Mid-Atlantic/Northeast Visibility Union

MANE-VU

Reducing Regional Haze for Improved Visibility and Health

INTER-RPO

CONSULTATION

BRIEFING BOOK

Inter-RPO Consultation Briefing Book

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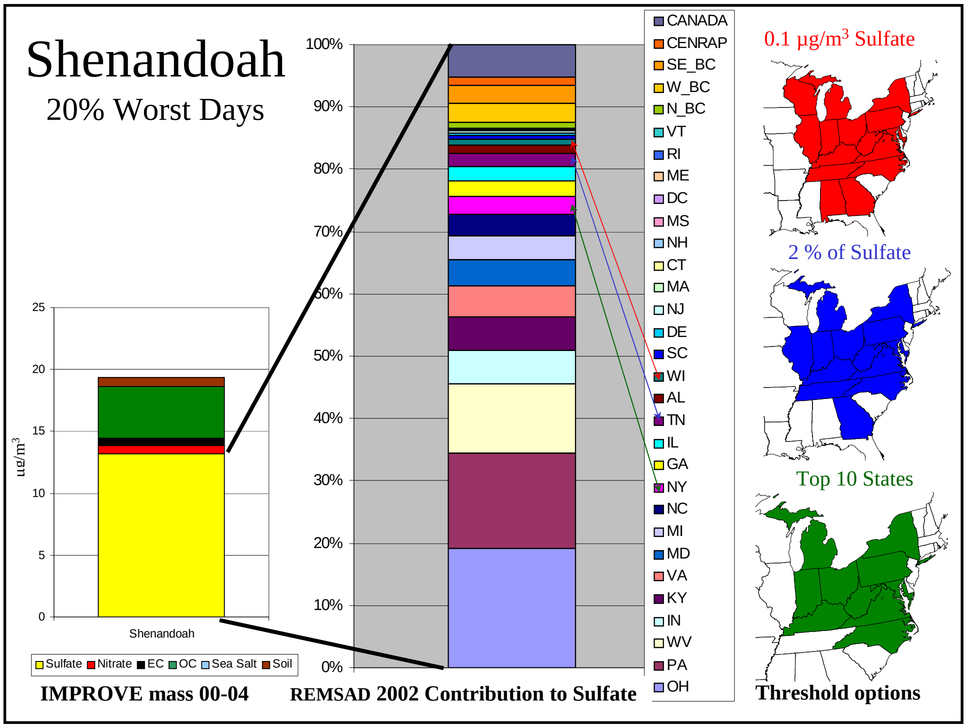
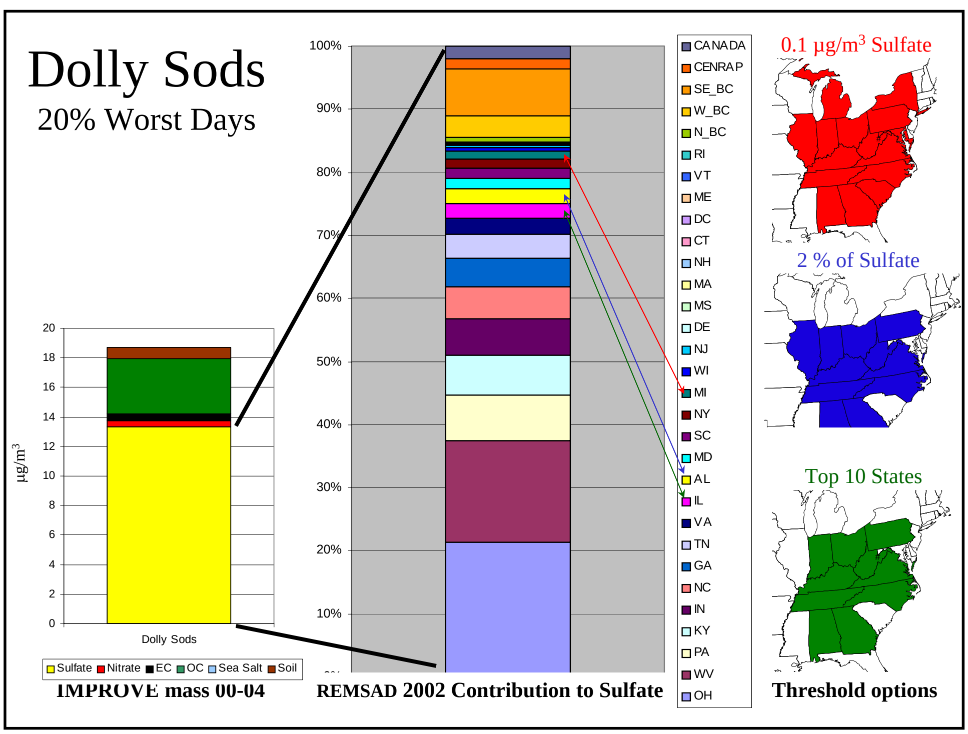

Shenandoah
20% Worst Days
IMPROVE mass 00-04
REMSAD 2002 Contribution to Sulfate
0.1 µg/m3 Sulfate
2 % of Sulfate
Top 10 States
Threshold options
Sulfate Nitrate EC OC Sea Salt Soil
CANADA CENRAP SE_BC W_BC N_BC VT RI ME DC MS NH CT MA NJ DE SC WI AL TN IL GA NY NC MI MD VA KY IN WV PA OH


Dolly Sods
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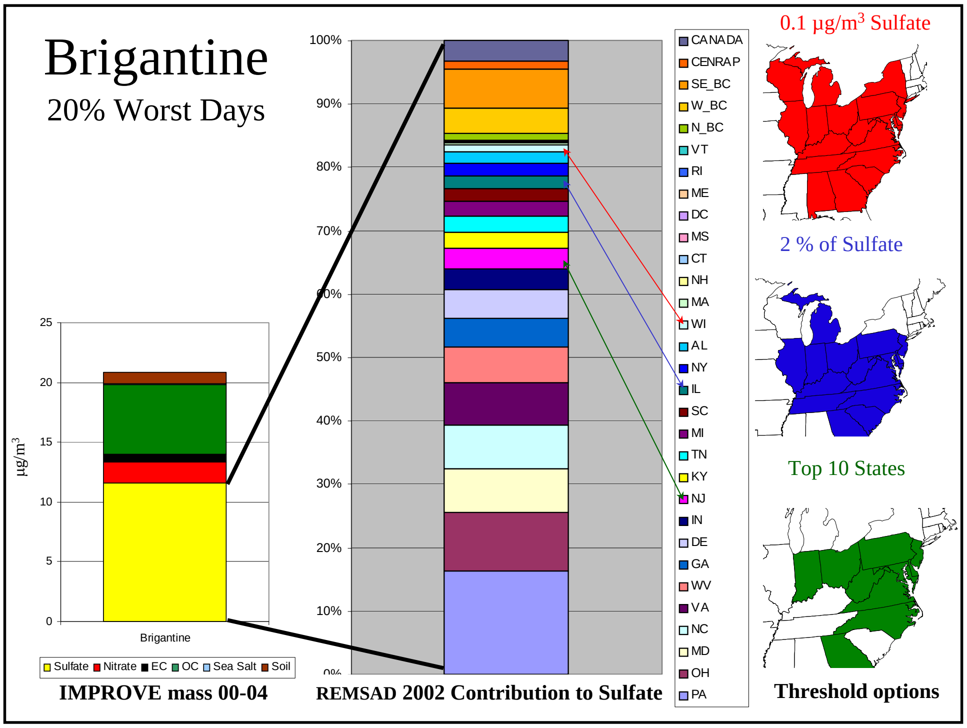
Brigantine
20% Worst Days
IMPROVE mass 00-04
µg/m3
25
20
15
10
5
0
Brigantine
Sulfate Nitrate EC OC Sea Salt Soil
REMSAD 2002 Contribution to Sulfate
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
CANADA
CENRAP
SE_BC
W_BC
N_BC
VT
RI
ME
DC
MS
CT
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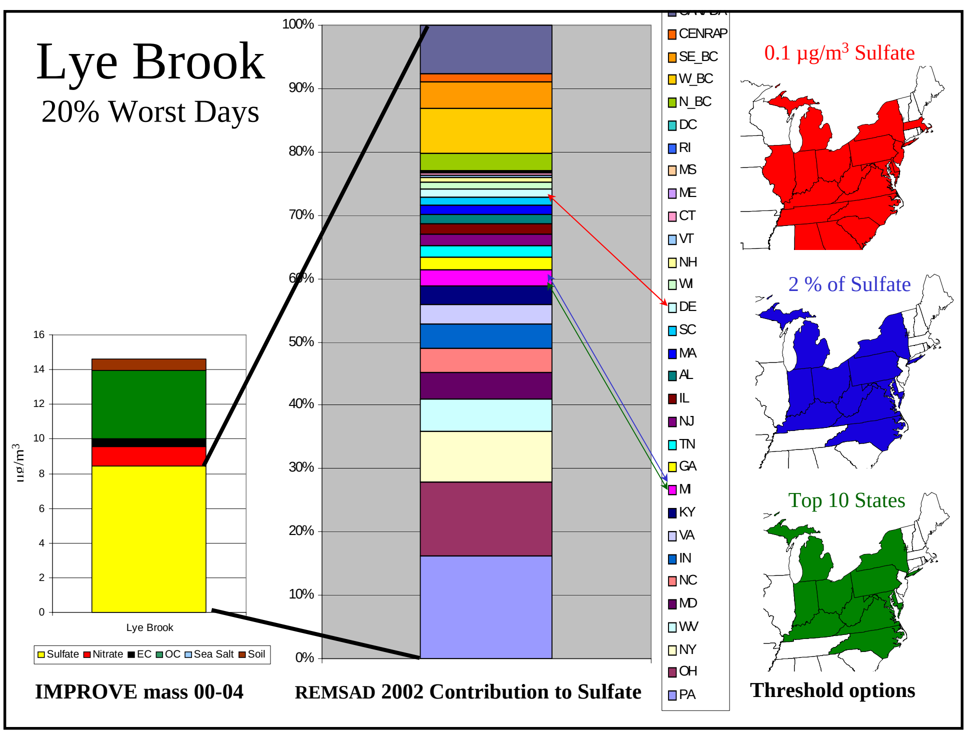
OH
PA
0.1 µg/m3 Sulfate
2 % of Sulfate
Top 10 States
Threshold options


