Supplemental Information for:

Modeling the Effects of Changes in New Source Review on National SO_2 and NO_x Emissions from Electricity-Generating Units

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Description of Supporting Information

Table S.1 summarizes all of the Integrated Planning Model (IPM) runs that are described and compared in the article. The runs differ based on which New Source Review (NSR) regulation and enforcement policy is in place and the regulatory setting. The possible NSR regulations are the Equipment Replacement Provision (ERP) rule and the prerevision multifactor test. The likely effects of using ERP to determine NSR applicability are arguable very similar to the likely effects of using the hourly emissions test that was recently proposed by the Environmental Protection Agency (EPA) (*7*). For the prerevision rule, four possible consequences are modeled. The regulatory settings assume that either the Clean Air Interstate Rule (CAIR) and other recently adopted rules are in place, or that they not.

Tables S.2 and S.3 provides the results of the cost-effectiveness analysis. Table S.2 contains results from the model runs where CAIR is not imposed, while the results in Table S.3 reflect the presence of CAIR. The results where emissions are not discounted and where both emissions and costs are discounted at a 5% rate are referenced in the article. We also provide calculations of the control cost per ton of emissions, with SO_2 and NO_X treated equally, for a 3% and 7% discount rate. These are the two discount rates that the EPA uses in its regulatory impact analyses.

Table S.4 provides the results of the spatial analysis that is described in the article. In the article, we compare how NO_X and SO_2 emissions differ between high R/R/R scenario and the ERP scenario both inside and outside the CAIR region. The table also shows how the patterns of flue gas desulfurization (FGD) and Selective Catalytic Reduction (SCR) retrofits vary between the two scenarios and in the two regions. The different pattern of NO_X and SO_2 emissions, and how these pollutants change over time in the two regions across the scenarios, is in part due to

the continued presence of the Title IV SO_2 cap, which is national in scope, and that no such national cap exists for NO_X.

Table S.1: IPM Model Runs

Regulatory Setting	**NSR Rule**	**Scenario Name and Assumed Incentive Effects of NSR Rule**		**Notes**
Without CAIR: Title IV SO_2 and NO_X SIP Call programs only or With CAIR: Clean Air Interstate Rule, Clean Air Mercury Rule and Best Available Retrofit Technology, as well as Title IV SO_2 program	Equipment Replacement Provision (ERP)	"ERP": Motivates no additional pollution control retrofits. Avoidance does not affect performance of generators.		Assumed to generate equivalent incentives as the proposed hourly emission test for NSR applicability (7). Equivalent to EPA's "base case" runs of the IPM model. The ERP scenarios assume that the incentives created by the NSR rule on existing sources are minor and are thus ignored in the model.
	Prerevision NSR (Rules prior to promulgation of ERP)	"Avoid":	NSR is avoided resulting in a 0.1%/year deterioration in efficiency (heat rate) and capacity of generators.	Follows U.S.EPA's assumption of the incentive effects of the prerevision rule as reported in the ERP regulatory impact analysis (16). The "Avoid" scenario with CAIR is not modeled
		"Low R/R/R":	Each year from 2007 to 2020, $\geq$ 2% of the coal-fired capacity that does not have FGD or SCR as of 2006 must either retrofit these controls, repower, or retire.	All R/R/R runs assume that EGUs with the lowest retrofit cost are subject to NSR first.
		"Middle R/R/R":	Same as Low R/R/R, except percentage is 5%	
		"High R/R/R":	Same as Low R/R/R, except percentage is 7.5%	
		"High R/R/R, Low Investment Cost"	Same as High R/R/R except renewable and IGCC investment costs are lower	Sensitivity analysis exploring the effect of lower cost non-emitting technologies on results. Only analyzed with the with CAIR setting.
		"High R/R/R, Low Natural Gas Prices"	Same as High R/R/R except with natural gas prices 15% lower in 2010, falling to 25% lower in 2020	Sensitivity analysis exploring the effect of lower natural gas prices. Only analyzed with the with CAIR setting.
Emission caps based on annual emissions from High R/R/R scenario	None			Sensitivity analysis exploring cost savings from using cap-and-trade programs to achieve emissions realized in High R/R/R scenario. Only analyzed in the with CAIR policy setting.

