



PROJECT UPDATE
EVALUATION OF FUTURE EMISSIONS STRATEGIES
FOR ELECTRIC GENERATING UNITS

March 2007

BACKGROUND

- Purpose: Emissions from Electric Generating Units (EGUs) contribute to regional haze in Class I areas throughout the eastern US. Therefore, states must evaluate strategies for reducing emissions from EGUs as part of their efforts to achieve reasonable progress in improving visibility at Class I areas.
- Model Used: The Mid-Atlantic/Northeast Visibility Union (MANE-VU) and other Regional Planning Organizations have followed the example of the US Environmental Protection Agency (EPA) in using the Integrated Planning Model (IPM), an integrated economic and emissions model, to predict future emissions from EGUs. IPM projects energy supply based on various assumptions and develops a least-cost solution to generating needed electricity within specified emissions targets.
- Strategy/Model Runs Defined: EPA's Clean Air Interstate Rule (CAIR) will reduce SO₂ and NO_x emissions in the eastern US through a cap and trade program. This project evaluated an emission control strategy for EGUs that further reduced emissions beyond CAIR (CAIR Plus) throughout the eastern US via a regional cap and trade program. Emissions reductions and costs were estimated.
- EPA has created several IPM versions. Until recently, the most current version was IPM 2.1.9, which EPA used in promulgating CAIR. Relevant subsequent runs include the following:
 - VISTAS CAIR Base Case
The Regional Planning Organizations collaborated with each other to update IPM 2.1.9 to use more current data about EGUs and more realistic fuel prices, creating a run called VISTAS PC_1f. This VISTAS IPM run is the one that has been used in regional air quality modeling for ozone state implementation plans.
 - MARAMA CAIR Base Case
MANE-VU, through MARAMA, contracted with ICF to prepare two new IPM runs. The MARAMA CAIR Base Case run, was also based on EPA's IPM 2.1.9. This run updated some of the information used in the VISTAS run, included CAIR and CAMR requirements and also updated specific assumptions (e.g., fuel prices, control

constraints, etc.) to better reflect current information. The MARAMA CAIR Base Case run is also sometimes called MARAMA_5c.

- MARAMA CAIR Plus

The second of these new runs, the MARAMA CAIR Plus run, was also based on EPA's IPM 2.1.9. using lower NO_x emission caps and lower SO₂ retirement ratios. This run also updated some of the information used in the VISTAS run, included CAIR and CAMR requirements and also updated specific assumptions (e.g., fuel prices, control constraints, etc.) to better reflect current information. The MARAMA CAIR Plus run is also sometimes called MARAMA_4c.

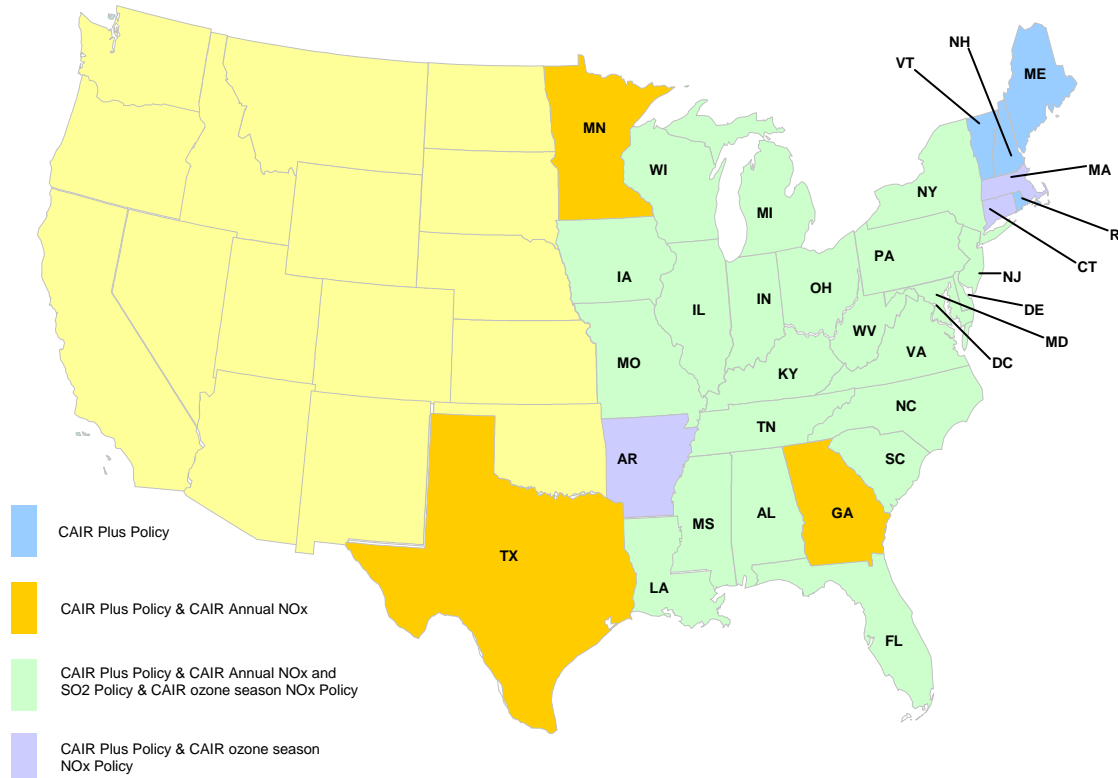
- EPA's new revised CAIR Base Case IPM 3.0

EPA recently issued IPM 3.0, a further updated version of the IPM model, which also incorporates more up-to-date information about specific EGUs and fuel prices. This version of IPM was not used in the MARAMA analysis because it was not available in time.

