Memorandum

TO: Docket for rulemaking: "National Emission Standards for Hazardous Air Pollutants: Coal-and Oil-Fired Electric Utility Steam Generating Units -- Reconsideration of Supplemental Finding and Residual Risk and Technology Review" (EPA-HQ-OAR-2018-0794)

DATE: December 14, 2018

SUBJECT: Compliance Cost, HAP Benefits, and Ancillary Co-Pollutant Benefits for "National Emission Standards for Hazardous Air Pollutants: Coal-and Oil-Fired Electric Utility Steam Generating Units -- Reconsideration of Supplemental Finding and Residual Risk and Technology Review"

1. Introduction & Summary of Results

This memorandum provides information related to the costs and benefits of controlling emissions from Coal and Oil-Fired Electric Utility Steam Generating Units (EGUs) for purposes of determining whether it is appropriate and necessary to regulate these sources under Clean Air Act (CAA) section 112. To evaluate these costs and benefits, the memo draws on the prior analysis of costs and benefits described in the 2011 Regulatory Impact Analysis (RIA) for the Mercury and Air Toxics Standards (MATS) final rule (U.S. EPA, 2011). EPA refers readers to the 2011 RIA for full details of the results presented below, including the underlying methodologies for deriving costs and benefits. The 2011 final rule RIA represents the best available information on the projected costs, benefits and impacts of the MATS rule at the time the Agency was making its regulatory decision. Thus, it provides the basis for assessing costs and benefits in the context of the section 112(n)(1)(A) determination of whether an appropriate and necessary finding was supportable as a prerequisite for the specific regulatory obligations imposed by the MATS rule.

Table 1 presents a summary of costs and the target pollutant benefits that EPA views as pertinent to the appropriate and necessary finding under section 112(n)(1)(A). Target pollutant benefits consist of the quantified and unquantified benefits from reductions in hazardous air pollutants (HAP). EPA also estimated that the MATS rule would result in ancillary benefits from the concomitant reduction of non-target pollutants. These include the quantified $PM_{2.5}$ co-benefits and other unquantified co-benefits that occur as a result of reductions of non-HAP emissions. However, for reasons described in the preamble, EPA views the HAP benefits, both quantified and unquantified, as the centrally relevant portion of the analysis for purposes of the appropriate and necessary finding. Therefore, in evaluating the net benefits of this proposed action, EPA has focused on the target pollutant impacts. The quantifiable portion of the target HAP benefits are not even moderately commensurate with the compliance cost of the rule, as the difference between costs and HAP benefits is substantial using either discount rate.

Table 1. Summary of 2016 Costs and Target HAP Benefits[a, b] (billions of 2007$) as estimated in 2011 MATS RIA

Description	Estimate (3% Discount Rate)	Estimate (7% Discount Rate)
Costs[c]	$9.6	$9.6
Target HAP Benefits[d]	$0.004 to $0.006 + B	$0.0005 to $0.001 + B
Net Benefits (target benefits-costs)	($9.6) to ($9.6) + B	($9.6) to ($9.6) + B

[a] All estimates represent annualized estimates of the benefits and costs of the final MATS in 2016.
[b] Estimates are rounded to two significant figures.
[c] Total social costs are approximated by the compliance costs.[d] B is the sum of all unquantified HAP benefits and disbenefits.

2. Costs and benefits in the context of section 112(n)(1)(A)

The RIA supporting the final MATS rule summarized estimates of costs as well as estimates of both quantified and unquantified benefits associated with reducing HAP and non-HAP air pollutants. A short summary of the key conclusions is provided below for costs, HAP benefits and ancillary non-HAP benefits. These three elements are discussed more completely in Chapters 3, 4, and 5 of the 2011 RIA.

a. Costs

These compliance cost estimates were established using the Integrated Planning Model (IPM). IPM, developed by ICF International, is a state-of-the-art, peer-reviewed dynamic, deterministic linear programming model of the contiguous U.S. electric power sector. IPM provides forecasts of least-cost capacity expansion, electricity dispatch, and emission control strategies while meeting electricity demand and various environmental, transmission, dispatch, and reliability constraints. The model is designed to reflect electricity markets as accurately as possible using the best available information from utilities, industry experts, gas and coal market experts, financial institutions, and government statistics. Notably, the model includes state-of-the-art estimates of the cost and performance of air pollution control technologies, including those for control of mercury and other HAP emissions.