Table S.2: Sensitivity of Cost-Effectiveness Analysis with Respect to Choice of Discount Rate, without CAIR (Title IV, NOx SIP Call)

Discount Rate	NSR Approach	SO_2 Emissions, 2007-2020 (thousands of shot tons)	NO_x Emissions, 2007-2020 (thousands of short tons)	Total Discounted Cost (billion 1999 $)	Cost Effectiveness ($/ton)
Undiscounted emissions, 5% rate for costs	ERP	132,430	51,930	$ 867.2	---
	"Low" R/R/R (2%)	132,250	49,140	$ 869.7	$ 849
	"Middle" R/R/R (5%)	133,150	45,670	$ 882.8	$2,812
	"High" R/R/R (7.5%)	118,670	41,150	$ 899.1	$1,301
3% for emissions and costs	ERP	104,383	40,637	$1,016.1	---
	"Low" R/R/R (2%)	104,365	38,560	$1,019.2	$1,483
	"Middle" R/R/R (5%)	105,317	36,130	$1,035.6	$5,446
	"High" R/R/R (7.5%)	95,963	32,895	$1,055.9	$2,462
5% for emissions and costs	ERP	90,090	34,910	$ 867.2	---
	"Low" R/R/R (2%)	90,140	33,190	$ 869.7	$1,503
	"Middle" R/R/R (5%)	91,110	31,250	$ 882.8	$5,900
	"High" R/R/R (7.5%)	84,130	28,640	$ 899.1	$2,607
7% for emissions and costs	ERP	78,414	30,249	$ 746.7	---
	"Low" R/R/R (2%)	78,516	28,805	$ 748.7	$1,530
	"Middle" R/R/R (5%)	79,492	27,255	$ 759.2	$6,542
	"High" R/R/R (7.5%)	74,287	25,125	$ 772.4	$2,787

Table S.3: Sensitivity of Cost-Effectiveness Analysis with Respect to Choice of Discount Rate, with CAIR (CAIR, Clean Air Mercury Rule and Clean Air Visibility Rule)

Discount Rate	NSR Approach	SO_2 Emissions, 2007-2020 (thousands of short tons)	NO_x Emissions, 2007-2020 (thousands of short tons)	Total Discounted Cost (billion 1999 $)	Cost Effectiveness ($/ton)
Undiscounted emissions, 5% rate for costs	ERP	79,520	32,960	$ 900.9	
	"Low" R/R/R (2%)	79,530	32,960	$ 900.9	Costs and emissions increase
	"Middle" R/R/R (5%)	79,910	32,250	$ 901.8	$ 2,900
	"High" R/R/R (7.5%)	79,280	30,200	$ 910.1	$ 3,100
3% for emissions and costs	ERP	63,780	26,386	$1,056.5	
	"Low" R/R/R (2%)	63,784	26,386	$1,056.6	Costs and emissions increase
	"Middle" R/R/R (5%)	64,139	25,918	$1,057.8	$11,705
	"High" R/R/R (7.5%)	64,268	24,491	$1,068.6	$ 8,580
5% for emissions and costs	ERP	55,670	23,010	$ 900.9	
	"Low" R/R/R (2%)	55,670	23,010	$ 900.9	Costs and emissions increase
	"Middle" R/R/R (5%)	56,000	22,650	$ 901.8	$53,000
	"High" R/R/R (7.5%)	56,450	21,530	$ 910.1	$13,000
7% for emissions and costs	ERP	48,975	20,235	$ 774.9	
	"Low" R/R/R (2%)	48,979	20,235	$ 775.0	Costs and emissions increase
	"Middle" R/R/R (5%)	49,294	19,961	$ 775.6	Costs and emissions increase
	"High" R/R/R (7.5%)	49,964	19,065	$ 782.0	$38,907

Table S.4: Emissions and Retrofits inside and outside of CAIR region with ERP and High R/R/R Scenarios

		2007	2010	2015	2020
SO_2 emissions (million short tons) †					
ERP	CAIR region	7003	5140	4075	3370
	non-CAIR region	869	906	652	602
	Total	*7872*	*6046*	*4727*	*3972*
High R/R/R scenario	CAIR region	7573	5759	3827	2665
	non-CAIR region	884	910	651	507
	Total	*8457*	*6669*	*4478*	*3172*
NO_X emissions (million short tons) †					
ERP	CAIR region	2608	1407	1154	1120
	non-CAIR region	793	807	605	605
	Total	*3401*	*2214*	*1759*	*1725*
High R/R/R scenario	CAIR region	2625	1409	1152	851
	non-CAIR region	795	807	462	183
	Total	*3420*	*2216*	*1614*	*1034*
Percentage of coal capacity with FGD‡					
ERP	CAIR region	27%	45%	57%	64%
	non-CAIR region	59%	63%	85%	88%
High R/R/R scenario	CAIR region	27%	42%	66%	93%
	non-CAIR region	59%	63%	86%	96%
Percentage of coal capacity with SCR‡					
ERP	CAIR region	34%	50%	62%	63%
	non-CAIR region	2%	3%	7%	7%
High R/R/R scenario	CAIR region	34%	51%	71%	88%
	non-CAIR region	2%	3%	40%	92%

†Emissions are from coal-fired electricity generation units above 25 megawatts.
‡Total coal capacity in each region does not vary significantly across the scenarios.