Mid-Atlantic/Northeast Visibility Union

MANE-VU

PROJECT RESULTS

EVALUATION OF TIGHTER FEDERAL EMISSIONS CAPS

FOR ELECTRIC GENERATING UNITS

June 5, 2007

BACKGROUND

- **Purpose**: This project evaluated an emission control strategy for Electric Generating Units (EGUs) that further reduced emissions beyond current federal requirements throughout the eastern US via a tighter regional cap and trade program. Emissions reductions and costs were estimated in comparison to the federal program.
- **Why EGUs**: Emissions from 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.
- **Which Model**: To predict future emissions from EGUs, 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. IPM projects electricity supply based on various assumptions and develops a least-cost solution to generating needed electricity within specified emissions targets.
- **Strategy**: EPA's Clean Air Interstate Rule (CAIR) and Clean Air Mercury Rule (CAMR) will reduce SO_2, NO_x, and mercury emissions in the eastern US. This project evaluated an emission control strategy for EGUs that tightened CAIR throughout the eastern US. Emissions reductions and costs were estimated.
- **Model Runs**: IPM runs are defined by numerous economic and engineering assumptions.
    - EPA developed Base Case v.2.1.9 using IPM to evaluate the impacts of CAIR and the Clean Air Mercury Rule (CAMR). (Recently, EPA updated their input data and developed Base Case v.3.0. **Due to timing, all of the following runs were based on EPA Base Case v.2.1.9 with some updates and corrections**.)
    - VISTAS CAIR Base Case. The Regional Planning Organizations collaborated with each other to update EPA Base Case v.2.1.9 using more current data about EGUs with more realistic fuel prices, creating an IPM run called VISTAS PC_1f. This VISTAS IPM implementation is the one that has been used in regional air quality modeling for ozone and haze 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 based on the VISTAS PC_1f run and underlying EPA Base Case v.2.1.9, with some of the information

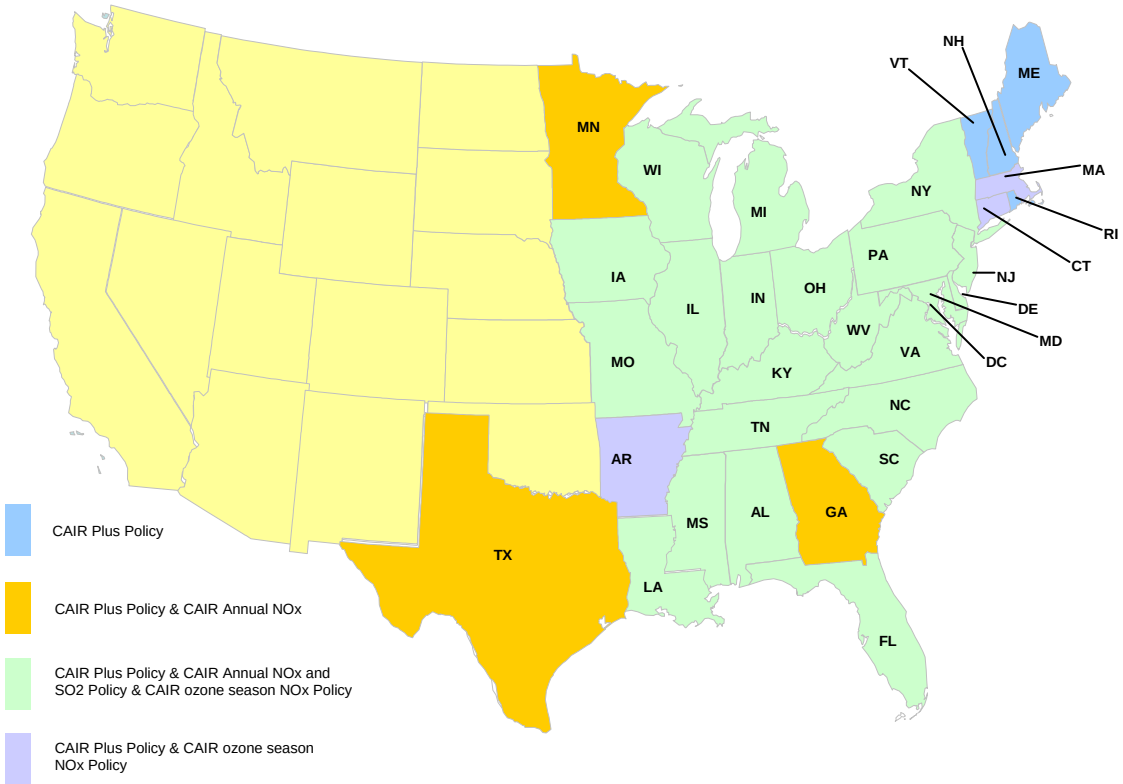
updated, (e.g., fuel prices, control constraints, etc.) to better reflect current information. The MARAMA CAIR Base Case run is also sometimes called MARAMA_5c.

