ARGUED DECEMBER 10, 2013
DECIDED APRIL 15, 2014

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

WHITE STALLION ENERGY CENTER, LLC, et al., **Petitioners,** **v.** **UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,** **Respondent.**	**Case No. 12-1100, and consolidated cases**

DECLARATION OF JAMES E. STAUDT, PH.D., CFA

I, James E. Staudt, make the following declaration in support of the Motion of Industry Respondent Intervenors to Govern Future Proceedings, and declare under penalty of perjury that the following is true to the best of my knowledge, information and belief:

1. I am an engineer and Chartered Financial Analyst with decades of experience in all aspects of energy and air pollution control in the electricity generation sector, as reflected in my CV attached hereto as Exhibit 1. I conduct market studies for the air pollution control industry and, as part of my business,

routinely track the installation of air pollution control equipment on power plants. This is done by review of publicly available information and by direct interaction with people who work at air pollution control companies and at power companies.

2. As reflected in the report attached hereto as Exhibit 2, I have conducted a review of the actual costs that have been incurred by the power generation industry to comply with EPA's Mercury and Air Toxics Standards (the "Rule") and compared these costs to those that EPA estimated *ex ante* as reflected in EPA's Regulatory Impact Analysis ("RIA") for the final Rule.

3. The data regarding costs reflect the final data regarding actual compliance costs through June 30, 2015 and projections of additional measures that might be implemented by the extended deadline of April 2016 for complying with the Rule. The data reflect all existing contracts for the installation of any air pollution control systems that represented any material aspect of EPA's cost estimate in the RIA. Further, all contracts that would be required to install equipment to meet the requirements of the Rule by even the extended deadlines will have been executed and will be reflected in the publicly available data.

4. To the extent that a contract has not been executed for a generating unit operating under a compliance extension, the owner of the generating unit will plan to retire that unit or to use natural gas in lieu of coal or oil to fuel the unit.

5. Experience with technologies deployed for compliance with the Rule has shown them to be less expensive and more effective than originally assumed in EPA's analysis. Technological improvements and a lower price of natural gas than originally projected have further reduced costs. As a result, the true cost of complying with the Rule is approximately $7 billion per year less than estimated by EPA, making the true cost of the Rule approximately $2 billion or less than one-quarter of what EPA originally estimated the Rule to cost.

6. The reduced actual cost of meeting the Rule's emissions limits are due to the facts that: (1) improvements in dry sorbent injection ("DSI") and activated carbon injection ("ACI") technologies have significantly lowered the costs of those pollution control systems; (2) natural gas prices have been significantly lower than those upon which EPA's estimates were premised; and (3) EPA overestimated the generation capacity that would require installation of fabric filters (also known as baghouses), dry flue gas desulfurization ("FGD") systems and wet FGD upgrades. As a result of EPA's overestimate of the generation capacity requiring those systems, the amortized capital costs, costs associated with fuel changes, variable operating and maintenance costs, and fixed operating and maintenance costs associated with each of these systems were also overestimated. The effect has been that the actual costs have been significantly lower than EPA's *ex ante* estimates.

7. With respect to fabric filter installations, EPA's Air Markets Program Data show only about 82 GW of Electric Utility or Small Power Producer Generation equipped with baghouses for particulate matter control at the end of second quarter 2015. My firm and its clients, who include manufacturers of pollution control equipment, are aware of about 8.7 GW in capacity of additional fabric filter projects currently underway at power plants that received compliance extensions and are not associated with new FGD systems. In other words, the RIA overestimated the fabric filter installations by about 100 GW (191 GW of total fabric filter projected to be installed versus about 91 GW).

8. With respect to dry FGD, EPA's RIA forecast 51 GW of dry FGD to be installed in the Policy Case versus 29 GW in the Base Case, when, in fact, Air Markets Program Data show that at the end of second quarter 2015 there were only about 33 GW of dry FGD installed, so that the RIA overestimated the required installations by 18 GW. Although additional dry FGD installations are planned in the coming years, these are primarily being installed for Regional Haze Rules or for other SO_2 reduction needs.

9. With respect to wet FGD upgrades, EPA's forecast of 63 GW in wet FGD upgrades is also higher than the actual capacity that has been installed. In 2015 there was about 170 GW of wet FGD installed on coal-fired electric utility units or small power plants and just over 2 GW of additional wet scrubber capacity in

requested compliance extensions. On the other hand, a review of EPA's 2009 Information Collection Request data shows only about 7,600 MW of the roughly 52,000 MW of capacity with wet FGD installed that reported hydrochloric acid emissions to the Information Collection Request, or about 15%, had hydrochloric acid emissions in excess of the Rule's emissions limit. This would suggest only about 30 GW of wet FGD upgrades to be expected. About 16 GW of wet FGD upgrades have been identified in applications for compliance extensions. While there is no official data showing the level of wet FGD upgrades, it is reasonable to assume that at least 16 GW and no more than 30 GW of wet FGD upgrades will be performed for compliance with the Rule. To that point, most of the wet FGD upgrades were justified on the basis of improved SO_2 control for other regulatory programs such as the Cross-State Air Pollution Rule.

10. EPA's estimates for the operating costs associated with DSI and for ACI did not account for the improved performance of these reagents or sorbents in reducing the demand for reagent/sorbent or the cost of waste disposal. EPA also forecast an increase in fuel cost as natural gas replaced coal as utility fuels.

11. EPA's forecast Policy Case projected a cost of natural gas in 2015 of $5.66/MMBtu versus $5.40/MMBtu in its Base Case. Data from the Energy Information Administration indicates that in 2015 natural gas to utility customers has ranged from a high of$4.99/thousand cubic feet down to $3.24/thousand cubic

feet, or about \$4.99/MMBtu to about \$3.24/MMBtu because a cubic foot of gas has very close to 1,000 Btu's of energy. Therefore, much lower natural gas prices than forecast by EPA have made gas a much more attractive fuel and has resulted in the cost of compliance with the Rule to be much lower than anticipated.

12. Table 1 summarizes the overestimate in costs resulting from EPA's overestimate of the new air pollution control equipment that would be required to comply with the Rule:

Table 1. Approximate overestimate of costs

	FF [1]	dry FGD [2]	DSI [3]	wet FGD [4]	ACI [5]	Total
Capital, million\$	\$16,072	\$8,838	\$0	\$5,692	\$414	\$31,016
Annualized, capital, million\$	\$1,816	\$999	\$0	\$643	\$47	\$3,505
Operating costs, million \$	\$102	\$391	\$1,400	\$37	\$1,787	\$3,718
Total Annual Million \$	\$1,918	\$1,390	\$1,400	\$680	\$1,834	\$7,223

Notes:

1. *The overestimate of FF is the amount over actual installations that is not explained by dry FGD*
2. *Dry FGD estimate for excess dry FGD over actual installed*
3. *DSI estimate assumes that actual reagent is roughly one third of EPA assumption.*
4. *Wet FGD upgrade assumes 30 GW of actual upgrade versus 63 GW predicted. No formal data is available. Also factors in the fact that the actual reduction in wet FGD versus the Base Case was greater than forecast by EPA*
5. *Accounts for: EPA assumption about fly ash waste for facilities where fly ash is collected with carbon; higher carbon demand from units with ESP versus TOXECON because EPA assumed more TOXECON installations, which include new baghouses; overestimate of ACI installations after rule is fully implemented*

13. My analysis of the dramatic reductions in cost is also reflected in the securities filings of electricity generating companies, which show a consistent pattern of actual costs falling significantly below those that were originally projected, as reflected in Exhibit 3.

14. EPA's original estimate of cost of $9.6 billion per year in 2015 exceeds the actual cost to utilities by over $7 billion. These results are neither unusual nor are they surprising. In virtually all cases where *ex ante* estimates of the costs of complying with pollution control requirements are compared with actual pollution control costs, the actual costs are significantly lower than the costs originally estimated both by EPA and by industry, sometimes by an order of magnitude.

15. Moreover, at this point all fixed capital expenses have already been incurred or must be paid pursuant to existing contracts. Therefore, a large portion of the expense of the Rule is already committed. I have also conducted a rough bottom up estimate of the costs of the Rule, in which I have used conservative estimates. This estimate is that the total cost of the Rule is now slightly less than $2 billion per year, with almost half of that cost amortized capital that has already been committed. Thus, the remaining costs will likely be less than $1 billion.