ASSUMPTIONS

- The results of the MARAMA CAIR Base Case IPM 2.1.9 run and the MARAMA CAIR Plus IPM 2.1.9 run are summarized in the draft ICF report titled "Comparison of CAIR and CAIR Plus Proposal using the Integrated Planning Model (IPM), March 2007 ("the draft ICF report").
- For purposes of this analysis, the CAIR region included all states included in any part of the EPA CAIR annual or seasonal program as well as all New England states. Figure 1 below from the draft ICF report is a U.S. map with the states affected by CAIR and CAIR Plus policies as implemented in the MARAMA CAIR and CAIR Plus IPM runs.

Figure 1: States affected by CAIR and MARAMA CAIR Plus Policies



- Table 3 below from the draft ICF report summarizes the NO_x budgets implemented in the MARAMA Base Case and MARAMA CAIR Plus IPM Policy runs. This shows the overall reduction in NO_x emissions to be achieved through the implementation of CAIR Plus.

Table 3: NO_x Budgets in the CAIR/CAIR Plus Region (Thousand Tons)

Year	NO _x Ozone Season Budget		NO _x Annual Budget	
	MARAMA Base Case	MARAMA CAIR Plus Policy Case	MARAMA Base Case	MARAMA CAIR Plus Policy Case
2009	568	623	1,722*	1,553*
2010	568	623	1,522	1,353
2012	568	415	1,522	902
2015	518	395	1,370	858
2018	485	382	1,268	829

*Includes NO_x Compliance Supplement Pool of 199,997 tons included in 2009.

- As shown below in Table 4 from the draft ICF report, the CAIR Plus run required a greater number of SO₂ allowances be retired for each ton of pollution discharged. This effect of this was to reduce the total amount of SO₂ emissions allowed within the CAIR region.

Table 4: SO₂ Allowance Retirement Ratios in the CAIR/CAIR Plus Region

Year	SO ₂ Allowance Retirement Ratio	
	MARAMA Base Case	MARAMA CAIR Plus Policy Case
2009	1.00	1.00
2010	2.00	2.50
2012	2.00	2.94
2015	2.52	3.32
2018	2.86	4.16

Note: The 2015 budgets and retirement ratios in Tables 3 and 4 are the average of the budgets and retirement ratios over the period 2013-2017.

RESULTS

- The analysis included in the draft ICF report projects that CAIR Plus would reduce national SO₂ emissions in 2018 from all fossil and non-fossil fuel-fired Electric Generating Units (EGUs) by 832,000 tons per year, from 4,774,700 to 3,942,700 tons per year, a 17% reduction.
 - SO₂ emissions in 2018 from all fossil and non-fossil fuel-fired EGUs are projected to decline by 28% in the MANE-VU region, 11% in the Midwest, 30% in the Southeast, and 15% in the Central States. The CAIR Plus strategy would not apply in the West, so emissions there would grow by 5%.
- The analysis included in the draft ICF report also projects that CAIR Plus would reduce national NO_x emissions in 2018 from all fossil and non-fossil fuel-fired Electric Generating Units (EGUs) by 480,100 tons per year, from 2,064,800 to 1,584,700 tons per year, a 23% reduction.

- The draft ICF report projects that the annualized incremental cost of the CAIR Plus policy (over and above the cost of the CAIR program) would be \$2.57 Billion (1999\$) in 2018. This includes the annualized capital costs of new control equipment and new plants, fuel costs, and variable and fixed operation and maintenance costs.
- The draft ICF report projects that the marginal cost of SO₂ emission reductions as manifested in the projected SO₂ allowance prices would increase from \$1,105 (1999\$/ton) in 2018 with CAIR to \$1,390 (1999\$/ton) with CAIR Plus.
- The costs and benefits listed above reflect the projection that in comparison to the CAIR base case, more new plants would be built under a CAIR+ strategy, more older plants would be retired, the generation mix changes towards lower emission intensive fuel and plant types, and there is an increase in natural gas-fired generation and a reduction in coal generation from coal steam EGUs in all years except 2012. Increased installation of controls and an increase in coal generation occur in 2012, the first year when the SCR and SO₂ scrubber feasibility constraints are no longer applied in the CAIR+ strategy. In years after 2012, the CAIR+ SO₂ and NO_x policies continue to become more stringent resulting in an increase in natural gas-based generation.
- Costs and benefits also result from the CAIR+ projection that an additional 16 gigawatts (GWs) of power production would be controlled by SO₂ scrubbers and an additional 65 GW controlled by SCR (for NO_x) as compared to the projected controls under CAIR.

MORE INFORMATION

- A draft ICF report summarizing the results of the MARAMA CAIR and CAIR Plus runs is available at www.marama.org under regional haze, projects, MANE-VU future year modeling emissions inventories.
- Information about the VISTAS CAIR Base Case run is summarized in an appendix to the above report. More information is also posed at www.ladco.org under regional air quality planning, G. IPM Emissions Summaries.

TECHNICAL OVERSIGHT COMMITTEE

Representatives from each MANE-VU state have participated in reviewing draft materials prepared under this project. Team members include:

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