost all of the incremental retirements are in states east of the Mississippi River.

Some of the retired capacity is replaced by new natural gas-fired combined cycle units. This has to occur in some locations in order to maintain reserve margins.[7] However, when reserve margins do not force replacement capacity, a significant part of the generation that comes from those retired units in the Baseline is replaced by greater generation from existing natural gas combined cycle units in the same region. Nationally, by 2015 there is an incremental build of 1 GW of natural gas combined cycle units and an incremental build of 1.5 GW of combustion turbines driven by the MATS and CSAPR Rules combined. (It is about the same even if only the MATS Rule is imposed on top of the CAIR-only Baseline.)

Total Capital Spending by 2015

Thus, there are capital costs incurred due to retrofits and replacement capacity. Between 2012 and 2015, the model projects that this capital requirement would be $84 billion to comply with both MATS and CSAPR. This represents a 30% increase over the capital requirements in a Baseline with either CAIR or CSAPR. Such an increase might create financing challenges for individual operating companies and the sector as a whole, which could lead to credit downgrades and possibly higher costs of borrowing. We have not attempted to include these potential costs in our estimates (nor has EPA included them in theirs).

NON-CAPITAL COSTS

The capital spending is the most significant feature of the costs. In addition, there are increased costs of generation that are due to: the greater use of natural gas to displace the coal-fired plants that retire specifically as a result of the MATS Rule, operating costs of the retrofits, and the reductions in unit efficiencies resulting from the retrofits themselves.[8] To some extent, these added operating costs are offset by reduced costs of maintaining the coal plants that are retired. The net effect of these operating costs, plus the annualized capital payments for the $84 billion in investment, is reflected in the total costs that were reported in Figure 1.

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[7] Each region in the model has a reserve margin. If the available capacity relative to the region's peak demand falls below the required reserve level then capacity must be added to the system.

[8] The retrofits often require additional power from the facility to operate, resulting in a net reduction in the efficiency of the plant.

OVERALL MACROECONOMIC IMPACTS ASSOCIATED WITH THE COSTS OF THE MATS RULE

The consequences of the MATS Rule are not just limited to the electric sector. The electric sector has to invest significant capital to comply with the MATS Rule. This capital and other added spending for compliance will induce lower industrial output (because the cost of power, natural gas, and other commodities will increase) and hence drive down income for workers. Although the investments also will create jobs installing the retrofits and building new power plants, the net effect of complying with the MATS Rule will be an increase in the costs of electricity and natural gas, and will produce a drag on the economy as a whole. EPA did not evaluate the MATS Rule using a macroeconomic model so they could not produce a net impact on jobs; instead they cited an estimated 46,000 short-term jobs and 8,000 long-term utility jobs created.[9]

Because the N_{ew}ERA model integrates electric sector costs with the rest of the economy, our analysis also directly estimates the impacts on wages and net employment as a result of the MATS Rule. Our estimate of the net impact (inclusive of job gains associated with installing retrofits and building new power plants) of the MATS Rule in 2015 is a loss in income equivalent to 180,000 full-time jobs (215,000 full-time jobs if compared relative to CAIR). Figure 3 shows that while the largest job losses are in 2015, there are continuing job losses over time as the economy shrinks due to higher energy costs.

Figure 3: Change in Full-Time Job Equivalents

Change in Full-Time Job Equivalents (Thousands)	2015	2018	2021	2024
CSAPR/MATS (relative to CSAPR)	-180	5	-60	-50
CSAPR/MATS (relative to CAIR)	-215	-15	-75	-85

The costs of the MATS Rule are also reflected in several other common economic measures. For example, the present value of GDP losses from 2012 through 2035 would be between $84 and $112 billion dollars ($84 billion is relative to CSAPR, $112 billion is relative to CAIR). Figure 4 shows the annual GDP losses and the present value loss through 2035. Not surprisingly, the largest loss is in 2015 when the MATS Rule is assumed to be fully implemented.

9 Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards, p. 6-1.