16. Finally, the companies that supply activated carbon and DSI reagents have invested at least several hundred million dollars and perhaps close to one billion dollars in the United States into new manufacturing plants, plant expansions, additional personnel, and supply chain infrastructure in order to produce the materials necessary to meet the anticipated ongoing and future demand of the utility industry for these materials in complying with the Rule. These investments were necessary for the development and production of the improved reagents that

have enabled the utility industry to avoid many of the capital costs identified in paragraphs 7 through 9 and are also responsible for the reduction in operating costs associated with DSI and ACI as discussed in paragraph 10. In the event the Rule is vacated, this will dramatically reduce the demand for these products, have a severe negative impact on these companies and their employees, and will disrupt the ability of these companies to serve the electric utility and other markets in the future.

Dated: September 24, 2015

James E. Staudt

Exhibit 1

James E. Staudt, Ph.D., CFA

Dr. Staudt has been involved in the energy sector for several decades, and is a nationally-recognized expert in the energy and air pollution control and monitoring industries. He has experience that spans many aspects of power generation to include use of fossil energy, turbomachinery, nuclear energy, energy storage and process sensor development. His experience also spans other energy-intensive industries, such as Portland Cement, Refining, Iron & Steel, Pulp & Paper and others. Dr. Staudt has a deep knowledge of both the technical issues of the energy industry as well as economics and finance as they relate to this industry.

- Dr. Staudt has authored emissions control technology documents and software that are licensed by professionals in the United States, Europe, and Asia.
- He has worked with state and federal agencies on regulation of emissions from fossil fueled power plants and major industrial facilities.
- He has advised owners of energy and manufacturing facilities on how to most cost-effectively meet their environmental obligations.
- He has advised technology suppliers on business strategy, to include market analysis, mergers and acquisitions, and valuation of businesses.
- He has advised investors in energy and environmental sector companies.to include valuations
- Dr. Staudt is a reviewer for the Mass Ventures START program for the Commonwealth of Massachusetts. START is a program funded by the Commonwealth of Massachusetts to assist Massachusetts-based companies that have been successful in the Federal Small Business Innovation Research (SBIR) program.

Dr. Staudt's experience in the energy and air pollution sectors spans over three decades. Prior to starting his consulting practice, Andover Technology Partners (ATP), in 1997, Dr. Staudt was employed by suppliers of air pollution control or monitoring technology and energy industry equipment. At these employers he was in senior management roles and developed technologies that are widely used at industrial facilities. He was a founder of a process sensor and analyzer company. Previous employment also includes serving as a commissioned officer in the US Navy nuclear power program.

Dr. Staudt has published over 60 technical papers, articles or reports and has also authored numerous reports for clients as part of his consulting practice.

Education and Professional Credentials

- B.S. in Mechanical Engineering from the U.S. Naval Academy (1979)
- M.S. (1986) in Engineering from the Massachusetts Institute of Technology (M.I.T.)
- Ph.D (1987) in Engineering from the Massachusetts Institute of Technology (M.I.T.) with a minor in Business Management
- Chartered Financial Analyst (CFA) designation (2001)

Awards

2007 US Environmental Protection Agency Science and Technology Achievement Award

- *Providing the Public with a Comprehensive Summary of Technologies for Control of Mercury Emissions from Electric Utility Boilers*

Business and Professional Associations

- Member, CFA Institute
- Associate Member, Institute of Clean Air Companies

Military Service

From 1979 to 1984 Dr. Staudt served as a commissioned officer in the U.S. Navy in the Engineering Department of the nuclear-powered aircraft carrier USS ENTERPRISE (CVN-65), attaining the rank of Lieutenant (O-3) prior to leaving the service.

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James E. Staudt, Ph.D.

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Exhibit 2

Andover Technology Partners 978-683-9599
Consulting to the Air Pollution Control Industry

Review and Analysis of the Actual Costs of Complying With MATS in Comparison to Predicted in EPA's Regulatory Impact Analysis

At this point we are in a position to make a post-hoc assessment of what the cost has been to comply with US EPA's Mercury and Air Toxics Standards (MATS) for power plants. In its Regulatory Impact Analysis (RIA) for the final rule.[1] EPA estimated a cost for the rule of $9.6 billion (2007 dollars) versus quantified benefits of between $33 billion to $81 billion, depending upon discount rate (plus other unquantified benefits). The $9.6 billion annual cost is primarily the cost to control coal-fired units, at an estimated $9.4 billion. This $9.4 billion includes the following components:

- Amortized capital
- Costs associated with change in fuel
- Variable operating and maintenance (VOM)
- Fixed operating and maintenance (FOM)

These costs are estimated using the Integrated Planning Model (IPM), which is described later. The fuel costs are associated with the costs of switching to natural gas or to lower chlorine coal.

Experience with technologies deployed for MATS compliance has shown them to be less expensive and more effective than originally assumed in EPA's analysis. Technological improvements and a lower price of natural gas than originally projected have further reduced costs. As a result, the true cost of complying with the MATS rule is approximately $7 billion per year per year less than estimated by EPA, making the true cost of the rule approximately $2 billion, or less than one-quarter of what EPA originally estimated the Rule to cost.

Except for the fuel charge, EPA's forecast of the cost impact of the MATS rule is determined in large part by the forecast of installed air pollution control equipment, which is shown in Figure 1. This figure shows the forecast installations (expressed as GW of installed capacity) in the Base Case and forecast installations in the case of the MATS rule. As shown, EPA forecast a reduction in wet FGD systems (fewer FGD retrofits in the policy case than in the Base Case) and increases in dry FGD systems, FGD upgrades, increase in Dry Sorbent Injection (DSI), an increase in Activated Carbon Injection (ACI), and increases in Fabric Filters (FF) and ESP upgrades. These forecasts are determined using ICF International's Integrated Planning Model (IPM), which is described briefly in the insert on the following

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1 Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards, EPA-452/R-11-011, December 2011

page, and the methodology and assumptions for IPM are described in detail in the documentation found on EPA's web site.

Methods to comply with the regulation may include addition of control technology, changing fuels, or even retirement. For every technology considered EPA makes assumptions about the capital and operating cost of the technology and the performance of the technology with regard to emissions control performance. Costs for fuels are considered as well, and this is particularly important when an option is to change to different fuels. IPM selects the approach that provides the lowest cost to comply, or, alternatively, the highest future value for operation of the facility. IPM estimates the future dispatch of the facility based upon the economics of that facility relative to other facilities in the region. In cases where the facility is determined to be uneconomical to operate in the future, IPM will determine that the facility will be retired and electricity supplied from other sources.

According to the RIA issued with the final rule: *"This analysis projects that by 2015, the final rule will drive the installation of an additional 20 GW of dry FGD (dry scrubbers), 44 GW of DSI, 99 GW of additional ACI, 102 GW of additional fabric filters, 63 GW of scrubber upgrades, and 34 GW of ESP upgrades. . . . With respect to the increase in operating ACI, some of this increase represents existing ACI capacity on units built before 2008. EPA's modeling does not reflect the presence of state mercury rules, and EPA assumes that ACI controls on units built before 2008 do not operate in the absence of these rules. In the policy case, these controls are projected to operate and the projected compliance cost thus reflects the operating cost of these controls. Since these controls are in existence, EPA does not count their capacity toward new retrofit construction, nor does EPA's compliance costs projection reflect the capital cost of these controls (new retrofit capacity is reported in the previous paragraph)."*

EPA uses the Integrated Planning Model (IPM) to analyze the projected impact of environmental policies on the electric power sector in the 48 contiguous states and the District of Columbia. Developed by ICF Consulting, Inc. and used to support public and private sector clients, IPM is a multi-regional, dynamic, deterministic linear programming model of the U.S. electric power sector. It provides forecasts of least-cost capacity expansion, electricity dispatch, and emission control strategies for meeting energy demand and environmental, transmission, dispatch, and reliability constraints. IPM can be used to evaluate the cost and emissions impacts of proposed policiest o limit emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon dioxide (CO_2), and mercury (Hg) from the electric power sector. The IPM was a key analytical tool in developing the Clean Air Interstate Rule (CAIR).