Lye Brook
20% Worst Days
IMPROVE mass 00-04
µg/m3
16
14
12
10
8
6
4
2
0
Lye Brook
Sulfate Nitrate EC OC Sea Salt Soil
REMSAD 2002 Contribution to Sulfate
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
CENRAP
SE_BC
W_BC
N_BC
DC
RI
MS
ME
CT
VT
NH
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IL
NJ
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NY
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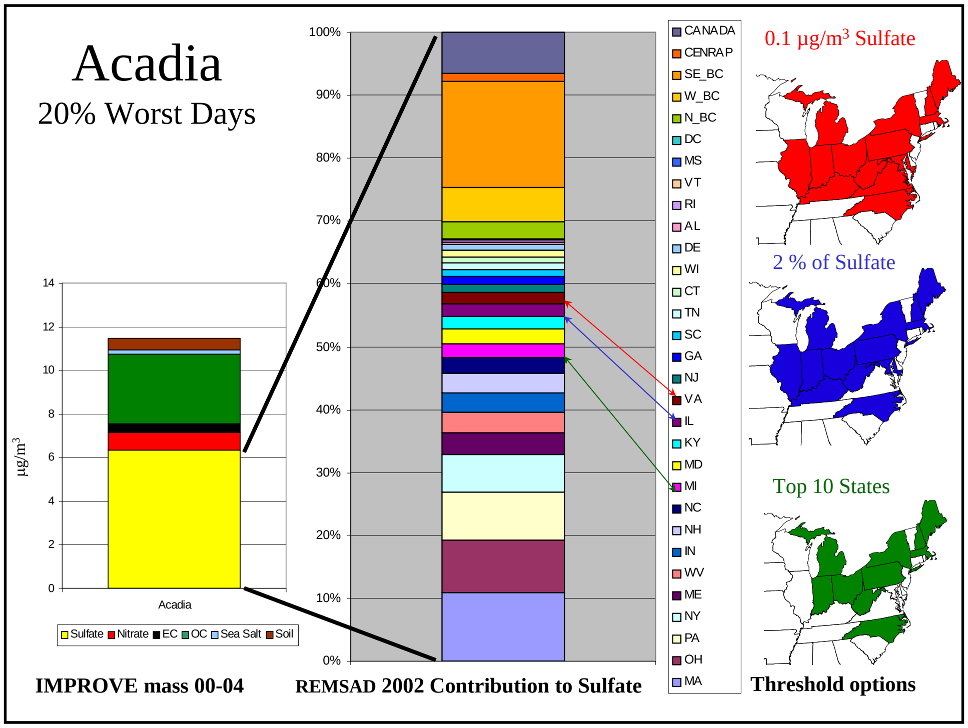
0.1 µg/m3 Sulfate
2 % of Sulfate
Top 10 States
Threshold options


Acadia
20% Worst Days
µg/m3
Acadia
Sulfate Nitrate EC OC Sea Salt Soil
IMPROVE mass 00-04
REMSAD 2002 Contribution to Sulfate
CANADA
CENRAP
SE_BC
W_BC
N_BC
DC
MS
VT
RI
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ME
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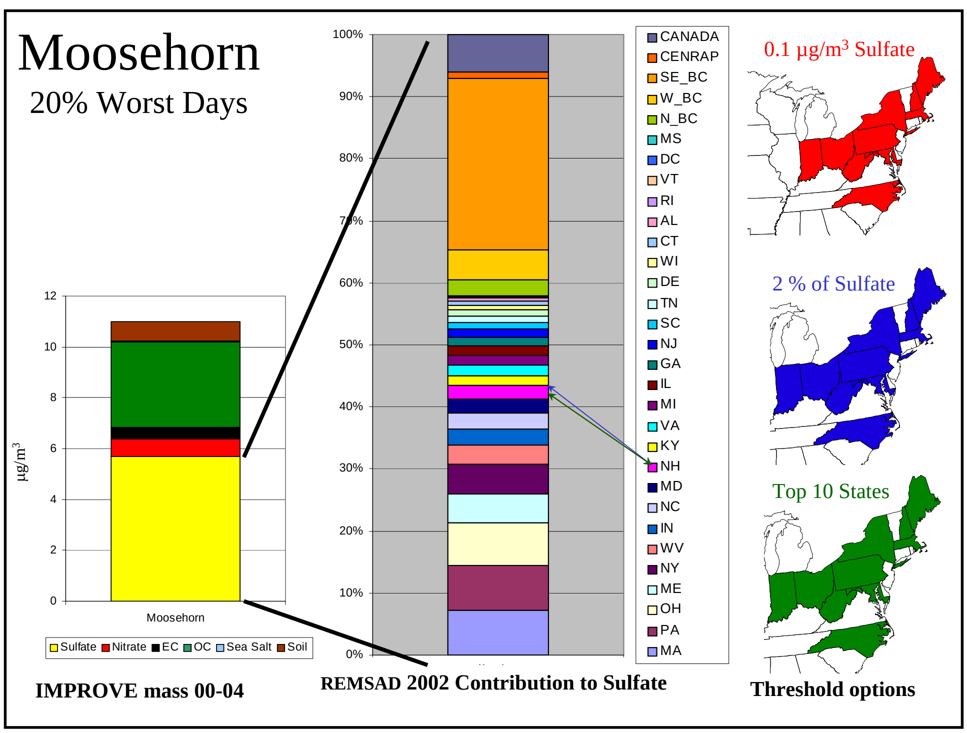
PA
OH
MA
0.1 µg/m3 Sulfate
2 % of Sulfate
Top 10 States
Threshold options