In the MATS RIA, the power sector's "compliance costs" were estimated as the change in electric power generation costs between a base case without MATS and a policy case where the sector complies with the HAP emissions limits in the final MATS. The base case provided a future projection of the power sector in 2016 in the absence of MATS and served as the baseline against which projections under policy cases were compared. The policy case examined in the MATS RIA introduced the requirements of the rule as constraints on affected EGUs, which resulted in new projections of power sector outcomes under MATS. In simple terms, these compliance costs were an estimate of the increased expenditures by the entire power sector to comply with the EPA's requirements while continuing to serve a given level of electricity demand. These costs were summarized in Table 3-16 of the 2011 RIA, which is included below as Table 2. The costs of MATS in 2016 were estimated to be $9.6 billion (2007$).

Table 2. Detailed Compliance Costs in 2015 under MATS (billions of 2007$) as estimated in 2011 MATS RIA

Description	2015[a, b]
IPM Projection	$9.4
Monitoring/Reporting/Recordkeeping	$0.158
Oil-Fired Fleet	$0.056
Total	$9.6

[a] The year 2016 is the compliance year for MATS, though as we explain in later chapters, we use 2015 as a proxy for compliance in 2016 for IPM emissions and costs due to availability of modeling impacts in that year.
[b] Table 3-5 of the 2011 MATS RIA shows annualized compliance costs for MATS in 2015, 2020 and 2030. Annualized compliance costs over the time frame range from $7.4 to $9.6 billion (2007$).

In section 5 of the Executive Summary, the 2011 MATS RIA discussed several factors that may have introduced uncertainties in the projected compliance cost estimates. First, the projected compliance costs as defined above were used to approximate the social costs of this rule. The projected social costs of the rule may have differed and been higher or lower than the projected compliance costs because of preexisting distortions in the economy. Second, the compliance cost projections did not capture possible costs associated with employment shifts as workers are retrained at the same company or re-employed elsewhere in the economy. Third, the analysis did not include permitting costs associated with updating Title V permits. Finally, technological innovation was not incorporated into these cost estimates. As a result of these factors, the 2011 MATS RIA-based projected compliance cost estimates may be over- or under-estimated, with the direction of the potential bias being ambiguous.

b. Benefits

The 2011 MATS RIA estimated benefits were broken out into two separate categories: HAP benefits and criteria pollutant co-benefits. Here, for this proposed action, EPA has further distinguished between these categories of benefits: the HAP reductions, as the explicit focus of regulations to reduce emissions under CAA section 112, are described as "target pollutant" benefits, while the simultaneous reduction of non-HAP pollutants that occurs when the technology to control for HAPs is deployed are considered "ancillary" co-benefits. These ancillary co-benefits are outside the direct regulatory focus of CAA section 112.

c. Target pollutant benefits

Regulations under CAA section 112 are intended to reduce emissions of HAP. The EPA efforts at quantifying the HAP benefits of this rule focused on estimating the benefits of reducing mercury emissions because mercury is the only HAP controlled by this rule for which there were sufficient available analytic tools to conduct a national-scale benefits assessment. In particular, the RIA estimated the human health benefits associated with reducing maternal exposure to methylmercury among populations who consume self-caught freshwater fish. The monetized benefits from reductions in mercury emissions, calculated only for children exposed to recreationally caught freshwater fish, were expected to be $0.004 to $0.006 billion in 2016 using a 3% discount rate and $0.0005 to $0.001 billion using a 7% discount rate.

EPA also identified a number of unquantified HAP-related benefits of MATS in the 2011 RIA. There are other neurologic, cardiovascular, genotoxic, and immunotoxic effects associated

with exposures to mercury, including impacts on motor skills and attention/behavior, for which it was not possible to quantify the estimated value of the MATS rule. Additionally, deposition of mercury to waterbodies can also have an impact on ecosystems and wildlife; however, more research is required to link these ecological effects to ecosystem services and estimate an economic value of mercury reductions. Data and methodological limitations also prevented us from estimating the economic value of impacts from reductions in other HAP such as arsenic, benzene, cadmium, chlorine, formaldehyde, lead, manganese, nickel and selenium that may be emitted from coal- and oil-fired EGUs. These unquantified HAP benefits are represented by the letter "B" in Table 1.

d. Ancillary co-pollutant benefits

The 2011 MATS RIA quantified the number and economic value of $PM_{2.5}$-related premature deaths and illnesses. These benefits were calculated using a benefit-per-ton methodology derived from air quality model simulations of the MATS rule, as described in section 5.2.3 of the 2011 RIA. As reported in Table 5-19 of the 2011 RIA, EPA estimated that the ancillary co-pollutant benefits of the MATS rule would range between $37 and $90 billion with a 3% discount rate or between $33 and $81 billion with a 7% discount rate. The MATS RIA also considered an array of potential $PM_{2.5}$ ozone-related effects in qualitative terms, because sufficient data was not available to estimate these benefits. Such endpoints included $PM_{2.5}$-related reproductive and developmental effects, the incidence of $PM_{2.5}$-related cancer and cardiovascular endpoints including cerebrovascular events. Ozone-related effects not quantified included premature mortality, respiratory hospital admissions and emergency department visits, school absences, changes in outdoor worker productivity, cardiovascular, reproductive and developmental effects.