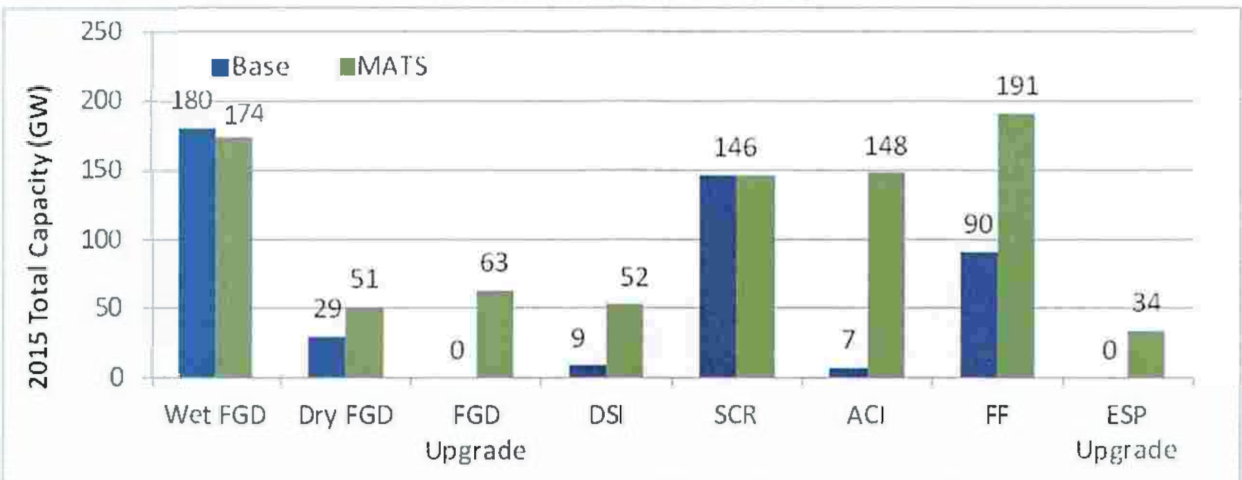
Among the factors that make IPM particularly well suited to model multi-emissions control programs are (1) its ability to capture complex interactions among the electric power, fuel, and environmental markets; (2) its detail-rich representation of emission control options encompassing a broad array of retrofit technologies along with emission reductions through fuel switching, changes in capacity mix and electricity dispatch strategies; and (3) its capability to model a variety of environmental market mechanisms, such as emissions caps, allowances, trading, and banking. IPM's ability to capture the dynamics of the allowance market and its provision of a wide range of emissions reduction options are particularly important for assessing the impact of multi-emissions environmental policies like CAIR.

http://www.epa.gov/airmarkets/progsregs/epa-ipm/

Now that we know what companies have done to comply with the MATS rule, we are in a position to determine how accurate this forecast was. There are a few things that stand out about the methods that were projected by EPA for industry to comply with the rule:

- The very high level of projected fabric filter systems
- The level of projected dry FGD systems
- The level of scrubber upgrades
- The high cost of dry sorbent injection ("DSI") and activated carbon injection ("ACI") systems that did not take account of technological advances reducing those costs
- The limited amount of fuel switching compared to actual levels driven by low shale gas prices

Figure 1. Operating Pollution Control Capacity on Coal-fired Capacity (by Technology) under the Base Case and with MATS, 2015 (GW)[2]



Fabric Filter- EPA's Air Markets Program Data shows only about 82 GW of Electric Utility or Small Power Producer Generation equipped with baghouses for particulate matter control at the end of second quarter 2015. Another 8.7 GW of fabric filter projects– not part of dry FGD projects - are underway with extensions for a total of perhaps 91 GW.[3] In other words, IPM overestimated the baghouse installations by about 100 GW (191 GW of total FF projected to be installed versus 91 GW) as shown in Figure 2. This is related to assumptions about DSI, dry FGD and the need for PM upgrades.

Dry FGD - IPM forecast 51 GW of dry FGD to be installed in the MATS policy case versus 29 GW in the Base Case when, in fact, AMPD data shows that at the end of second quarter 2015 there were only about 33 GW of dry FGD installed – or an overestimate of 18 GW as shown in Figure 2. Although there are an estimated 22 GW of dry FGD projects underway to be completed in the coming years and MATS extensions have been permitted associated with these projects,[3] these

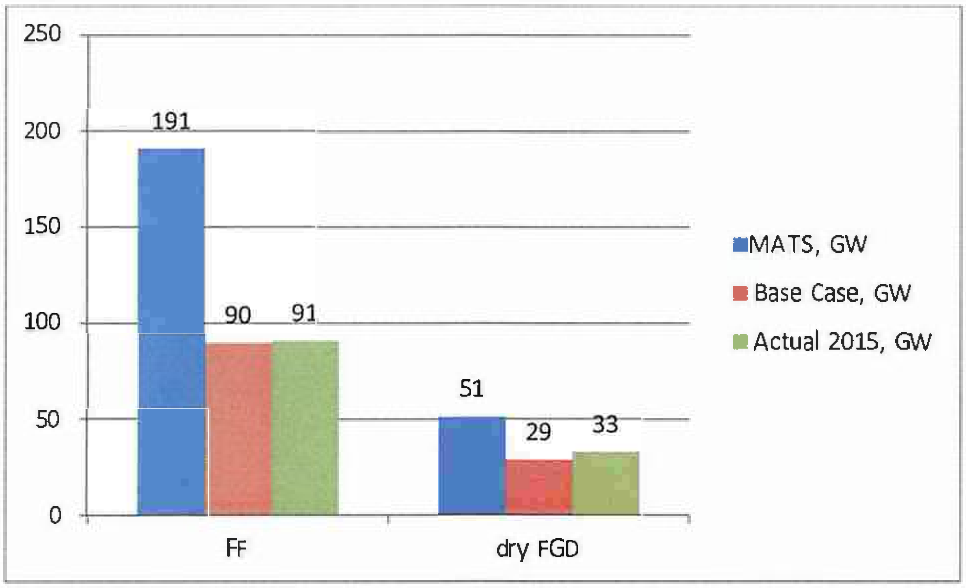
[2] Note: The difference between controlled capacity in the base case and under the MATS may not necessarily equal new retrofit construction, since controlled capacity above reflects incremental operation of dispatchable controls in 2015. Additionally, existing ACI installed on those units online before 2008 are not included in the base case to reflect removal of state mercury rules from IPM modeling. For these reasons, and due to rounding, numbers in the text below may not reflect the increments displayed in this figure. See IPM Documentation for more information on dispatchable controls.

[3] Michael J. Bradley and Associates, "MATS Compliance Extension Status Update", MJB&A Issue Brief, June 24, 2015. Examination of the underlying data showed that of the 17 GW of FF with extensions, 8.3 GW were associated with FGD systems, leaving 8.7 GW of FF not associated with FGD.

dry FGD systems are primarily part of plans for compliance with the Regional Haze Rule or other SO_2 control requirements.

Scrubber upgrades– EPA's forecast of 63 GW in wet FGD upgrades is higher than actual. In 2015 there was about 170 GWofwet FGD installed on coal fired electric utility units or small power plants. On the other hand, a review of the Information Collection Request (ICR) data shows only about 7,600 MW of the roughly 52,000 MW of capacity with wet FGD installed that reported HCl emissions to the ICR, or about 15%, had HCl emissions in excess of the MATS limit. This would suggest only about 30 GW of FGD upgrades to be expected. About 16 GW of scrubber upgrades have been identified in applications for MATS extensions.[3] While there is no official data showing the level of wet FGD upgrades, it is reasonable to assume that at least 16 GW and no more than 30 GW of scrubber upgrades were performed. To that point, most of the FGD system upgrades were justified on the basis of improved SO_2 control for CAIR or CSAPR rather than MATS.

Figure 2. MATS and Base Case projections, and 2015 actual or planned installations of FF and dry FGD, expected to be directly a result of MATS, GW



The projected fixed and variable operating costs are also impacted by the type of equipment projected to be used and the assumed reagent usage rates for this equipment. Of particular concern with regard to variable operating cost are reagent usage assumptions relating to dry sorbent injection (DSI).
This Report will review each of the following as they relate to EPA's projection of cost to the MATS rule.