Figure 4: Change in Gross Domestic Product

Change in GDP (Billions of 2010$)	2012	2015	2018	2021	2024	2027	2030	2033	Present Value
CSAPR/MATS (relative to CSAPR)	-$1	-$22	$1	-$4	-$4	-$4	-$5	-$5	-$84
CSAPR/MATS (relative to CAIR)	-$3	-$25	$1	-$4	-$7	-$7	-$7	-$7	-$112

Similar to GDP, the MATS Rule also leads to losses in consumption or disposable income for consumers. The present value of consumption losses from 2012 through 2035 would be between $35 and $71 billion dollars ($35 billion is relative to CSAPR, $71 billion is relative to CAIR). Figure 5 shows the annual consumption losses and the present value loss through 2035. For consumption, the largest losses are in 2012 as investment has to ramp up to meet the 2015 compliance deadline, which requires a diversion of funds from consumption to investment.

Figure 5: Change in Consumption (billions, 2010$

Change in Consumption (Billions of 2010$)	2012	2015	2018	2021	2024	2027	2030	2033	Present Value
CSAPR/MATS (relative to CSAPR)	-10	-3	1	0	0	0	-1	-1	-35
CSAPR/MATS (relative to CAIR)	-13	-5	-1	-2	-2	-2	-3	-4	-71

CONCLUSION

Both NERA's analysis with the N_{ew}ERA model and EPA's analysis with IPM find that complying with the MATS Rule will impose annual costs on the electric sector that are approximately $10 billion in 2015 and almost $100 billion on a present value through 2034. Not included in these numbers are the potential for higher financing costs due to the more than $80 billion in incremental capital that will be required in 2015.

NERA's analysis goes a step further than EPA's analysis in a few different ways. First, we also looked at the cost of complying with the MATS Rule relative to a Baseline with CAIR (instead of CSAPR). This comparison may be more relevant given that the electric sector must be working towards compliance with both the MATS Rule and CSAPR (assuming that the current stay is lifted). Second, because the N_{ew}ERA model is an integrated model of the entire economy, we are able to identify the economic impacts outside of the electric sector, which were largely ignored by EPA. These include significant net declines in labor wages, which would result in losses of full-time job equivalents; declines in the growth of the U.S. economy as measured by GDP; and declines in consumption, or household disposable income.

APPENDIX A – Additional Details on the N_{ew}ERA Model

NERA developed the N_{ew}ERA model to forecast the impact of policy, regulatory, and economic factors on the energy sectors and the economy. When evaluating policies that have significant impacts on the entire economy, one needs to use a model that captures the effects as they ripple through all sectors of the economy and the associated feedback effects. The N_{ew}ERA model combines a macroeconomic model with all sectors of the economy (except for the electric sector) with a detailed electric sector model. This combination allows for a complete understanding of the economic impacts of different policies on all sectors of the economy.

The macroeconomic model incorporates all production sectors and final demand of the economy. Policy consequences are transmitted throughout the economy as sectors respond until the economy reaches equilibrium. The production and consumption functions employed in the model enable gradual substitution of inputs in response to relative price changes, thus avoiding all-or-nothing solutions.

The main benefit of the integrated framework is that the electric sector can be modeled in great detail yet through integration the model captures the interactions and feedbacks between all sectors of the economy. Electric technologies can be well represented according to engineering specifications. The integrated modeling approach also provides consistent price responses since all sectors of the economy are modeled. In addition, under this framework we are able to model electricity demand response.

There are great uncertainties about how the U.S. natural gas market will evolve, and the N_{ew}ERA model is designed explicitly to address the key factors affecting future natural gas supply and prices. One of the major uncertainties is the availability of shale gas in the United States. To account for this uncertainty and the subsequent effect it could have on the domestic and international markets, the N_{ew}ERA model includes resource supply curves for U.S. natural gas. The model also accounts for foreign imports and U.S. exports of natural gas, by using a supply (demand) curve for U.S. imports (exports) that represents how the global LNG market price would react to changes in U.S. imports or exports.

The electric sector model is a detailed model of the electric and coal sectors. Each of the more than 17,000 electric generating units in the United States is represented in the model. The model minimizes costs while meeting all specified constraints, such as demand, peak demand, emissions limits and transmission limits. The model determines investments to undertake and unit dispatch. Because the N_{ew}ERA model is an integrated model of the entire U.S. economy, electricity demand can respond to changes in prices and supplies.

The steam coal sector is represented within the N_{ew}ERA model by a series of coal supply curves and a coal transportation matrix. The N_{ew}ERA model represents the domestic and international crude oil and refined petroleum markets.

The N_{ew}ERA model outputs include demand and supply of all goods and services, prices of all commodities, and terms of trade effects (including changes in imports and exports). The model outputs also include gross regional product, consumption, investment, disposable income, and changes in "job equivalents" based on labor wage income.