Moosehorn
20% Worst Days
µg/m3
Moosehorn
Sulfate Nitrate EC OC Sea Salt Soil
IMPROVE mass 00-04
REMSAD 2002 Contribution to Sulfate
CANADA
CENRAP
SE_BC
W_BC
N_BC
MS
DC
VT
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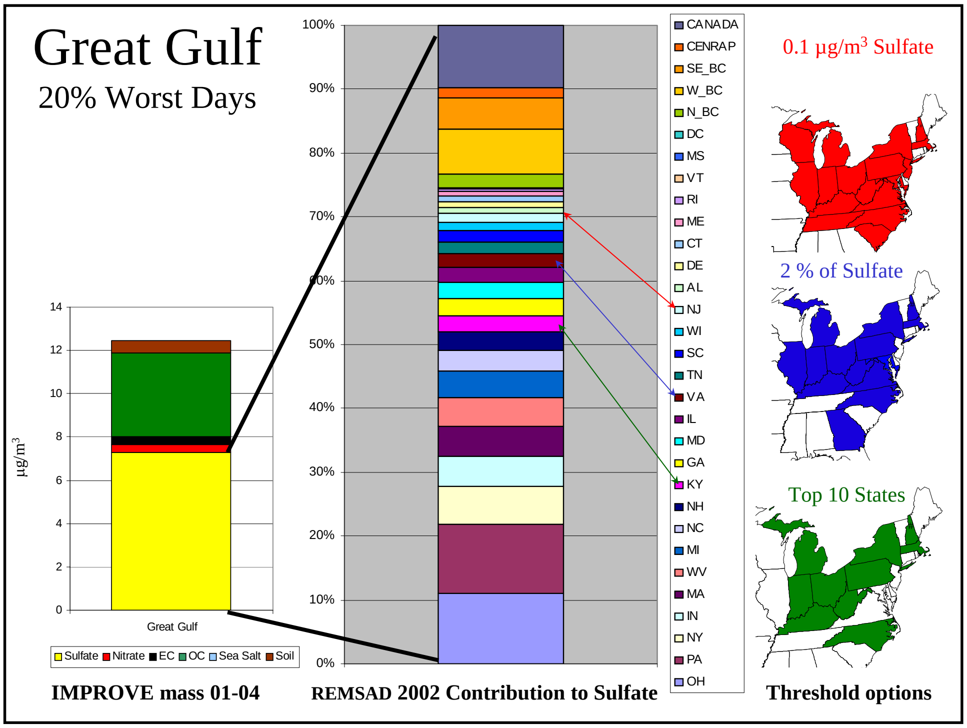
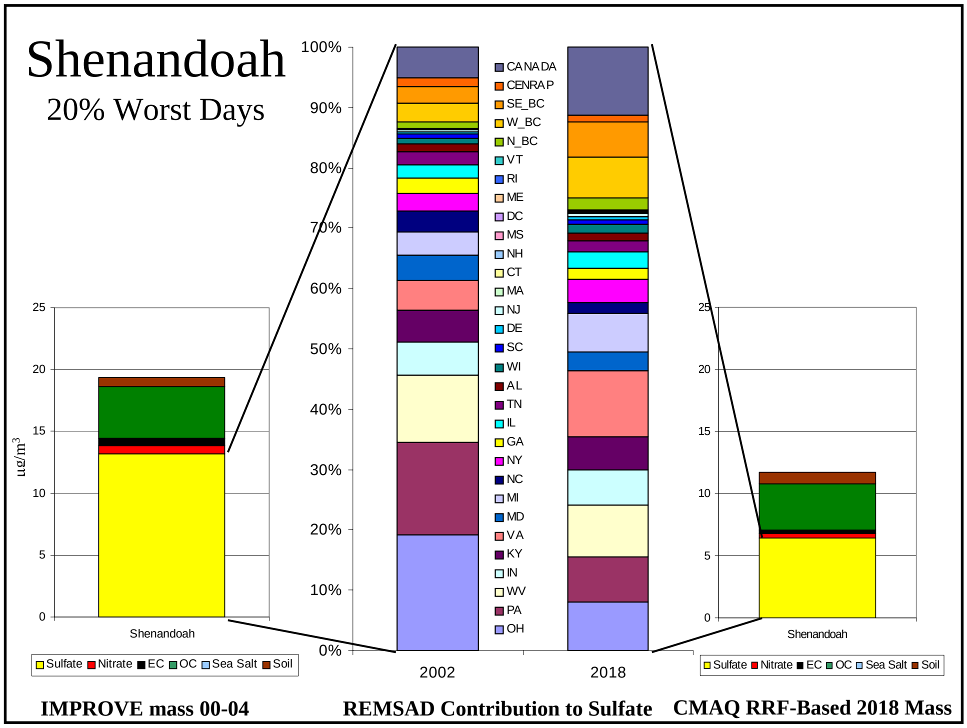
MA
0.1 µg/m3 Sulfate
2 % of Sulfate
Top 10 States
Threshold options



2002/2018 Sulfate Attribution



Shenandoah
20% Worst Days
ug/m3
Shenandoah
Sulfate Nitrate EC OC Sea Salt Soil
2002
2018
CANADA
CENRAP
SE_BC
W_BC
N_BC
VT
RI
ME
DC
MS
NH
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MA
NJ
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SC
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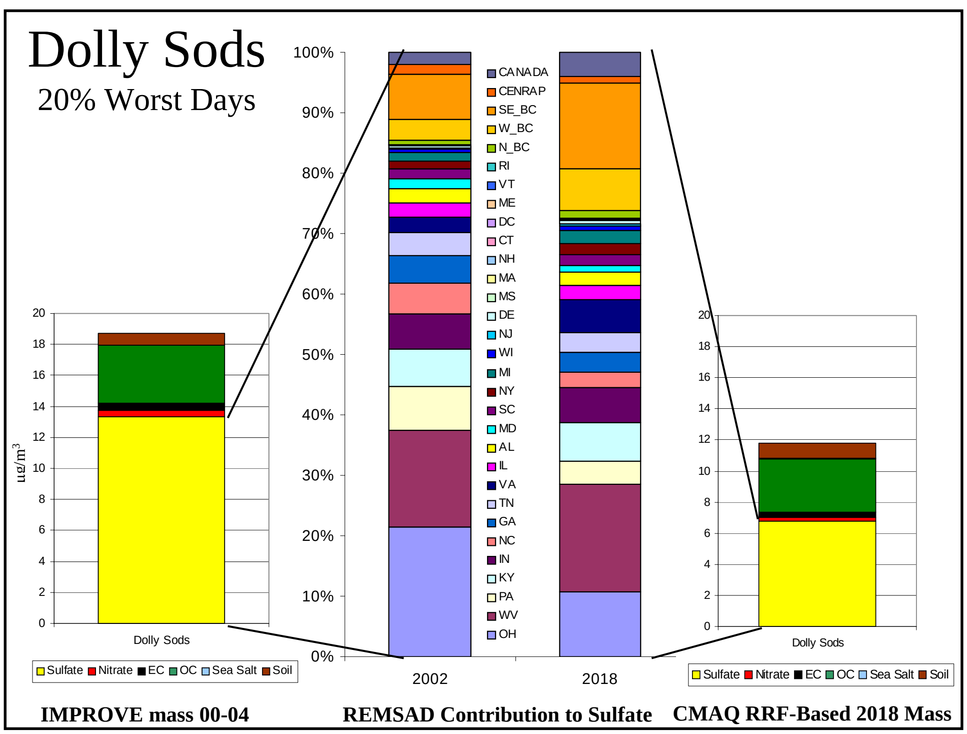
IN
WV
PA
OH
IMPROVE mass 00-04
REMSAD Contribution to Sulfate
CMAQ RRF-Based 2018 Mass