- Capital and operating cost projections relating to EPA forecasts for DSI
- Capital and operating cost projections relating to EPA forecasts for dry FGD
- Forecasts for PM control retrofits to fabric filters
- Forecasts for ACI variable operating and maintenance costs

- Fuel cost projections

Projections for the capital and operating costs for Dry Sorbent Injection (DSI)

In practice, DSI may be deployed for control of SO_3, HCl or SO_2. For SO_3 control the DSI system may be deployed in combination with an ACI system to enhance the Hg capture of the ACI system. On the other hand, IPM only forecasts DSI systems for MATS compliance as a means for controlling HCl. Therefore, many of the DSI systems installed to enhance Hg control in response to the MATS rule were not installed to control the pollutant EPA targeted DSI for. By and large, DSI systems for SO_3 control, however, are quite inexpensive to own and operate compared to those used for SO_2 or HCl control as a result of the comparatively very low reagent demand necessary to control SO_3. Therefore, the costs of the DSI systems associated with SO_3 capture can be ignored when compared against these other costs.

DSI capital cost

EPA's assumptions regarding use of a fabric filter in combination with DSI and EPA's assumptions about DSI treatment rates for controlling HCl introduce a number of issues. As described in Section 5.5.3 of the IPM documentation, EPA assumes that facilities that select DSI for reduction of HCl emissions always install a fabric filter. Treatment rate is assumed by EPA to be at a Normalized Stoichiometric Ratio of 1.55 using milled Trona per Appendix 5-4 of the IPM v4.10 documentation.[4] Experience has shown that lower treatment rates are possible without the need to retrofit a fabric filter.

Sodium based sorbents, such as Trona actually improve ESP capture efficiency due to the beneficial impact on fly ash resistivity making a fabric filter retrofit unnecessary. In fact, very few DSI systems that have been installed in response to the MATS rule entailed installation of a fabric filter. EPA's overestimation of fabric filters is due in part to the assumption that use of DSI for HCl control requires a baghouse. Assuming that the 9 GW of DSI forecast in the Base Case does not have FF, this means that IPM forecast at least an additional 43 GW of DSI that was equipped with FF (52 GW projected in the policy case versus 9 GW in the Base Case). Fabric filters increase the installed cost of a DSI system by a substantial amount – costing on the order of \$150-\$250/kW, depending upon the size of the facility and other factors.

Although EPA assumed that a fabric filter would be necessary for control of HCl, it is also worth examining the capital costs EPA uses for use of DSI upstream of an ESP, because this is by far the most common application of DSI. Appendix 5-4 of the IPM documentation describes the cost estimating approach developed by Sargent & Lundy for use in the IPM.[4] This methodology predicts capital costs of \$40/kW for a 500 MW plant and costswell in excess of \$100/kW for plants of about 100 MW in size. Discussions of these costs with both utilities and technology providers indicates pretty clearly that these capital cost estimates are well above what has been experienced in practice. This may be the result of the overestimation of Trona demand – that would necessitate more equipment than in fact is necessary.

[4] Sargent & Lundy, "IPM Model – Updates to Cost and Performance for APC Technologies Dry Sorbent Injection for SO2 Control Cost Development Methodology Final", August 2010 Project 12301-007

DSI operating costs

DSI operating costs are also lower than estimated. EPA assumed that DSI would provide 90% HCl removal and would require a normalized stoichiometric ratio (NSR) of 1.55 when using DSI in combination with a baghouse for capturing HCl. Studies by Solvay[5] showed DSI achieving over 98% HCl removal at much lower treatment rates. They examined several sorbents at different milling levels.

- Trona (S200) - d50 : 30 µm
- Milled Trona (5250) - dS0: 1S µm, d90: 60 µm
- Milled Sodium Bicarbonate (S350) - dS0 : 12 µm, d90 : 40 µm
- Finely Milled Sodium Bicarbonate (S4S0) - d50: 7 µm ,d90: 17 µm
- Hydrated Lime - d90 : 45 µm, purity: 96.8%

Figures 3a and 3b show the results of pilot tests performed with injection upstream of an ESP and Figures 4a and 4b show the results of pilot tests performed with injection upstream of a baghouse. As demonstrated by Figure 3a, 90% HCl capture was achieved with milled Trona (D250) with an NSR or roughly 0.3 and 99% capture was achieved with an NSR of roughly 0.6. This compares to an assumed forecast of 1.55 for 90% capture. EPA's assumed treatment rate at 90% removal was therefore almost five times what is shown in this data. As demonstrated in Figure 3a, with an ESP milled trona produced 90% capture at an NSR of about 0.35 and 99% capture with an NSR of about 0.70. However, in this case much better performance was provided by the more reactive sodium bicarbonate (S350 and S450). While any given facility may experience slightly different results than shown in these pilot tests, it is clear that whether using trona or sodium bicarbonate it is possible to achieve well in excess of 90% without a fabric filter at treatment rates well below those assumed by EPA.

SO_2 capture is normally well below that of HCl because $5O_2$ is slower to react, and Figures 3b and 4b confirm that. At treatment rates where milled trona is expected to achieve 90% HCl capture, roughly 20% $5O_2$ capture is expected, and at treatment rates where 99% HCl capture is achieved, roughly 40% SO_2 capture is expected. These significant levels of SO_2 capture are nonetheless lower than the 70% assumed by EPA.

Another aspect of operating costs is waste disposal. EPA assumes that the by-product must be disposed of at a much higher cost than normally used for landfill of coal combustion products. This is an unnecessary cost because sodium by product can be blended or neutralized and disposed of as a non-hazardous waste at a much lower cost. Moreover, if this were a sufficiently large concern, the facility owner could use calcium-based reagent, such as hydrated lime, which produces a highly stable product.

Other factors that caused the IPM forecast of fabric filters to be too high was the result of overestimation of dry FGD, overestimation of waste disposal costs associated with ACI, and underestimation of the ability of existing ESPs to achieve the MATS PM emission standard with simple upgrades.

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5. Yougen Kong, Mike Wood, Solvay Chemicals Inc.," HCl Removal in the Presence of SO2 Using Dry Sodium Sorbent Injection", Houston, Texas, available at www.solvay.com

