Updates to EPA Base Case 2009 ARRA
Using the Integrated Planning Model (IPM) - Addendum

This document catalogs the updates to capital and operating costs for emissions control technologies in EPA Base Case 2009 ARRA using the Integrated Planning Model (IPM). These costs were updated from IPM Base Case 2006 (v3.0) to be consistent with other updates that were made to reflect the latest AEO 2009 ARRA assumptions. The 2006 costs were compared to the AEO 2009 ARRA technology costs to determine the appropriate adjustment factor to apply. Based on the analysis, capital costs for control technologies have been scaled up by 50% and are reported in 2006$s in EPA Base Case 2009 ARRA.

Illustrative Scrubber Costs (2006$) for Representative MW and Heat Rates under the Assumptions in EPA Base Case 2006

Scrubber Type	Capacity (MW)	Heat Rate (Btu/kWh)			Cost
		9,000	10,000	11,000	
LSFO Minimum Cutoff: 100 MW Maximum Cutoff: None Assuming 5.0 lbs/MMBtu SO_2 Coal	100	745	748	751	Capital Cost ($/kW)
		20	20	20	Fixed O&M ($/kW-yr)
		1.4	1.5	1.6	Variable O&M (mills/kWh)
	300	365	368	371	Capital Cost ($/kW)
		12	12	12	Fixed O&M ($/kW-yr)
		1.4	1.5	1.6	Variable O&M (mills/kWh)
	500	273	278	281	Capital Cost ($/kW)
		10	10	10	Fixed O&M ($/kW-yr)
		1.4	1.5	1.6	Variable O&M (mills/kWh)
	700	224	227	230	Capital Cost ($/kW)
		9	9	9	Fixed O&M ($/kW-yr)
		1.4	1.5	1.6	Variable O&M (mills/kWh)
	1000	189	192	197	Capital Cost ($/kW)
		7	7	7	Fixed O&M ($/kW-yr)
		1.4	1.5	1.6	Variable O&M (mills/kWh)
LSFO Minimum Cutoff: 100 MW Maximum Cutoff: None Assuming 3.0 lbs/MMBtu SO_2 Coal	100	446	457	468	Capital Cost ($/kW)
		12	14	13	Fixed O&M ($/kW-yr)
		2.2	2.6	2.8	Variable O&M (mills/kWh)
	300	237	248	261	Capital Cost ($/kW)
		9	9	9	Fixed O&M ($/kW-yr)
		2.2	2.6	2.8	Variable O&M (mills/kWh)
	500	198	209	222	Capital Cost ($/kW)
		6	6	6	Fixed O&M ($/kW-yr)
		2.2	2.6	2.8	Variable O&M (mills/kWh)
	700	177	189	201	Capital Cost ($/kW)
		5	5	5	Fixed O&M ($/kW-yr)
		2.2	2.6	2.8	Variable O&M (mills/kWh)
	1000	166	179	192	Capital Cost ($/kW)
		4	4	4	Fixed O&M ($/kW-yr)
		2.2	2.6	2.8	Variable O&M (mills/kWh)

Cost (2006$) of NO_x Combustion Controls for Coal Boilers (300 MW Size)

Boiler Type	Technology	Captial ($/kW)	Fixed O&M ($/kW-yr)	Variable O&M (mills/kWh)
Dry Bottom Wall-Fired	Low NO_x Burner without Overfire Air (LNB without OFA)	30.76	0.31	0.064
	Low NOx Burner with Overfire Air (LNB with OFA)	41.76	0.43	0.085
Tangentially-Fired	Low NO_x Coal-and-Air Nozzles with Close-Coupled Overfire Air (LNC1)	16.21	0.17	0.000
	Low NO_x Coal-and-Air Nozzles with Separated Overfire Air (LNC2)	22.66	0.22	0.029
	Low NO_x Coal-and-Air Nozzles with Close-Coupled and Separated Overfire Air (LNC3)	25.89	0.27	0.029

Scaling Factor

For all of the above combustion controls the following scaling factor is used to obtain the capital and fixed operating and maintenance costs applicable to the capacity (in MW) of the unit taking on combustion controls. No scaling factor is applied in calculating the variable operating and maintenance cost.

$$(\$ \text{ for X MW Unit}) = (\$ \text{ for 300 MW Unit}) \times (300/X)^{0.359}$$

where

($ for 300 MW Unit) is the value obtained using the factors shown in the above table and X is the capacity (in MW) of the unit taking on combustion controls.

Post Combustion NO_x Controls for Coal Plants (2006$)

Post-Combustion Control Technolgoy	Capital ($/kW)	Fixed O&M ($/kW-yr)	Variable O&M (mills/kWh)	Percent Removal
SCR[2]	178.24	0.79	0.71	90%
SNCR[3]	Term 1 - 30.47 Term 2 - 34.76	Term 1 - 0.30 Term 2 - 0.35	0.79	35%
SNCR[4] (Cyclone)	17.65	0.17	1.56	35%
SNCR[5] (Fluidized Bed)	30.54	0.31	0.91	50%

Notes:

[1] Cannot provide reductions any further beyond 0.06 lbs/mmBtu

[2] SCR Cost Scaling Factor:

SCR Capital and Fixed O&M Costs: $(242.72/MW)^{0.27}$

SCR Variable O&M Costs: $(242.72/MW)^{0.11}$

Scaling factor applies up to 600 MW.

[3] SNCR Cost Scaling Factor:

SNCR Capital and Fixed O&M Costs: $(Term1*(200/MW)^{0.577} + Term2*(100/MW)^{0.681})/2$

[4] Cyclone Cost Scaling Factor:

High NO_x Coal SNCR—Cyclone Capital and Fixed O&M Costs: $(300/MW)^{0.577}$

VO&M = 1.35 for MW ≤ 300,

VO&M = 1.35 – ((MW – 300)/100) * 0.015 for MW > 300.

[5] Fluidized Bed Cost Scaling Factor:

SNCR - Fludized Bed Capital and Fixed O&M Costs: $(200/MW)^{0.577}$

Reference

Khan, S. and Srivastava, R. "Updating Performance and Cost of NO_x Control Technologies in the Integrated Planning Model," Mega Symposium, August 30, 2004 - September 2, 2004, Washington, D.C.

Post Combustion NO_x Controls for Coal Plants (2006$)

Post-Combustion Control Technology	Captial ($/kW)	Fixed O&M ($/kW-yr)	Variable O&M (mills/kWh)	Percent Removal
SCR[1]	51.5	1.06	0.12	80%
SNCR[2]	17.3	0.18	0.53	50%

Notes:

[1] SCR Cost Scaling Factor:
SCR Capital Cost and Fixed O&M: $(200/MW)^{0.35}$
Scaling factor applies up to 500 MW

[2] SCNR Cost Scaling Factor:
SNCR Capital Cost and Fixed O&M: $(200/MW)^{0.577}$
Scaling factor applies up to 500 MW

Reference:

Cost Estimates for Selected Applications of Nox Control Technologies on Stationary Combustion Boilers , Bechtel Power Corporation for US EPA, June 1997