- MARAMA CAIR Plus Run. The MARAMA CAIR Plus run was also based on VISTAS PC_1f run and the underlying EPA Base Case v.2.1.9, but using lower NO_x emission caps and higher SO_2 retirement ratios. Consistent with the MARAMA CAIR Base Case Run, the CAIR Plus Run also updated some of the information used in the VISTAS run (e.g., fuel prices, control constraints, etc.) to better reflect current information. The MARAMA CAIR Plus run is also sometimes referred to as MARAMA_4c.

ASSUMPTIONS

- The assumptions for and results of the MARAMA CAIR Base Case run and the MARAMA CAIR Plus run are summarized in the final draft ICF report titled "Comparison of CAIR and CAIR Plus Proposal using the Integrated Planning Model (IPM), May 30 2007.
- 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 final 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 final 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 as compared to CAIR.

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

	NO_x Ozone Season Budget		NO_x Annual Budget	
Year	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.

Note: The 2015 budgets as modeled in IPM are the average of the budgets over the period 2013-2017. The actual ozone season NO_x budgets proposed are 485 thousand tons in CAIR and 382 thousand tons in CAIR plus for 2015. The actual annual NO_x budgets proposed are 1,268 thousand tons in CAIR and 829 thousand tons in CAIR plus for 2015.

- As shown below in Table 4 from the final draft ICF report, the CAIR Plus run required a greater number of SO_2 allowances be retired for each ton of pollution discharged. The effect of this was to reduce the total amount of SO_2 emissions allowed within the CAIR Plus region.

Table 4: SO_2 Allowance Retirement Ratios in the CAIR/CAIR Plus Region

	SO_2 Allowance Retirement Ratio	
Year	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 retirement ratios as modeled in IPM are the average of the retirement ratios over the period 2013-2017. The actual retirement ratios are 2.86 for CAIR and 3.57 for CAIR Plus for 2015.

RESULTS

- Strengthening CAIR would achieve significant emission reductions, increase the use of natural gas, decrease the use of coal, and drive the construction of new, cleaner plants.
- The final draft ICF report projects that CAIR Plus would reduce national SO_2 emissions in 2018 from all fossil and non-fossil fuel-fired Electric Generating Units (EGUs) by 845,300 tons per year, from 4,785,600 to 3,940,300 tons per year, an 18% reduction.
    - SO_2 emissions in 2018 from all fossil and non-fossil fuel-fired EGUs are projected to decline by 31% in the MANE-VU region, 12% in the Midwest, 29% 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%. (See report, Table 8.)

- The 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 480,500 tons per year, from 2,065,600 to 1,585,100 tons per year, a 23% national reduction (27% in MANE-VU) (Table 9).
- The 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 (Table 5). This includes the annualized capital costs of new control equipment and new plants, fuel costs, and variable and fixed operation and maintenance costs. This is a 2% increase (Table A5.8).
- The report projects that the marginal cost of SO_2 emission reductions as manifested in the projected SO_2 allowance prices would increase from $1,106 (1999$/ton) in 2018 with CAIR to $1,392 (1999$/ton) with CAIR Plus, a 26% increase (Table 6).
- The report estimates that with CAIR Plus, in the US an additional 17 gigawatts (GWs) of coal plant capacity would be controlled by SO_2 scrubbers and an additional 65 GW controlled by SCR (for NO_x) as compared to the projected controls under CAIR (Table 7).
- The costs and benefits listed above reflect that in comparison to the CAIR base case,
    - more new plants would be built under a CAIR Plus strategy, and more older plants would be retired; newer plants would have lower emissions (pp. 15-17);
    - the generation mix would change towards lower emission intensive fuel and plant types, including more IGCCs (pp. 16-17); and
    - natural gas-fired generation would increase and generation from coal steam EGUs would decrease after 2012, as the CAIR Plus SO_2 and NO_x policies continue to become more stringent. (See p. 15.)

MORE INFORMATION

- The final draft ICF report summarizing the results of the MARAMA CAIR and CAIR Plus runs is available at www.manevu.org under Publications—Reports. It is also posted at www.marama.org under regional haze, projects, MANE-VU future year emissions inventories.
- Information about the VISTAS CAIR Base Case run is summarized in an appendix to the report. More information is also posted 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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