Figure 3a. HCl removal with injection upstream of an ESP

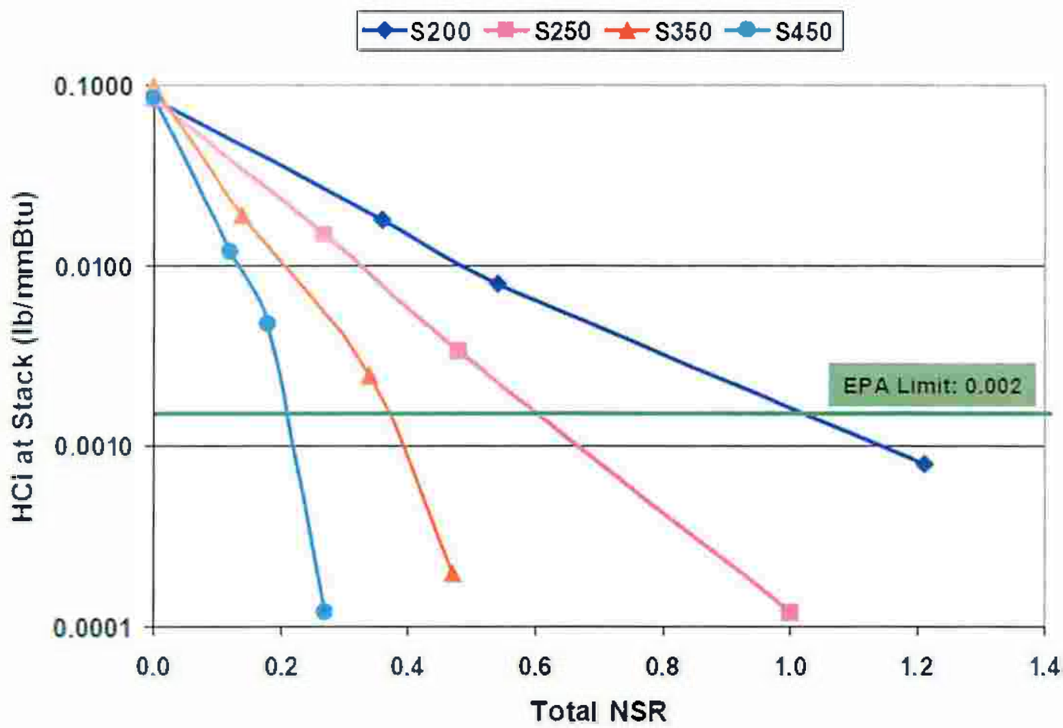


Figure 3b. SO_2 reduction with injection upstream of an ESP

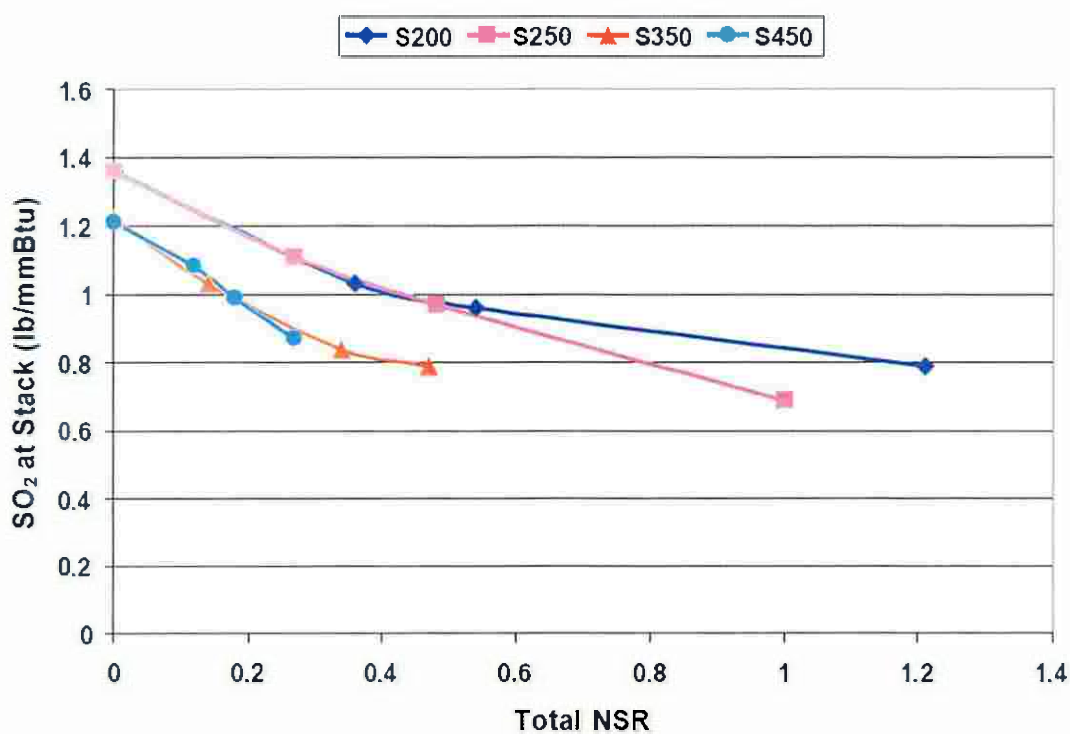


Figure 4a. HCl removal with injection upstream of baghouse

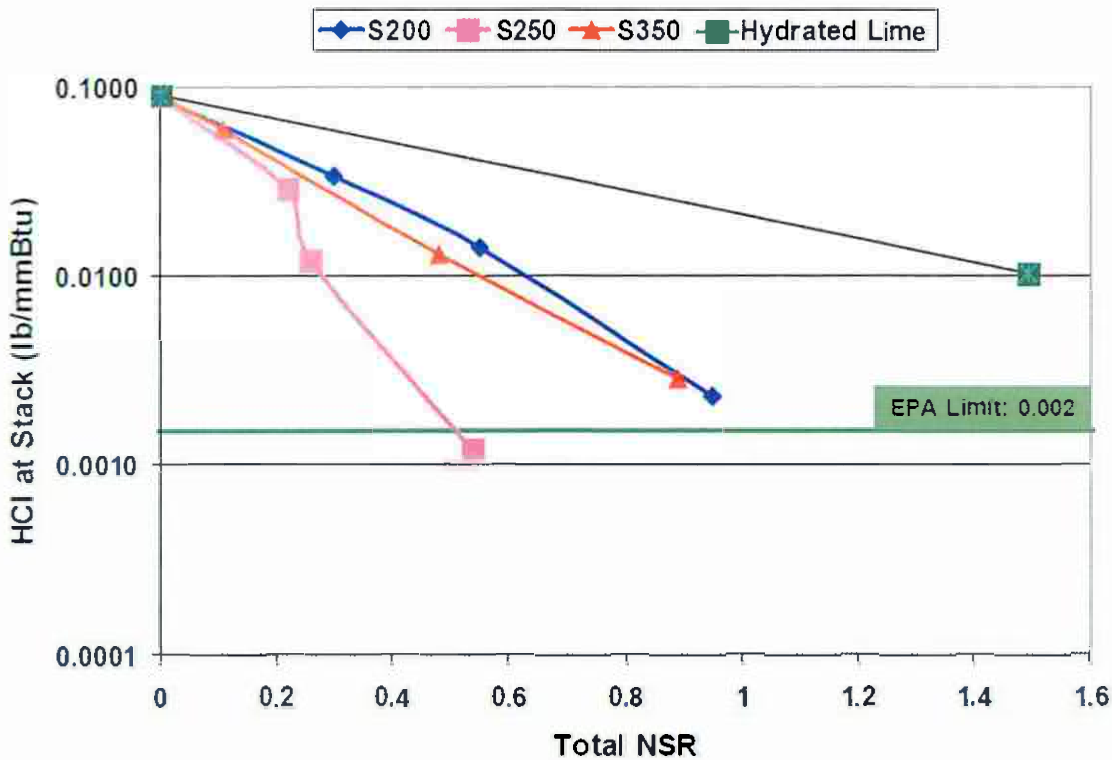
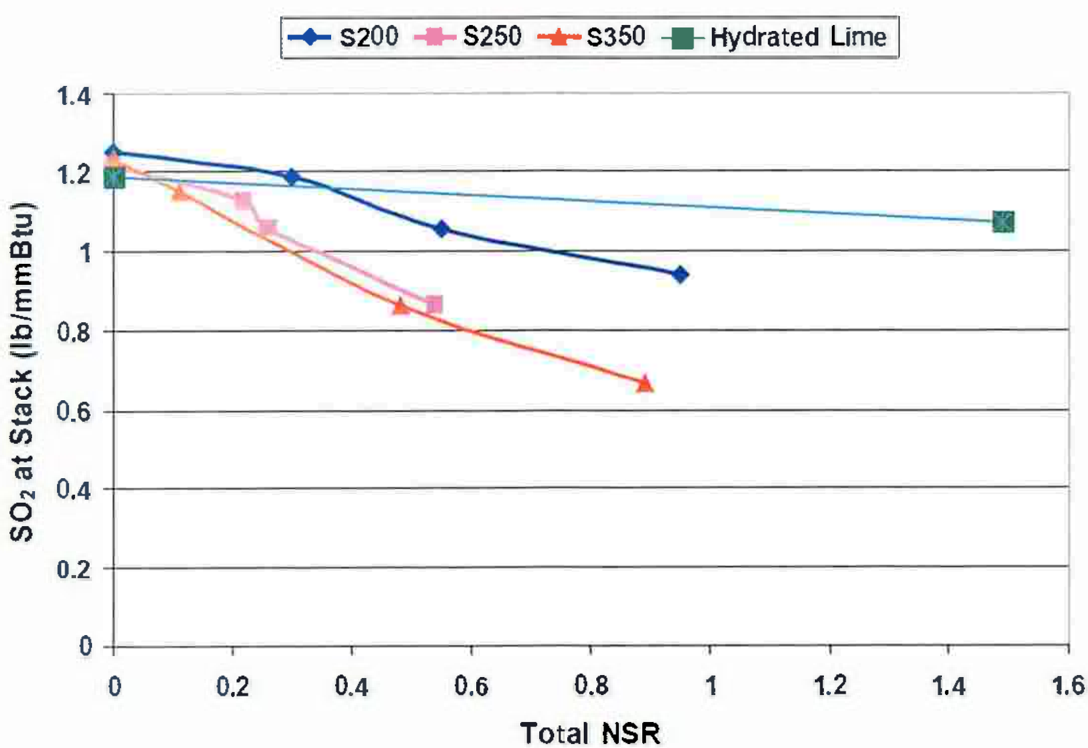


Figure 4b. SO_2 reduction with injection upstream of a baghouse



Projections for dry FGD

Dry FGD systems are commonly installed with fabric filters. As a result, an overestimation of dry FGD installations will result in an overestimation of fabric filter installations. The reason for the high forecast for dry FGD is likely the result of forecasts for DSI costs with a fabric filter (that may have made the incremental cost for dry FGD more acceptable) or the assumption by EPA that DSI is limited to only 90% HCl capture (that would force dry FGD to be selected by the IPM if greater than 90% HCl reduction was necessary). These assumptions would cause IPM to project that companies would select dry FGD for acid gas control rather than DSI in situations where DSI is, in fact, capable of providing adequate acid gas control. But, the effects of DSI and dry FGD can explain about 65 GW[6] of the roughly 100 GW of FF that were forecast but are not actually installed.