Dolly Sods
20% Worst Days
ug/m3
Dolly Sods
Sulfate Nitrate EC OC Sea Salt Soil
2002
2018
CANADA
CENRAP
SE_BC
W_BC
N_BC
RI
VT
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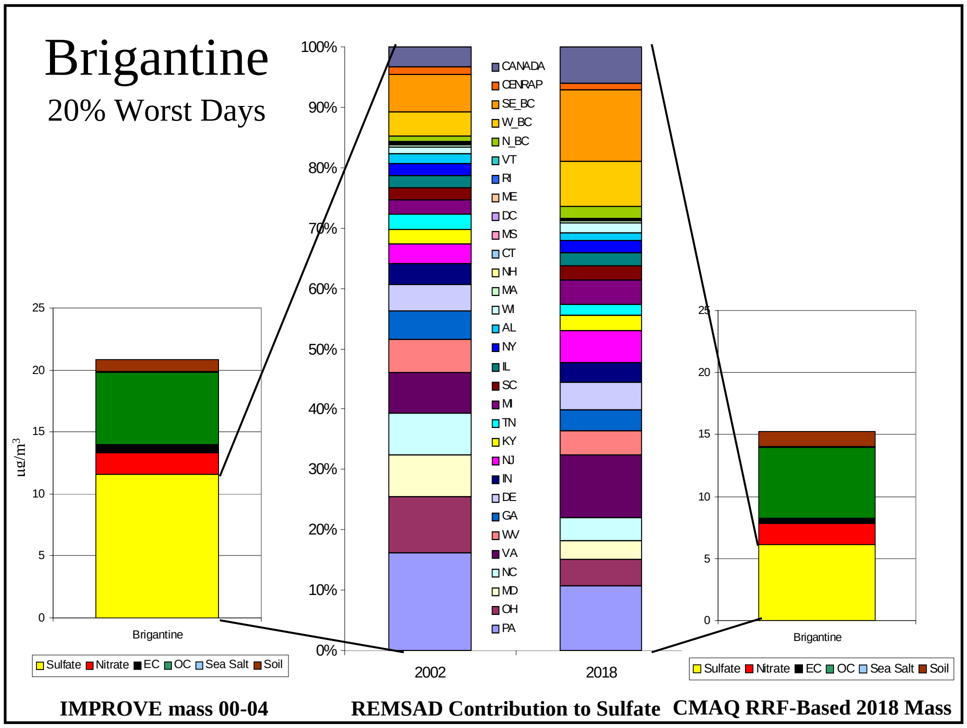
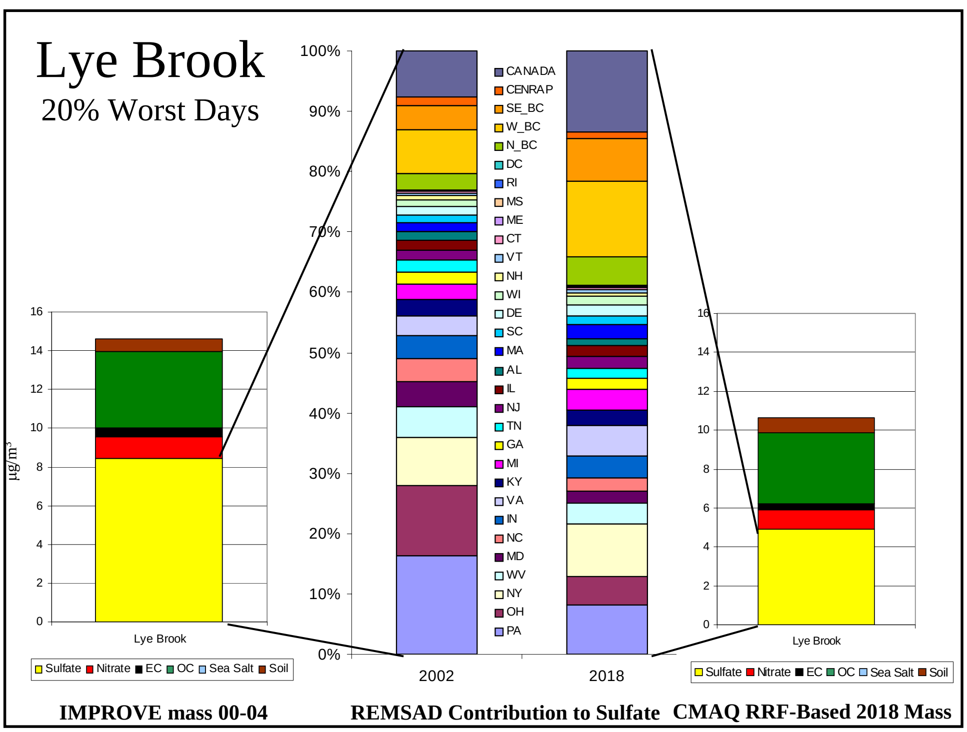
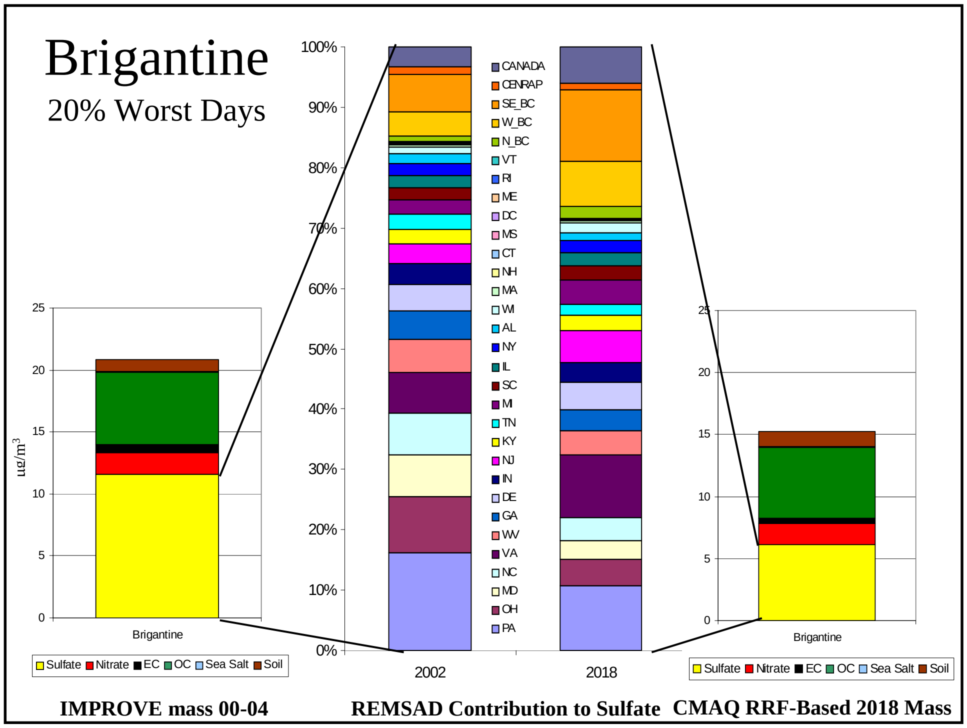
IMPROVE mass 00-04
REMSAD Contribution to Sulfate
CMAQ RRF-Based 2018 Mass



Brigantine
20% Worst Days
IMPROVE mass 00-04
REMSAD Contribution to Sulfate
CMAQ RRF-Based 2018 Mass
Sulfate Nitrate EC OC Sea Salt Soil
CANADA CENRAP SE_BC W_BC N_BC VT RI ME DC MS CT NH MA WI AL NY IL SC MI TN KY NJ IN DE GA WV VA NC MD OH PA
2002
2018



Lye Brook
20% Worst Days
IMPROVE mass 00-04
REMSAD Contribution to Sulfate
CMAQ RRF-Based 2018 Mass
Sulfate Nitrate EC OC Sea Salt Soil
CANADA CENRAP SE_BC W_BC N_BC DC RI MS ME CT VT NH WI DE SC MA AL IL NJ TN GA MI KY VA IN NC MD WV NY OH PA
2002
2018


Brigantine
20% Worst Days
ug/m3
Brigantine
Sulfate Nitrate EC OC Sea Salt Soil
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2002
2018
CANADA
CENRAP
SE_BC
W_BC
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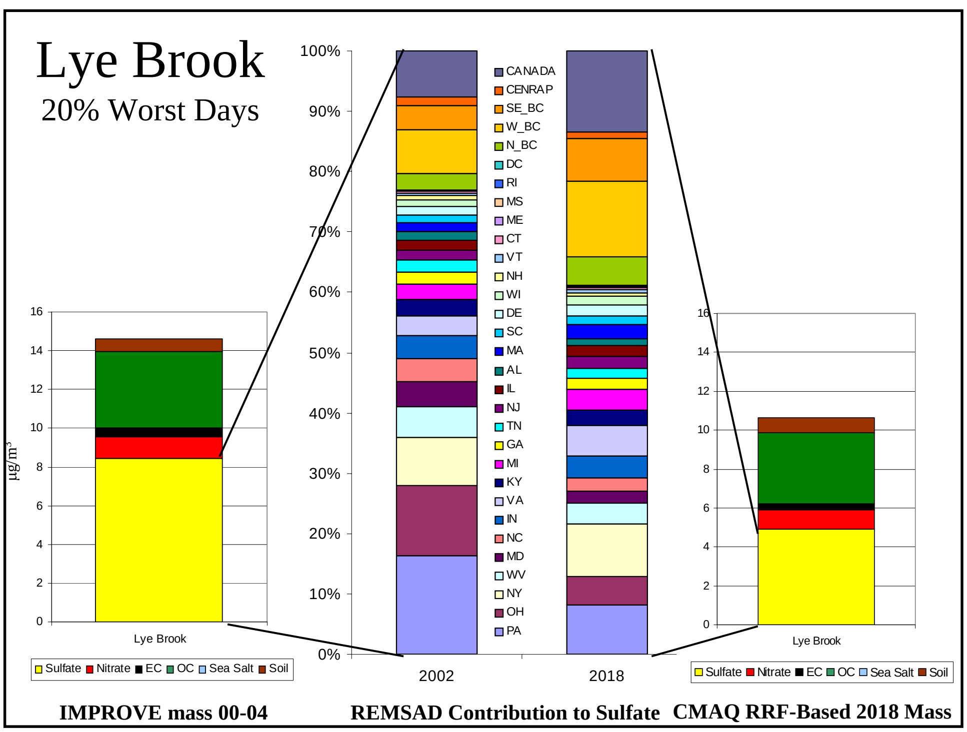
IMPROVE mass 00-04
REMSAD Contribution to Sulfate
CMAQ RRF-Based 2018 Mass


Lye Brook
20% Worst Days
µg/m3
Lye Brook
Sulfate Nitrate EC OC Sea Salt Soil
2002
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CANADA
CENRAP
SE_BC
W_BC
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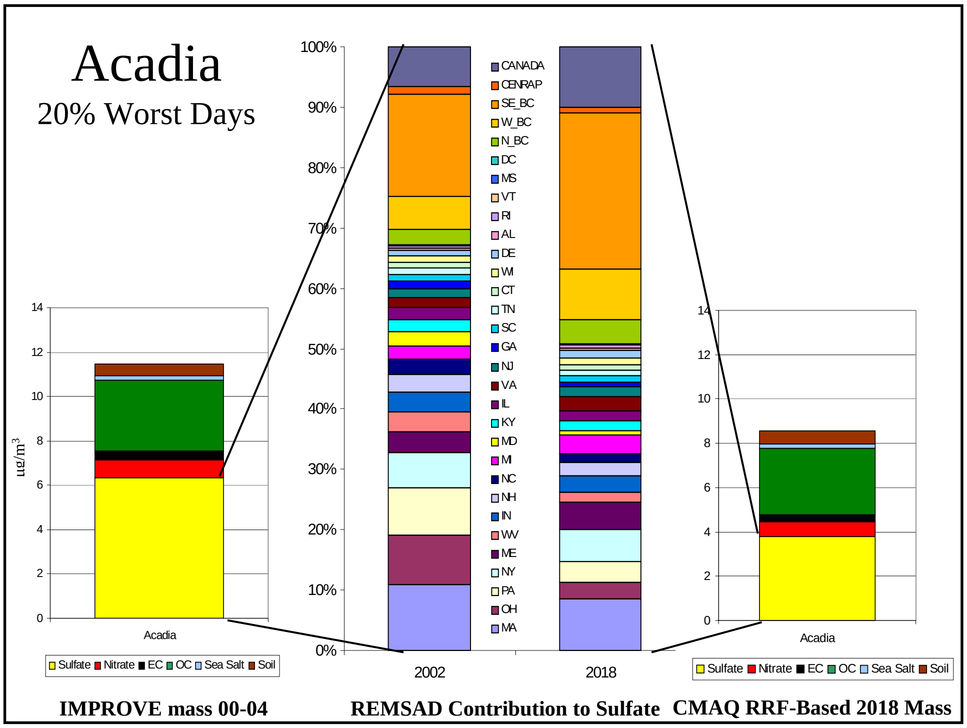
IMPROVE mass 00-04
REMSAD Contribution to Sulfate
CMAQ RRF-Based 2018 Mass


