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COALCAST

FUELCAST

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Subject: Coal Fired Power Investment in Air Pollution Controls

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U.S. power industry has made significant capital investments in air pollution control technologies to remove sulfur dioxide (SO<sub>2</sub>), particulate matter, and nitrogen oxide (NO<sub>x</sub>) emissions at their coal-fired power plants. Through 2008, these capital investments have reached roughly \$90 Billion (nominal\$) (\$32 Billion in SO<sub>2</sub> control equipment, \$31 Billion in particulate controls and \$27 billion in NO<sub>x</sub> controls) at existing coal plants alone. The bulk of these investments have been made to comply with evolving environmental regulations that were adopted after the plants were originally built and placed online. An additional \$6 Billion will be added associated with new plants under construction or permit ready. These environmental capital investments will accelerate significantly with future carbon and mercury control regulations. In addition to these large capital investments, the coal plants can spend more than half of their annual non-fuel operating and maintenance budget on operating these environmental control systems.

The capital investments were developed from industry supplied costing data from Energy Information Association Form EIA-767data<sup>1</sup>, the Environmental Protection Agency's Clean Air Markets Continuous Emissions Monitoring Systems Database<sup>2</sup>, and public environmental control announcements from electric facility owners. In 2006, U.S. power industry reported environmental capital investments of \$16 Billion in flue gas desulfurization (FGD) technology (to remove SO<sub>2</sub>) and \$32 Billion for particulate controls systems on their coal-fired stations through 2005. However,

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<sup>1</sup> Energy Information Agency: EIA-767 <http://www.eia.doe.gov/cneaf/electricity/page/eia767.html>

<sup>2</sup> Environmental Protection Agency - Emissions data <http://camddataandmaps.epa.gov/gdm/>

this capital investment data filing requirement on the EIA Form 767 was discontinued in 2006 and transferred to an expanded EIA form 860. However, EIA no longer provides the environmental capital investment data in their published Form 860 database. Therefore, an alternate approach was adopted to estimate air pollution control investments between 2006-2008. This period not covered by existing published governmental data experienced large retrofit environmental control investments in anticipation of tightening emission cap requirements (e.g. from loss of supplemental pool NO<sub>x</sub> allowances, upcoming Clean Air Interstate Rule limits).

Post 2005 coal-fired air pollution control investments were estimated from a detailed collection of cost data from public announcements of air pollution control projects that came online during 2006-2008. EVA found that the power industry invested \$16 Billion of FGD's and \$.291MM in particulate controls at coal-fired power plants from 2006 through 2008. Combing the EIA-767 data with the public announcements, the total investment of FGD's and particulate controls through 2008 is \$32 Billion and \$31Billion, respectively.

While capital investments in FGD and particulate controls are reported, there was not a similar data filing requirement for capital investments in NO<sub>x</sub> controls. EVA established the total post combustion NO<sub>x</sub> control investments at existing coal-fired power plants to be \$23.7 Billion with an average cost of \$300/kW. EVA made use of a combination of it's collection of electric facility public announcements and the EPA's Continuous Emissions Monitoring Systems Database to calculate the total investment. The EPA data identified NO<sub>x</sub> controls on 121GW of existing coal-fired capacity, of which selective catalytic (SCR) and non-catalytic reduction (SNCR) accounted for 104GW and 17GW of capacity, respectively. EVA's compiled list of NO<sub>x</sub> investments from public announcements accounted for 98GW of SCR capacity. The 6 GW of SCR retrofit costs in which there were no public costing information was estimated based upon other units of similar size and furnace type.

In addition to the post combustion NO<sub>x</sub> controls, coal fired utilities had to invest in low NO<sub>x</sub> burners as part of their *Clean Air Act* Acid Rain program requirements. These low NO<sub>x</sub> controls were estimated to have cost roughly \$10/kW with a total industry investment of \$3.2 billion and were primarily made during the periods 1993-1995 and 1998-2000.

These environmental control investments will continue to grow as environmental requirements continue to tighten. As shown in the attached Figure, a new plant will spend roughly \$400/kW or 16 percent of the total new coal-fired power plant investment on environmental controls. Therefore, the 29 new coal plants currently under construction (16,415 MW) will spend an additional \$5.1 billion for their air pollution controls systems. Another 7 coal plants are expected to start construction within the next 2 years that will have \$1.7 billion in environmental controls.

Should new carbon control requirements be adopted in response to climate change concerns, a coal plant’s environmental control costs would increase to more than \$1,850/kW or 47 percent of the new project cost.

Outside the capital investment costs, a new plant also spends roughly 51 percent of their non-fuel operating expenditures on air pollution control operations<sup>3</sup>—roughly \$4.75/MWh.

Figure 1.

**Emission Controls as an Estimated Percentage of Total Costs for a New Pulverized Coal Plant**

	Percent of Total Cost	
	Plant Capital Cost	Plant O&M Cost
SO <sub>2</sub> Controls	12%	29%
NOx Controls	2%	12%
Mercury Controls	1%	9%
<b>Total for Emission Controls</b>	<b>16%</b>	<b>51%</b>

**Source:** Calculated by CRS from MIT, *The Future of Coal*, 2007, Tables A-3.D.3. and Tables A-3.D.4. Calculations were made for the point estimates in the report; the tables have cost ranges for capital costs and for mercury control O&M costs.

**Notes:** SO<sub>2</sub> = sulfur dioxide; NOx = nitrogen oxides; O&M = operations and maintenance.

<sup>3</sup> CRS Report for Congress-*Power Plants: Characteristics and Costs* November 13, 2008