Projections for PM control

EPA's assumptions regarding DSI and dry FGD do not adequately explain the overestimation of fabric filters in their MATS cost estimate. EPA also made assumptions about the need to retrofit fabric filters for PM control to meet the MATS PM standard or for use in ACI systems. The assumptions for PM were used in a spreadsheet to identify facilities projected to need upgrade of their ESP or retrofit of a fabric filter. The projection developed with the spreadsheet was exogenously input to the IPM model to determine if improvement in PM collection efficiency was needed and, if so, what kind of improvement would be performed and what it would cost. In this manner that spreadsheet determined if a PM retrofit with a baghouse was necessary or if ESP upgrade was adequate. The approach used apparently underestimated the ability of the existing ESP to achieve the MATS PM emission standard. In fact, most ESPs were capable of achieving the emission standard without any modifications or with relatively modest changes– at most changes to the transformer rectifier sets and perhaps electrodes. In many cases rebalancing of flows was adequate at minimal cost.

The result is that EPA projected more fabric filter retrofits than were, in fact, built. EPA's modeling attributes 101 GW of FF to MATS versus the Base Case, some of which are attributed to dry scrubbers. Moreover, EPA also likely overestimated the cost of modifying existing ESPs to comply with the regulation. ATP's estimate of the market size for ESP upgrades in 2014 was only in the range of about $50 million based upon interviews with discussions with suppliers of these services and equipment.

ACI variable operating and maintenance costs

According to Appendix 5-3 to Chapter 5 of the IPM documentation,[7] EPA assumes that when activated carbon and fly ash are collected in the same PM control device that the cost of disposal for all solids – fly ash and activated carbon – are increased. The effect is that the projected cost of waste disposal exceeds that of the carbon sorbent – more than doubling the VOM. This is based upon the presumption that addition of activated carbon renders beneficial reuse of fly ash impossible. In practice, this does not

6 22 GW of additional dry FGD for MATS versus the Base Case plus 43 GW of additional FF on DSI for MATS versus the Base Case

7 Sargent & Lundy, "IPM Model – Revisions to Cost and Performance for APC Technologies Mercury Control Cost Development Methodology, Final", March 2011, Project 12301-009

happen. First, despite the desirability of beneficially reusing fly ash as a concrete additive, in practice most fly ash is not used for this purpose because of local market conditions or other reasons. Furthermore, activated carbon suppliers have developed "cement friendly" carbons that do not have the adverse impact of conventional carbons. The assumption that waste disposal costs increase so much may also partially account for the overestimate of fabric filters, as installation of an additional fabric filter would facilitate segregation of fly ash from activated carbon.

EPA also overestimated the ACI that is attributable to MATS–148 GW of ACI forecast for MATS versus 7 GW in the Base Case. According to ATP's estimates, *at least* 20 GW of ACI was in operation in 2014, clearly well over the 7 GW attributed by EPA to the Base Case. Furthermore, EPA's estimate of 148 GW of ACI exceeds somewhat ATP's estimates of total ACI systems, which is about 120 GW once MATS is fully implemented. ATP estimates that with the rule fully implemented, about 100 GW of ACI is attributable to MATS.

Fuel Costs

Facility owners will convert to natural gas or switch to higher cost coal if in their estimation this is a less costly approach to complying with the MATS rule. EPA's forecast Policy Case projected a cost of natural gas in 2015 of $5.66/MMBtu versus $5.40/MMBtu in its Base Case. Data from the Energy Information Administration indicates that in 2015 natural gas to utility customers has ranged from a high of $4.99/thousand cubic feet down to $3.24/thousand cubic feet, or about $4.99/MMBtu to about $3.24/MMBtu because a cubic foot of gas has very close to 1,000 Btu's of energy. Therefore, much lower natural gas prices than forecast by EPA have made gas a much more attractive fuel and has resulted in the cost of compliance with the rule to be much lower.

Impact on cost

A rough estimate of the impact on cost of the various assumptions addressed in this memo is shown in Table 1. This shows the estimated excess costs associated with:

- the fabric filter overestimate that is not associated with dry FGD,
- the overestimate of dry FGD
- the overestimate of reagent consumption associated with DSI
- the overestimate of capital cost associated with wet FGD upgrades,
- the overestimate associated with waste disposal assumptions for ACI,
- an adjustment to account for the underestimate of carbon use if the facilities that are assumed to install TOXECON systems do not,
- the overestimate of the ACI systems attributable to the MATS rule

Section 8 of the IPM documentation states that a capital charge rate of 11.3% is used for environmental retrofits, which is what is used to determine amortized capital charges. the assumed capacity factor is 65%. Cost estimates are developed using capital costs ($/kW), VOM ($/MWh) and FOM ($/kW-yr) rates taken from the IPM v4.10 documentation used to develop the MATS rule. The fabric filter overestimate is clearly the most significant, followed by the overestimate of dry FGD and the overestimate associated with DSI.

The overestimate of FF that is not explained by dry FGD is 82 GW. 43 GW of this is explained by DSI attributed to MATS, leaving 40 GW unexplained by DSI or dry FGD. This results in an additional 40 GW that can be ACI systems in TOXECON arrangements. As a result, there are roughly 101 GW (141 GW – 40 GW) that are ACI systems without TOXECON that where waste-disposal costs are overestimated. This is offset in part by the underestimate of sorbent costs if the 40 GW of forecast TOXECON systems are made to be conventional ACI systems upstream of an ESP.

Table 1. Approximate overestimate of costs

	FF [1]	dry FGD [2]	DSI [3]	wet FGD upgrade [4]	Wet FGD [5]	ACI Waste [6]	ACI carbon [7]	ACI excess [8]	Total
million$	$16,072	$8,838	$0	$4,700	$992	$0	$0	$414	$31,016
Annualized, capital, million $	$1,816	$999	$0	$531	$112	$0	$0	$47	$3,505
Operating costs, million$	$102	$391	$1,400	$0	$37	$1,196	-$207	$798	$3,718
Million$	$1,918	$1,390	$1,400	$531	$149	$1,196	-$207	$845	$7,223

Notes:

1. *The overestimate of FF is the amount over actual installations that is not explained by dry FGD*
2. *Dry FGD estimate for excess dry FGD over actual installed*
3. *DSI estimate assumes that actual reagent is roughly one third of EPA assumption.*
4. *Wet FGD upgrade assumes 30 GW of actual upgrade versus 63 GW predicted. No formal data is available.*
5. *The actual reduction in wet FGD versus the Base Case was greater than forecast by EPA*
6. *Accounts for EPA assumption about fly ash waste for facilities where fly ash is collected with carbon*
7. *Accounts for higher carbon demand from units with ESP versus TOXECON. EPA assumed more TOXECON installations, which include new baghouses.*
8. *Accounts for overestimate of ACI installations after rule is fully implemented. Only includes carbon for VOM as waste already addressed.*

Conclusion

Experience with technologies deployed for MATS compliance has shown them to be less expensive and more effective than originally assumed in EPA's analysis. As a result, the true cost of complying with the MATS rule is more than $7 billion per year less than estimated by EPA, making the true cost of the rule about one quarter of what EPA originally estimated the rule to cost.