Acadia
20% Worst Days
ug/m3
Acadia
Sulfate Nitrate EC OC Sea Salt Soil
2002
2018
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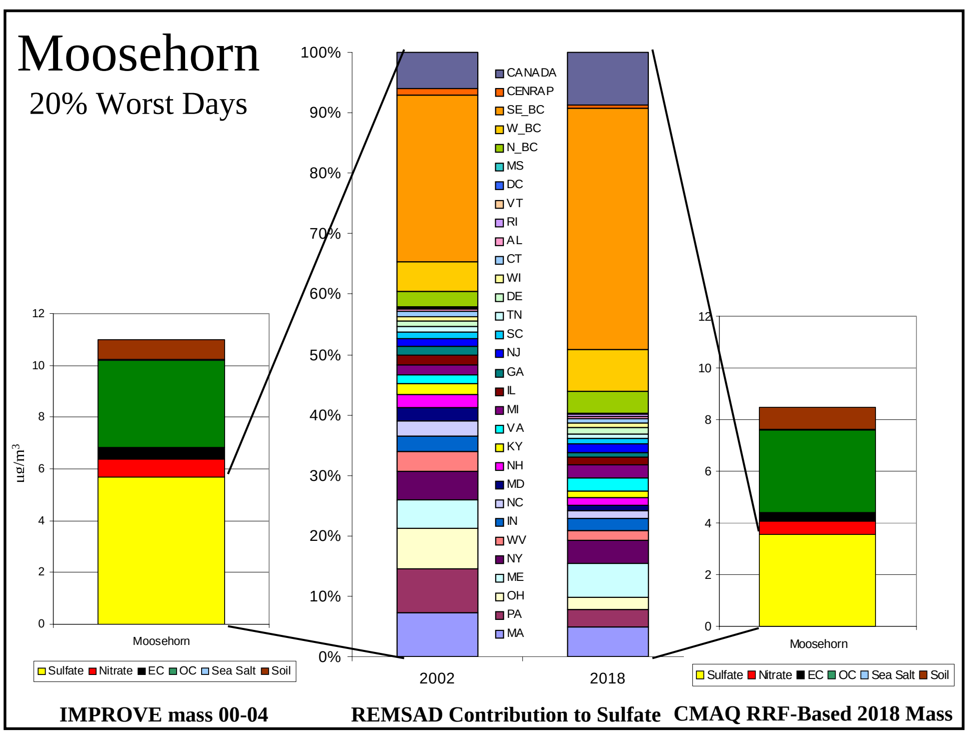
Acadia
Sulfate Nitrate EC OC Sea Salt Soil
IMPROVE mass 00-04
REMSAD Contribution to Sulfate
CMAQ RRF-Based 2018 Mass


Moosehorn
20% Worst Days
ug/m3
Moosehorn
Sulfate Nitrate EC OC Sea Salt Soil
2002
2018
CANADA
CENRAP
SE_BC
W_BC
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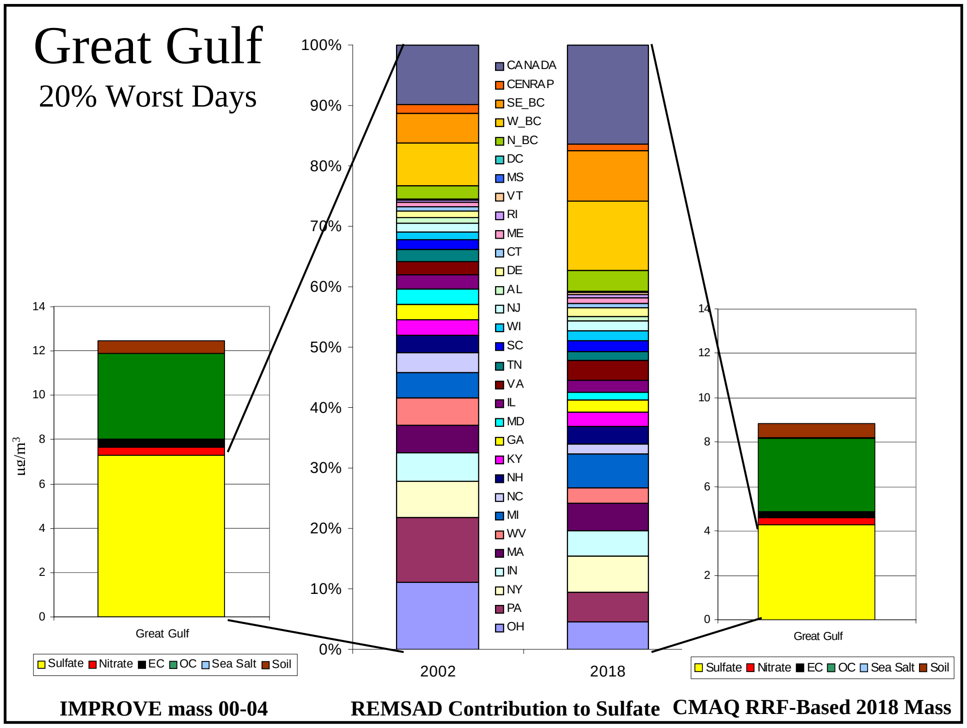
Moosehorn
Sulfate Nitrate EC OC Sea Salt Soil
IMPROVE mass 00-04
REMSAD Contribution to Sulfate
CMAQ RRF-Based 2018 Mass


Great Gulf
20% Worst Days
ug/m3
Great Gulf
Sulfate Nitrate EC OC Sea Salt Soil
IMPROVE mass 00-04
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2002
2018
CANADA
CENRAP
SE_BC
W_BC
N_BC
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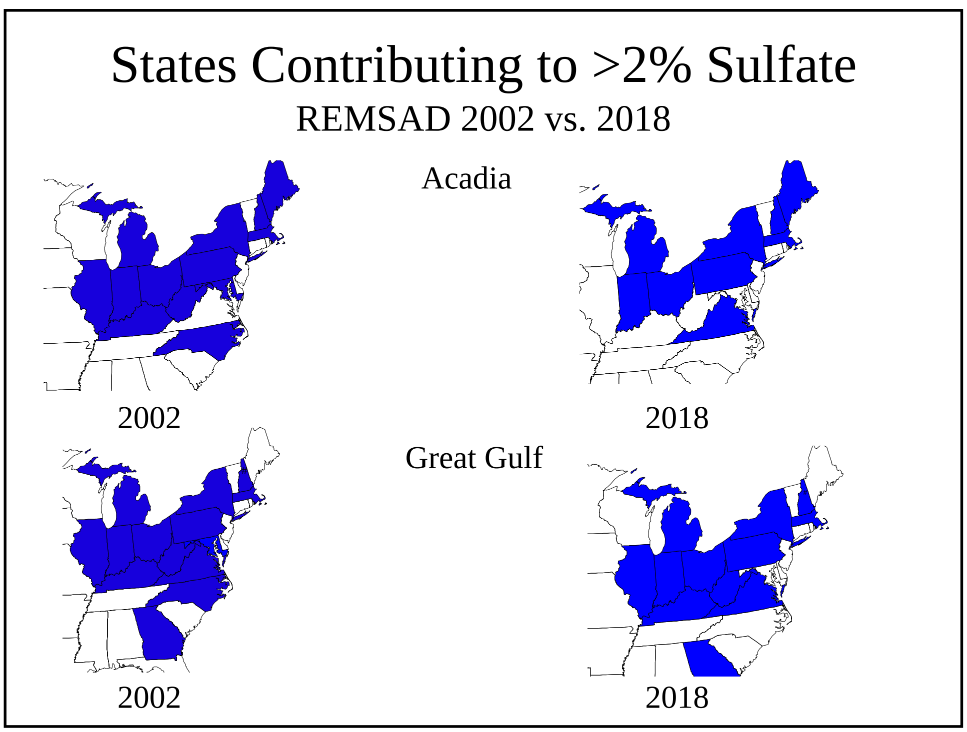
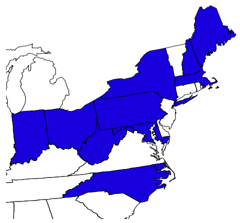
REMSAD Contribution to Sulfate
Great Gulf
Sulfate Nitrate EC OC Sea Salt Soil
CMAQ RRF-Based 2018 Mass