The estimated and quantified non-HAP co-benefits are subject to important uncertainties related to data gaps, model capabilities and scientific uncertainty. Table 5.4 of the 2011 MATS RIA summarizes a number of key uncertainties relevant to the analysis of criteria pollutant benefits. These include uncertainties related to underlying health impact functions. Specifically, uncertainties remain regarding the relationship between $PM_{2.5}$ exposure and the risk of premature death at low $PM_{2.5}$ concentrations. These uncertainties are particularly important because air quality has improved over time due to federal and state pollution control efforts, reducing the fraction of the U.S. population experiencing elevated $PM_{2.5}$ exposures. Furthermore, the data from the epidemiologic studies used for defining the concentration-response relationships do not reflect fully the lower levels of exposure that much of the U.S. population now faces. We are more confident in the magnitude of the risks estimated from simulated $PM_{2.5}$ concentrations that coincide with the bulk of the observed PM concentrations in the epidemiological studies that are used to estimate the benefits. Likewise, we are less confident in the risk estimated from simulated $PM_{2.5}$ concentrations that fall below the bulk of the observed data in these studies. As $PM_{2.5}$ continues to fall, a larger percentage of the population is exposed to levels occurring below the bulk of the observed data in these epidemiological studies.

To provide insight to the potential uncertainty in the estimated $PM_{2.5}$ mortality benefits at lower levels, in the 2011 MATS RIA EPA quantified the proportion of the benefits associated with concentrations below the lowest measured levels (LML) observed in the epidemiological studies used to quantify the concentration-response relationships. The LMLs for the studies used quantify the premature mortality relationship in the MATS rule were 7.5 $\mu g/m^3$ (Pope et al.

2002) and 10 $\mu g/m^3$ (Laden et al. 2006); in 2011 the annual primary NAAQS for $PM_{2.5}$ was 15.0 $\mu g/m^3$. In 2011, we estimated that between 73% of the benefits of the original regulation were *at or above* the LML of the Pope et al. 2002 study and 11% *at or above* the LML of the Laden et al. (2006) study. More information on these analyses are available in the 2011 RIA.

3. Total Costs and Benefits

The total costs and benefits of MATS can be summarized as shown in Table 3. As noted, EPA believes that for purposes of the appropriate and necessary finding, the most appropriate basis for comparison is the relative size of the target pollutant benefits, both quantified and unquantified, relative to the costs imposed by the rule. Thus, net benefits here are calculated as HAP benefits minus costs of the rule. To perform this assessment, EPA used the results presented in 2011 MATS RIA as this RIA contained the best available information on the projected costs, benefits and impacts of the MATS rule at the time the Agency was making its regulatory decision.

Table 3. Summary of Costs and Benefits[a, b] in 2016 (billions of 2007$) as estimated in the 2011 MATS RIA

Description	Estimate (3% Discount Rate)	Estimate (7% Discount Rate)
Costs[c]	$9.6	$9.6
Target HAP Benefits[d]	$0.004 to $0.006 + B	$0.0005 to $0.001 + B
Net Target Pollutant Benefits (HAP benefits-costs)[d]	($9.6) to ($9.6) + B	($9.6) to ($9.6) + B
Ancillary Co-benefits[d, e]	$37 to $90 +B	$33 to $81 +B

[a] All estimates represent annualized estimates of the benefits and costs of the final MATS in 2016.

[b] Estimates are rounded to two significant figures.

[c] Total social costs are approximated by the compliance costs.

[d] B is the sum of all unquantified benefits and disbenefits.

[e] Co-benefits are composed primarily of monetized PM-related health benefits. The reduction in premature fatalities each year accounts for over 90% of total monetized co-benefits. Benefits in this table are nationwide and are associated with directly emitted $PM_{2.5}$ and SO_2 reductions. The estimate of social benefits also includes CO_2-related benefits calculated using the social cost of carbon, discussed further in Chapter 5 of the 2011 MATS RIA.

4. References

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