Exhibit 3

Company	Original Compliance Cost Estimates	Actual Cost of Compliance
FirstEnergy	Respecting the pending maximum achievable control of technology rules for mercury and hazardous air pollutants, *we still expect investments of about $2 billion to $3 billion in our generation fleet to comply*. Our investments are expected to primarily focus on reducing mercury, and particulate emissions at our supercritical units. – 2011 Q3 Earnings Call, Anthony Alexander CEO Now last year, I told you that our spend – *our capital spend was $2 billion to $3 billion to comply with this rule when it was MACT. Now that we understand the rule and we've dug into it and analyzed the situation more deeply, we are right now looking at a $1.3 billion to $1.7 billion spend to comply*. And we continue to work further to reduce that cost. And we will be in compliance by the spring of 2015. – 2011 Q4 Earnings Call, James H. Lash The new MATS were finalized at the end of 2011, ... *Our current estimate is that it may cost approximately $1.3 - $1.7 billion to bring our remaining units into compliance*.-- 2012 10-K As a result of this analysis, we have significantly reduced our projected capital investment related to MATS compliance. *We now estimate investment of about $975 million across our Fossil Fleet. This is down from the $1.3 billion to $1.7 billion estimate we provided in February and well below our initial projections of $2 billion to $3 billion*. While we still have work to do to confirm and refine our current estimate, we're clearly moving in the right direction. – 2012 Q2 Earnings Call, Anthony Alexander, CEO "As a result of this analysis, we have significantly reduced our projected capital investment related to MATS compliance. *We now estimate investment of about $975 million across our Fossil Fleet. This is down from the $1.3 billion to $1.7 billion estimate we provided in February and well below our initial projections of $2 billion to $3 billion*. While we still have work to do to confirm and refine our current estimate, we're clearly moving in the right direction. – 2012 Q2 Earnings Call, Tony Alexander We also significantly decreased our competitive cost structure. Annual operating expenses have been reduced through our continued focus on managing fuel costs and O&M expense. And more importantly, our projected capital spending in the generation group over the next several years has been reduced by more than	On December 28, 2012, the WVDEP granted a conditional extension through April 16, 2016 for MATS compliance at the Fort Martin, Harrison and Pleasants stations. On March 20, 2013, the PADEP granted an extension through April 16, 2016 for MATS compliance at the Hatfield's Ferry and Bruce Mansfield stations. In December 2014, FG requested an extension through April 16, 2016 for MATS compliance at the Bay Shore and Sammis stations and await a decision from OEPA. In addition, an EPA enforcement policy document contemplates up to an additional year to achieve compliance, through April 2017, under certain circumstances for reliability critical units. MATS was challenged in the U.S. Court of Appeals for the D.C. Circuit by various entities, including FirstEnergy's challenge of the PM emission limit imposed on petroleum coke boilers, such as Bay Shore Unit 1. On April 15, 2014, MATS was upheld by the U.S. Court of Appeals for the D.C. Circuit, however, the Court refused to decide FirstEnergy's challenge of the PM emission limit imposed on petroleum coke boilers due to a January 2013 petition for reconsideration still pending but not addressed by EPA. On November 25, 2014, the U.S. Supreme Court agreed to review MATS, specifically, to determine if EPA should have evaluated the cost of MATS prior to regulating. Depending on the outcome of the U.S. Supreme Court review and how the MATS are ultimately implemented, *FirstEnergy's total capital cost for compliance (over the 2012 to 2018 time period) is currently expected to be approximately $370 million (CES segment of $178 million and Regulated Distribution segment of $192 million), of which $133 million has been spent through 2014* ($56 million at CES and $77 million at Regulated Distribution). --201410-K, p. 16 *We're investing $370 million in upgrades to comply with MATS. Most of [the investments] will have been made by the time the Supreme Court rules*. – First Energy spokeswoman Stephanie Walton in March 30, 2015 in RTO Insider article

Company	Original Compliance Cost Estimates	Actual Cost of Compliance
	$1 billion through our recent actions. *This includes additional reductions in our expected spend for compliance with Mercury and Air Toxics Standards, which is now at $465 million across the entire generation fleet, with only an estimated $240 million at our competitive units.* The majority of the remaining capital will be invested in projects to extend the life of our nuclear assets, with new steam generators at Davis-Besse in 2014 and new steam generators and reactor head at Beaver Valley 2 in 2017. – 2013 Q3 Earnings Call, Anthony Alexander, CEO	
Southern Company	As you'll recall, we previously provided a MATS compliance capital projection of up to $2.7 billion for the 2012 through 2014 time frame. We also indicated that this amount could be reduced by $500 million to $1 billion, depending primarily on the number of baghouses in our final compliance strategy, bringing the final number to between $1.7 billion and $2.2 billion.... *Based on our current analysis, our projection for MATS compliance for 2012 through 2014 now totals $1.8 billion, representing a reduction of $900 million from our previous estimates.* While the number of baghouses has been reduced to 4 or 5 from a high of as many as 17, other costs have been added to our plan to reflect the need for additive injection systems and related plant modifications. As before, this plan also includes significant investment in transmission projects as well as fuel switching to natural gas. – 2012 Q2 Earnings Call, Art Beattie, CFO So it's – so at least in terms of kind of what we said before with respect to MATS, we said $2.7 billion. And then we-- as we got kind of the new rule, not the proposed rule, we said it could be between *$0.5 billion or $1 billion less, and therefore, we said $1.7 billion to $2.2 billion. Well, sure enough, it ended up at $1.8 billion. When you think about the total amount of CapEx, it was $18.2 billion or $18.3 billion, and now we kind of think it's going to be $16.4 billion, $16.3 billion, somewhere in that realm.*-- 2012 Q2 Earnings Call, Thomas Fanning, CEO With respect to the impact of the MATS rule on capital spending from 2012 through 2014, the Southern Company system's preliminary analysis anticipates that potential incremental environmental compliance capital expenditures to comply with the MATS rule are likely to be substantial and could be up to *$2.7 billion from 2012 through 2014*. – 2012 10-K p. II-22	The Company has developed a compliance plan for the MATS rule which includes reliance on existing emission control technologies, the construction of baghouses to provide an additional level of control on the emissions of mercury and particulates from certain generating units, the use of additives or other injection technology, the use of existing or additional natural gas capability, and unit retirements. Additionally, certain transmission system upgrades are required. 2015 10-K p II-134 The Southern Company system expects that capital expenditures to comply with environmental statutes and regulations will total approximately *$2.1 billion from 2015 through 2017, with annual totals of approximately $1.0 billion, $0.5 billion, and $0.6 billion for 2015, 2016, and 2017*, respectively. – 2015 10-K p. II-22 Southern Company has made about *$9 billion in investments in environmental control technology and anticipates spending an additional $2.1 billion over the next three years to comply with MATS* and other environmental regulations – Southern Company spokesman Jack Bonnikson to Bloomberg BNA via e-mail for April 2015 article