States Contributing to >2% Sulfate
REMSAD 2002 vs. 2018
Acadia
2002
2018
Great Gulf
2002
2018

States Contributing to >2% Sulfate

REMSAD 2002 vs. 2018

Moosehorn



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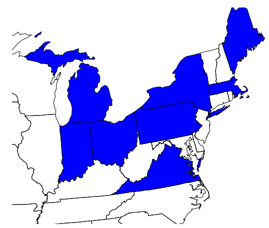
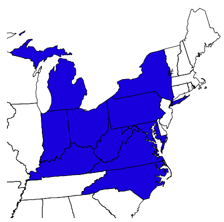


2018

Lye Brook



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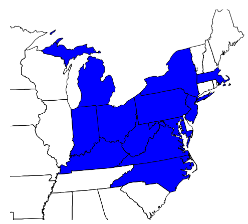
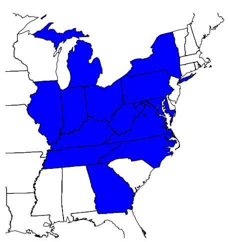


2018

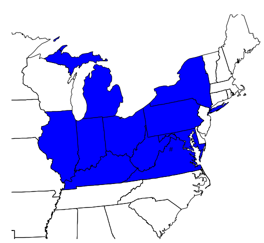
States Contributing to >2% Sulfate

REMSAD 2002 vs. 2018

Shenandoah

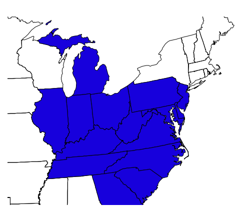


2002

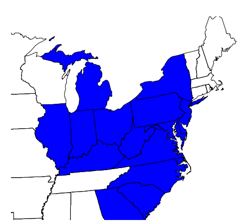


2018

Brigantine



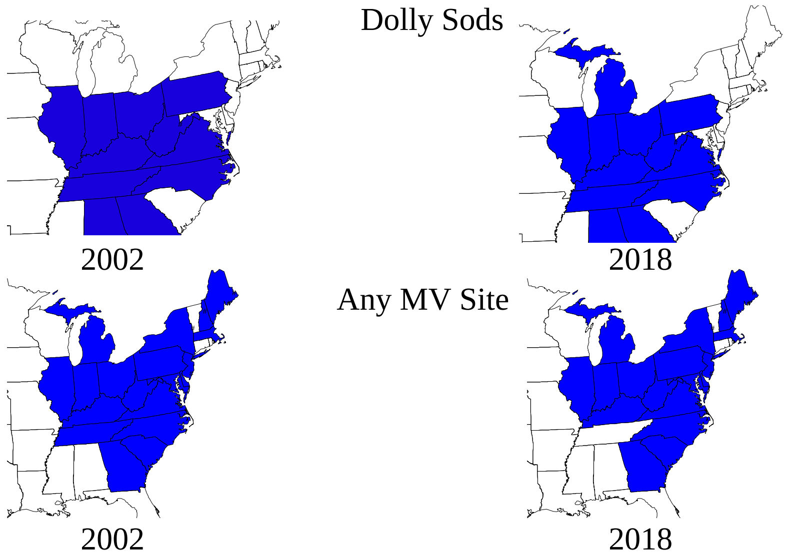
2002



2018

States Contributing to >2% Sulfate

REMSAD 2002 vs. 2018



BART

MANE-VU Approach to BART

BART-Eligible Source Identification

- MANE-VU developed preliminary list of BART-eligible EGUs based on review of Clean Air Markets Division databases (*A Basis for Control of BART-Eligible Sources*; http://www.nescaum.org/documents/a-basis-for-control-of-bart-eligible-sources/).
- MANE-VU developed preliminary list of BART-eligible non-EGUs based on review of state permit files (*Development of a list of BART-eligible sources in the MANE-VU region*; http://www.nescaum.org/documents/memo6-bart.pdf/).
- States reviewed preliminary lists and have developed their own final list of BART eligible sources

'Subject' to BART

- MANE-VU developed a preliminary demonstration that broad regions of the Eastern U.S. were likely to contribute to Baseline Regional Haze (*A Basis for Control of BART-Eligible Sources*; http://www.nescaum.org/documents/a-basis-for-control-of-bart-eligible-sources/).
- MANE-VU refined and finalized an assessment of contributing sources to sulfate in the Eastern U.S. in their contribution assessment report (*Contributions to Regional Haze in the Northeast and Mid-Atlantic United States*; http://www.nescaum.org/documents/contributions-to-regional-haze-in-the-northeast-and-mid-atlantic--united-states/)
- In 2004, the MANE-VU Board adopted the approach proposed by EPA that allowed states to find all MANE-VU BART-eligible sources "subject" to BART supported by findings in the preceding two reports that emissions from all MANE-VU states contribute some degree of visibility impairment in Class I areas. (No exemption modeling was conducted)

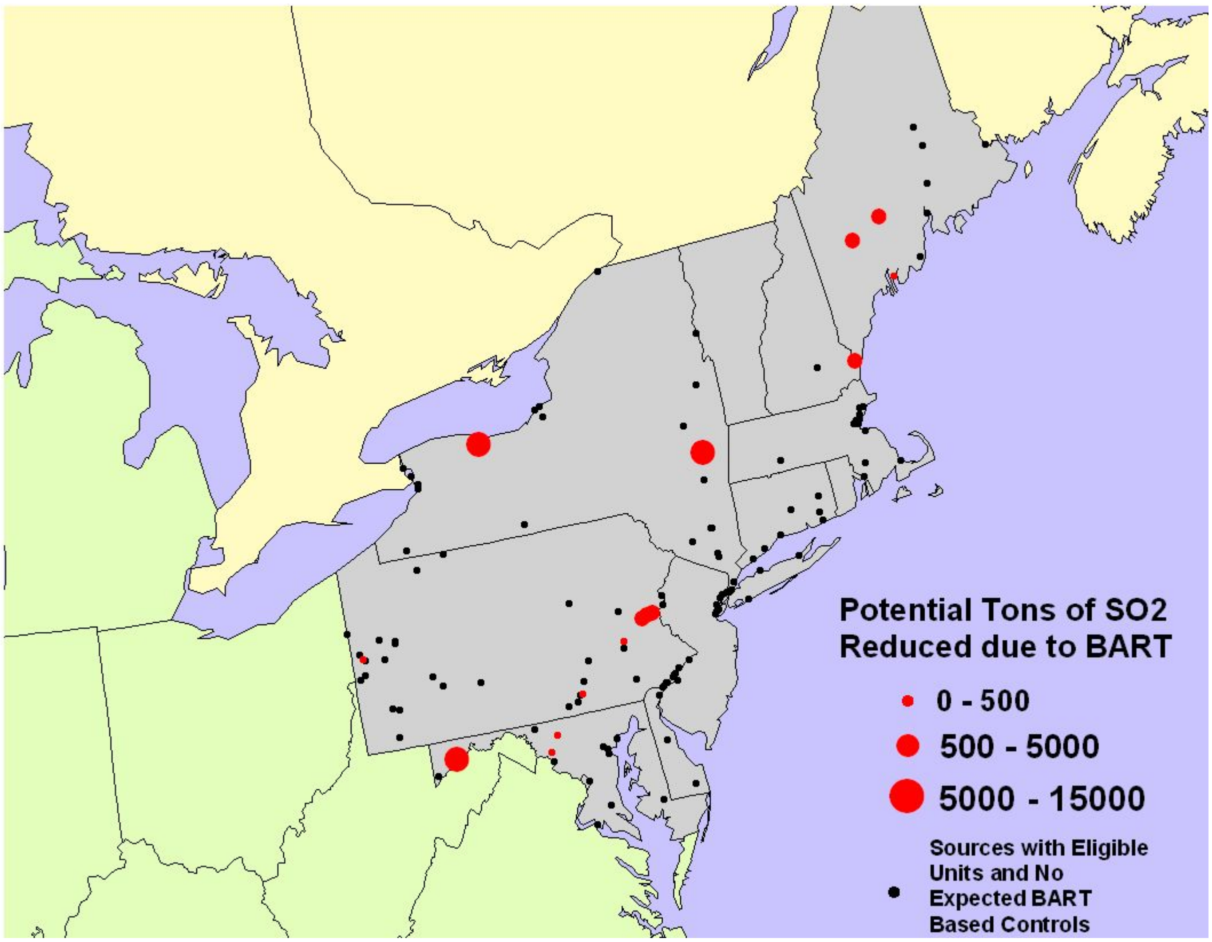
BART Determinations

- MANE-VU conducted a control technology assessment for four primary source categories that were most common in our region. This report focused on available control options and costs for EGUs, Industrial Boilers, Paper and Pulp facilities and Cement Plants. (*Assessment of Control Technology Options for BART-Eligible Sources*; http://www.nescaum.org/documents/bart-control-assessment.pdf/).
- MANE-VU coordinated and surveyed a working group of state staff focused on BART issues. Out of this survey process, MANE-VU identified potential BART control options for several BART eligible sources across the region. This information was synthesized to develop a regional "first-order" five-factor analysis to guide states as they develop their own five-factor analysis for BART-eligible sources in their state. (*Five Factor Analysis of BART-Eligible Sources*; http://www.nescaum.org/documents/bart-memo-02-09-07.pdf/). This report provides a suggested approach for considering each of the five statutory BART factors including the degree of visibility improvement that may result from installation of controls. For this factor it was suggested that a weight be given

such that no additional controls would be warranted for any source that has a current annual average contribution to visibility impairment at any Class I area of less than 0.1 delta deciview during 2002.

- Primary findings from this analysis are shown in the figure below and three attached tables. The analysis suggests that the majority of BART-eligible sources either do not warrant additional controls based on cost or visibility considerations or are being controlled already under other programs (e.g. CAIR) and that these controls will serve as BART.

Figure 1: Potential Reductions from BART-Eligible Sources in the MANE-VU Region



Note: "No Expected BART-Based Controls" implies that the eligible units at that source either do not warrant additional controls based on cost or visibility considerations <u>or are being controlled already</u> under other programs (e.g. CAIR) and that these controls will serve as BART.

Table 1. Possible range of SO_2 controls and costs based on survey of state staff

Type of Source	*Number of Sources*	*Control Strategies*	*Number of Emission Units Control Strategy May Apply*	*Total 2002 SO_2 Emissions*	*Total Estimated Decrease in SO_2 (tons/yr)*	*Estimated Cost ($/Ton SO2)*	*Notes*
Chemical Manufacturer	3	SO2 Scrubber	1	24000	9600	400-8000	Mid Range (1)
		Currently Controlled	2	80	NA	0	
Glass Fiber	6	Currently Controlled	6	17	0	0	
Coal Cleaning	1	No Known Further Controls	1	68	0	0	
EGU/Coal	5	Dry Scrubber	4	58000	52600	200-500	Mid Range, assume 90% scrubber efficiency
		0.33 lb/MMBtu	1	4000	1200	NA	
EGU/Oil (Resid and Dist)	17	0.3% fuel sulfur limit	3	1400	340	0	Switch to 0.3% has already occurred for 3 boilers.
		0.56 lb/MMBtu	1	85	NA	NA	
		2.0 % Fuel Sulfur Limit	1	600	300	NA	
		1.5% Fuel Sulfur Limit	1	5200	1300	NA	
		0.33 lb/MMBtu	1	4000	3100	NA	
		3.0 lb/MWh	5	31000	NA	NA	
		1.1-1.2 lb/MMBtu	2	480	NA	NA	
		Currently Controlled	3	1200	0	0	
Incinerator	2	Currently Controlled	2	84	0	0	
Metal Production	7	No Further Controls Warranted	5	2200	0	0	
		Increased efficiency of the facility's wet scrubber	2	3000	300	Limited Cost	Low Range
Paper and Pulp	30	FGD (SO_2 Scrubber)	3	13000	11000	400-8000	Mid Range (1)
		1.8% Fuel Oil	2	6050	3000	NA	
		2.0% Fuel Oil	1	2800	1400	NA	
		No Known further controls	3	10000	0	0	
		Currently Controlled	21	4000	0	0	
Portland Cement	25	Fuel switching: CE of SOx 10%	3	2300	230	NA	
		No Further Controls Warranted	5	3700	0	0	
		No Known Further Controls	7	300	0	0	
		SO_2 Scrubber	10	26000	19000	400-8000	Mid Range (1)
Refinery	37	Refinery RACT	9	5400	NA	0	
		SO2 Scrubber	3	NA	NA	400-8000	Mid Range (1)
		No Known Further Controls	25	NA	NA	0	

(1) Cost estimate from NESCAUM, 2005 for Industrial Boilers
NA- No information currently available.

Table2. Possible range of NO_X controls and costs based on survey of state staff

Type of Source	*Number of Sources*	*Control Strategies*	*Number of Emission Units Control Strategy May Apply*	*Total 2002 NO_x Emissions*	*Total Estimated Decrease in NO_x (tons/yr)*	*Estimated Cost (\$/Ton NO_x)*	*Notes*
Chemical Manufacturer	3	SCR	1	4900	3400	1300-10000	(2)
		Currently Controlled	2	5000	0	0	
Glass Fiber	6	Currently Controlled	6	180	0	0	
Coal Cleaning	1	Low NOx burners, CE of 15%	1	160	25	1-2 Million (capital cost)	Low Range
EGU/Coal	5	Currently Controlled	2	2900	820	0	
		SCR and 1.5 lb/MWh	2	9800	NA	1000-1500	Mid Range (1)
		NOx Budget & 1.5 #/MWh	1	2300	NA	NA	
EGU/Oil	17	Currently Controlled	6	3200	0	0	
		No Known Controls	3	390	0	0	
		NOx Budget	3	700	NA	NA	
		NOx Budget and 1.5 lb/MWh	4	5300	NA	NA	
		SNCR, 1.5 lb/MWh	1	2400	NA	500-700	Mid Range (1)
Incinerator	1	Currently Controlled	2	720	0	NA	
Metal Production	2	Currently Controlled	2	0	0	0	
	5	No Further Controls Warranted	5	110	0	0	
Paper and Pulp	30	SCR or SNCR	2	710	430	1300-10000	Mid to High Range (2)
		No Known Further Controls	13	4500	0	0	
		Currently Controlled	15	4600	0	0	
Portland Cement	25	Low NOx burners	3	2800	430	200-3000	Mid Range
		Low NO_x Burners and Mid Kiln Firing, 40% Reduction	2	8500	3400	1200-10000	Mid Range (2)
		SCR, 65% Red.	1	740	480	1300-10000	(2)
		No Known Further Controls	9	2000	0	0	
		Currently Controlled	1	1700	0	0	
		SNCR	9	7100	2900	900-1200	Mid Range
Refinery	37	Refinery RACT	9	2300	NA	NA	
		No Known Further Controls	25	0	0	0	
		SCR	2	460	40	1300-10000	(2)
		SNCR	1	1000	560	1300-10000	(2)

(1) Cost estimate from NESCAUM, 2005, EGU controls
(2) Cost estimate from NESCAUM 2005, Industrial Boiler controls
NA- No information currently available.

Table 3. Possible range of PM_{10} controls and costs based on survey of state staff

Type of Source	*Number of Sources*	*Control Strategies*	*Number of Emission Units Control Strategy May Apply*	*Total 2002 PM_{10} Emissions*	*Total Estimated Decrease in PM_{10} (tons/yr)*	*Estimated Cost (\$/Ton PM_{10})*	*Notes*
Chemical Manufacturer	3	Currently Controlled	3	200	0	0	
Coal Cleaning	1	No Known Further Controls	1	46	0	0	
EGU/Coal	10	Currently Controlled ESP	7	2000	0	0	
		PM co-benefit reductions expected due to FGD-25-50% reduction	2	1500	370	0	
		Baghouse	1	1500	NA	$50 M	Capital Cost
EGU/Natural Gas	2	Controls information included with oil/coal boilers	2	13	NA	NA	
EGU/Oil	18	Currently Controlled	13	410	42	0	
		No Known Further Controls	5	50	0	0	
Incinerator	2	Currently Controlled Fabric Filter	2	0	0	0	
Glass Fiber	6	Currently Controlled	6	190	0	0	
Metal Production	7	Currently Controlled	7	41	0	0	
Paper and Pulp	30	Upgrade from ESP to baghouse, CE of 4% estimate	2	180	7	$15 M	Capital Cost
		No Known Further Controls	7	280	0	0	
		Currently Controlled (ESP, Venturi Scrubbers, Demister, or MultiCyclones)	9	690	0	0	
		Current Controls	7	670	0	NA	
Portland Cement	25	Upgrade on current ESP, CE of 5%	3	210	11	Limited Cost	
		No Known Further Controls	15	300	0	0	
		Currently Controlled	6	370	0	0	
		Baghouse or electric precipitator	1	4	NA	NA	
Refinery	37	No Known Further Controls	28	NA	0	0	
		Refinery RACT	9	270	NA	NA	