Company	Original Compliance Cost Estimates	Actual Cost of Compliance
AEP	Estimating the capital spend for our environmental effort. *Originally, we started with a $6 billion to $8 billion anticipated capital outlay for these types of requirements. And that changed, from $5 billion to $7 billion, over a period of time when the EPA came up with the – came out the rules, particularly on particulate matter.* We had one situation where, instead of achieving 99.7% removal rate, the proposed rule was saying you had to achieve 99.9%, and that 0.2% was costing us about $800 million. So the EPA did listen and made the adjustments, so that adjusted reduction down as a result. *And then now, we're saying the cost is going to be from $4 billion to $5 billion.* And we've looked at technologies. We believe from a compliance standpoint that we can achieve further compliance reductions as a result of technology improvements, but also how we run the generation. So those are the kinds of things that we're looking at as well. – 2012 Q4 Earnings Call, Nicholas Akins, CEO *So we believe it's going to be $4 billion to $5 billion, and we're committed to continuing down that process. But now, right now, it says $4 billion to $5 billion*.–2012 Q4 Earnings Call, Nicholas Akins, CEO "So we continue to also move forward on the EPA-related mandates, such as Mercury HAPs MACT and others, as we transition our fleet with the planned . . . retrofits and refueling of 11,000 megawatts at a cost of around $*4 billion to $5 billion over the 2012 to 2020 time period.* -2013 Q1 Earnings Call, Nicholas Akins, CEO	Emissions of nitrogen and sulfur oxides, mercury and particulates from fossil fueled generation plants are subject to increased regulations, controls and mitigation expenses. Compliance with these legal requirements requires us to commit significant capital toward environmental monitoring, installation of pollution control equipment, emission fees and permits at all of our facilities and could cause us to retire generating capacity prior to the end of its estimated useful life. . . . *If we retire generation plants prior to the end of their estimated useful life, there can be no assurance that we will recover the remaining costs associated with such plants. We typically recover our expenditures for pollution control technologies, replacement generation, undepreciated plant balances and associated operating costs from customers through regulated rates in regulated jurisdictions.* --2014 10-K p 41 (See table below as well) We continue to refine the cost estimates of complying with these rules and other impacts of the environmental proposals on our coal-fired generating facilities. *Based upon our estimates, additional investment to meet these proposed requirements ranges from approximately $2.8 billion to $3.3 billion through 2020. These amounts include investments to convert some of our coal generation to natural gas..* – 2014 10-K p 10

Company	Original Compliance Cost Estimates	Actual Cost of Compliance
DTE	These rules have led to additional controls on fossil-fueled power plants to reduce nitrogen oxide, sulfur dioxide, mercury and other emissions. To comply with these requirements, DTE Electric has spent approximately $1.9 billion through 2012. *The Company estimates DTE Electric will make capital expenditures of approximately $335 million in 2013 and up to approximately $1.6 billion of additional capital expenditures through 2020 based on current regulation* – 2012 10-K p 90	DTE Electric is subject to the EPA ozone and fine particulate transport and acid rain regulations that limit power plant emissions of sulfur dioxide and nitrogen oxides. The EPA and the State of Michigan have issued emission reduction regulations relating to ozone, fine particulate, regional haze, mercury, and other air pollution. These rules have led to controls on fossil-fueled power plants to reduce nitrogen oxide, sulfur dioxide, mercury and other emissions. *To comply with these requirements, DTE Electric spent approximately $2.2 billion through 2014. The Company estimates DTE Electric will make capital expenditures of approximately $100 million in 2015 and up to approximately $30 million of additional capital expenditures through 2019 based on current regulations.* – 2014 10-K p 25 Estimated $400 million capital investment for environmental compliance for the years 2015-2019 – August 2015 Business Update
PPL	...from an environmental perspective, I think you're aware that on a competitive fleet side, we're very well equipped to deal with the MATS and the CSAPR. *So we're not looking at any major new incremental investments on the environmental side.*- 2012 Q1 Earnings Call, William Spence, CEO Now that we've signed contracts with various vendors, we've updated our estimate of capital spending necessary to complete our previously discussed environmental compliance projects [MATS and CSAPR]. *We now estimate these projects will come in closer to $2.5 billion, a reduction of $500 million from our original forecast.* We're able to deliver these savings to customers in Kentucky because we proactively addressed EPA regulations and were able to secure bids before others. - 2012 Q3 Earnings Call, William Spence, CEO "I think at this juncture, we don't see a lot of incremental CapEx required on the environmental front, for either Brunner Island or Montour stations in Pennsylvania. I think we are in fairly decent shape. There is some related to the math. Really, folks more around mercury control than it is around SOX or NOX. So at this point, I don't see any significant addition that we would need to make." – Q1 2014 Earnings Call, William Spence, CEO	LG&E, KU and PPL Energy Supply have received compliance extensions for certain plants. PPL, PPL Energy Supply, LKE, LG&E and KU are generally well-positioned to comply with MATS, primarily due to recent investments in environmental controls at PPL Energy Supply and approved ECR plans to install additional controls at some of LG&E's and KU's Kentucky plants. With respect to PPL Energy Supply's Pennsylvania plants, PPL Energy Supply believes that installation of chemical additive systems and other controls may be necessary at certain coal-fired plants, the capital cost of which is not expected to be significant. PPL Energy Supply continues to analyze the potential impact of MATS on operating costs. *PPL Energy Supply is retrofitting the scrubbers at its Colstrip, Montana plant, the cost of which is not expected to be significant..... LG&E's and KU's anticipated retirement of certain coal-fired electricity generating units located at Cane Run and Green River is in response to MATS and other environmental regulations. The retirement of these units is not expected to have a material impact on the financial condition or results of operations of PPL, LKE, LG&E or KU....*– 2014 10-K p 102

Company	Original Compliance Cost Estimates	Actual Cost of Compliance
Duke Energy	One of the reasons that we were pursuing the variance from the Multi-Pollutant Standard with the Illinois Pollution Control Board was in fact that we were able to comply with the MATS rules without that scrubber. And it was really these Illinois rules that were imposing the need to construct that scrubber... *So, we do believe that the capital expenditure plans that we've laid out, will -- while as to comply with MATS.* And it's really a function of a number of things. It's a function of the investments that we've already made in our plans overtime. We've made significant investments in pollution control equipment... We also burned low sulfur coal, which helps with our overall emissions. And as a result of compliance with the Multi-Pollutant Standard Illinois we are already using significant amounts of activated carbon for control of mercury. *So, through the -- I'd say the compliance with the Multi-Pollutant Standard, we've actually built into our operations of those things that are needed to comply with the MATS rules.* – Q3 2012 Earnings Call, Marty Lyons, Senior Vice President and CFO "At the end of this year we expect to have retired more than 3800 megawatts of this capacity. *As a combined company we have already invested around $7 billion in control equipment for our existing coal plants positioning now for compliance with more stringent air emission regulations. However we estimate we will spend an additional $5 billion to $6 billion over the next decade to comply with pending environmental regulations on air, water and coal ash.*" – Q4 2012 Earnings Call, Jim Rogers As a group, these non-GHG environmental regulations will require the Duke Energy Registrants to install additional environmental controls and accelerate retirement of some coal-fi red units. While the ultimate regulatory requirements for the Duke Energy Registrants from the group of EPA regulatory actions will not be known until all the rules have been finalized, for planning purposes, the Duke Energy Registrants *currently estimate the cost of new control equipment that may need to be installed to comply with this group of rules could total $5 billion to $6 billion, excluding AFUDC, over the next 10 years. This range includes estimated costs for new control equipment necessary to comply with the MATS of $650 million to $800 million.*–2012 10-K p 67 *$1.4 billion in environmental capex from '13-'15 (Includes $600-$650 million for MATS compliance)* –2013 Analyst Meeting *Anticipated ~$5-6 billion in compliance costs for approved or pending air, water, and waste regulations over the next 10 years* – Q2 2014 Earning Review and Business Update	Duke Energy Registrants are on track to meet the requirements. Strategies to achieve compliance include installation of new air emission control equipment, development of monitoring processes, fuel switching and acceleration of retirement for some coal-fired electric-generation units. – 2015 Q210-Q p 116 "As of June 30, we now have total ARO obligations of *$4.5 billion*, which represents our best estimate to comply with state and federal rules. These costs will be spent over the next several decades. We will continue to refine this estimated liability as plans are finalized." Q2 2015 Earnings call, Steve Young, EVP, CFO "Duke Energy is currently reviewing today's ruling by the Supreme Court... *at this time, there will be no immediate effect on Duke Energy's MATS compliance program. All Duke Energy power plants will continue existing compliance activities.*" – June 29, 2015 Spokesman Chad Eaton, via email for an article in Platts

AEP 2014 10K p 13

Historical and Projected Environmental Investments

	2012 Actual	2013 Actual	2014 Actual	2015 Estimate	2016 Estimate	2017 Estimate
			(in thousands)			
Total AEP (a)	$ 241,000	$ 424,200	$ 539,800	$ 661,000	$ 401,000	$ 531,000
APCo	52,400	44,800	31,300	70,000	53,000	151,000
I&M	30,000	28,300	51,400	40,000	49,000	84,000
OPCo (b)	70,300	129,300	—	—	—	—
PSO	26,300	56,100	72,100	85,000	49,000	9,000
SWEPCo	24,200	135,700	225,300	316,000	86,000	66,000