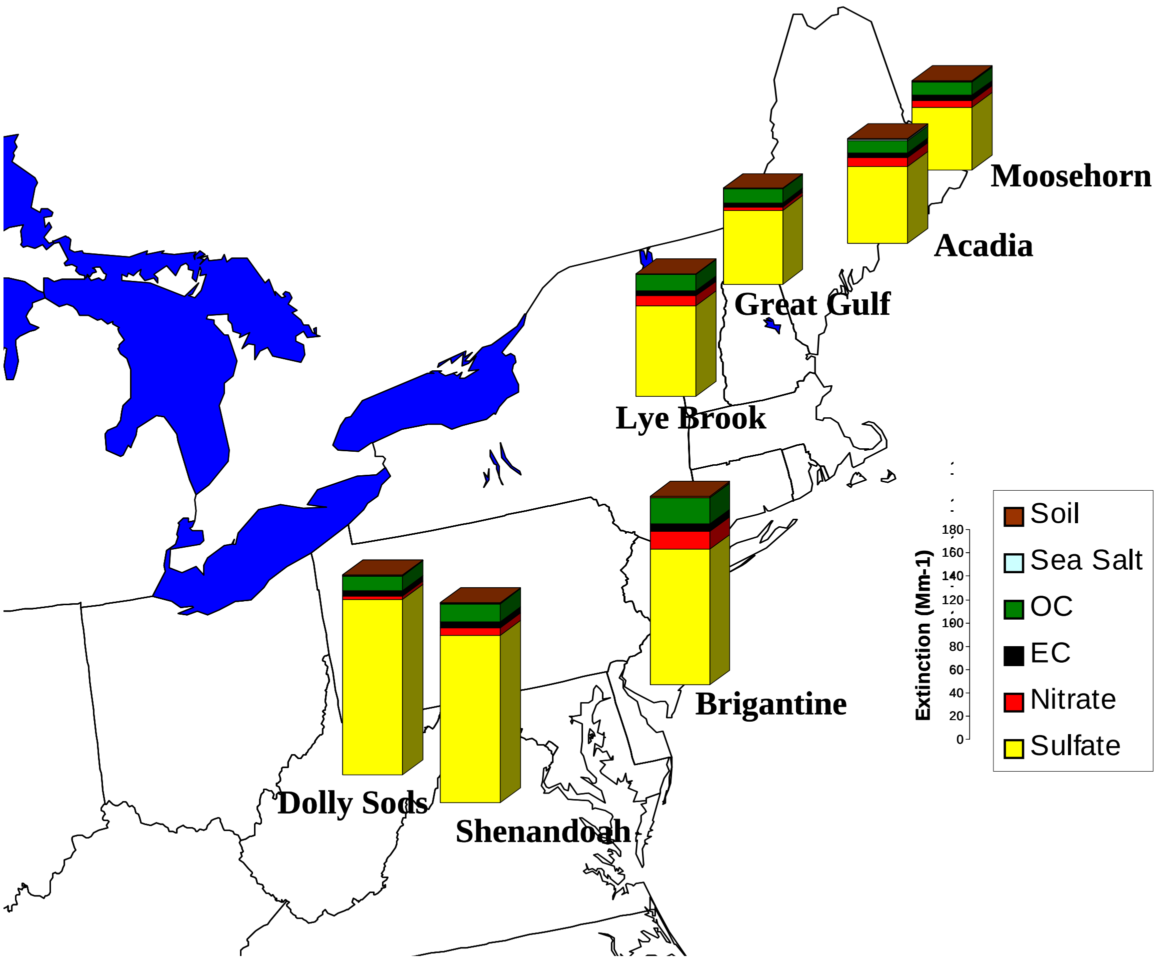
NA- No information currently available.

Technical Support for Reasonable Progress Goals and Long-Term Strategies

Focus on SO_2

- MANE-VU has conducted a contribution assessment and developed a conceptual model that indicates that the dominant contributor to visibility impairment at all sites during all seasons is particulate sulfate formed from emissions of SO_2. While other pollutants, including organic carbon, need to be addressed in order to achieve the national visibility goals, our technical assessments suggest that an early emphasis on SO_2 will yield the greatest near-term benefit. See **Figure 1**.
- Source region for SO_2 emissions is generally south and west (upwind) of MANE-VU Class I areas on worst visibility days.

Figure 1: Contribution of Sulfur to Visibility Impairment in the Eastern U.S. on 20% Worst Days

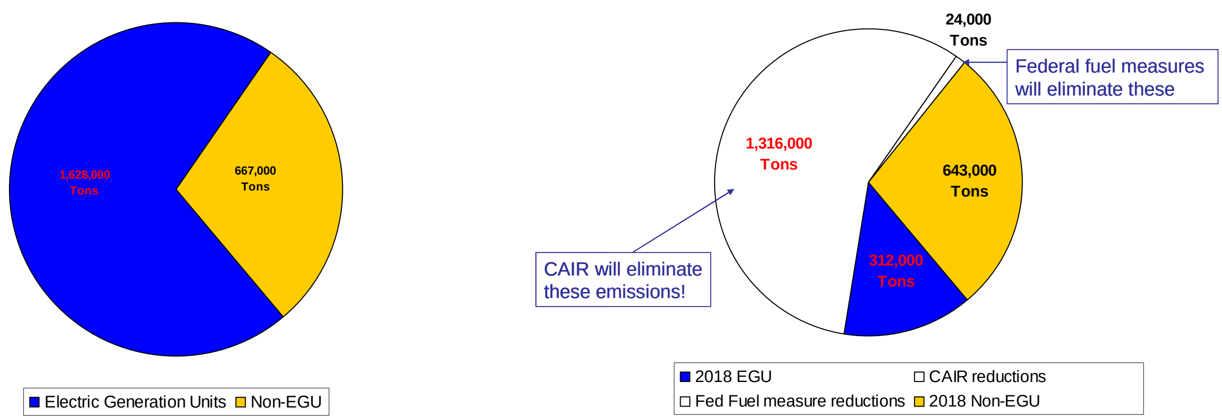


- Wood combustion near Class I areas contributes to organic carbon. This component of fine particle pollution also contributes to visibility impairment and is observed at MANE-VU sites.

Inventory Analysis

- By 2018, implementation of CAIR is projected to reduce 1.3 million tons of MANE-VU SO_2 emissions annually. Relative to our current 2002 total of 1.6 million tons per year in the power sector, this represents a very significant reduction of over 80% of power sector emissions in the MANE-VU region.
- By contrast, non-EGU SO_2 emissions are projected to be reduced by federal programs (primarily through on-road and non-road fuel standards) in the MANE-VU region by only 24,000 tons. This would bring our current SO_2 emissions of 667,000 tons per year down to approximately 643,000 tons per year.
- Significant opportunities remain to further reduce the projected remaining 312,000 tons of annual EGU SO_2 emissions as well as the 643,000 tons of annual non-EGU SO_2 emissions. See **Figure 2**.

Figure 2: Potential Reduction Opportunities in the MANE-VU Region



2002 Emissions   2018 Emissions

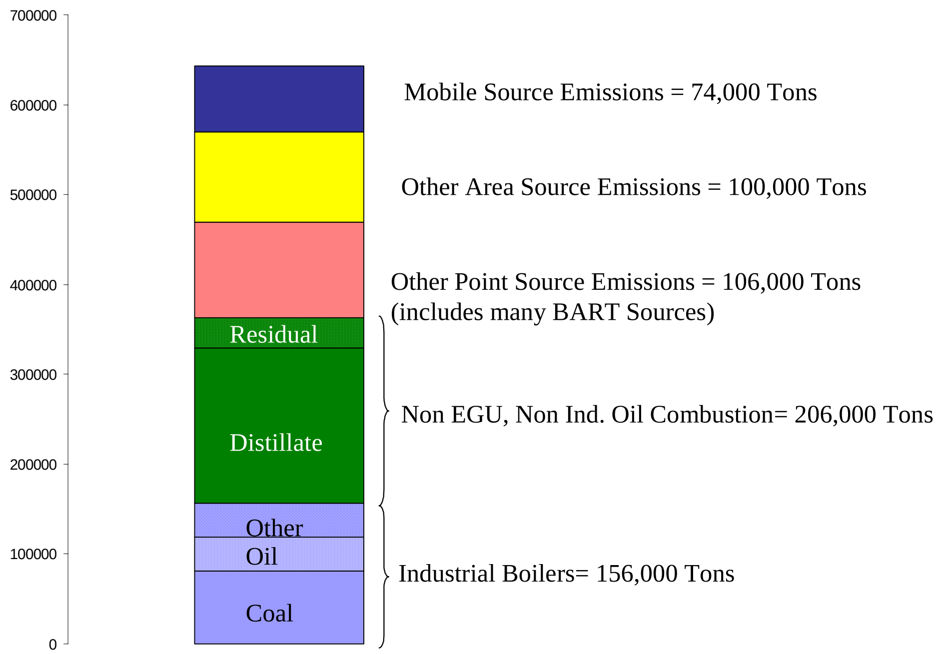
EGUs

- MANE-VU remains interested in CAIR+ for SO_2 as a means of achieving $PM_{2.5}$ NAAQS compliance and furthering regional haze progress in a reasonable (cost-effective) way.
- The MANE-VU four-factor analysis has identified several large EGUs (both within and outside MANE-VU) with significant impact on MANE-VU Class I visibility during 2002. Control options for these sources are being considered.

Non-EGU SO_2

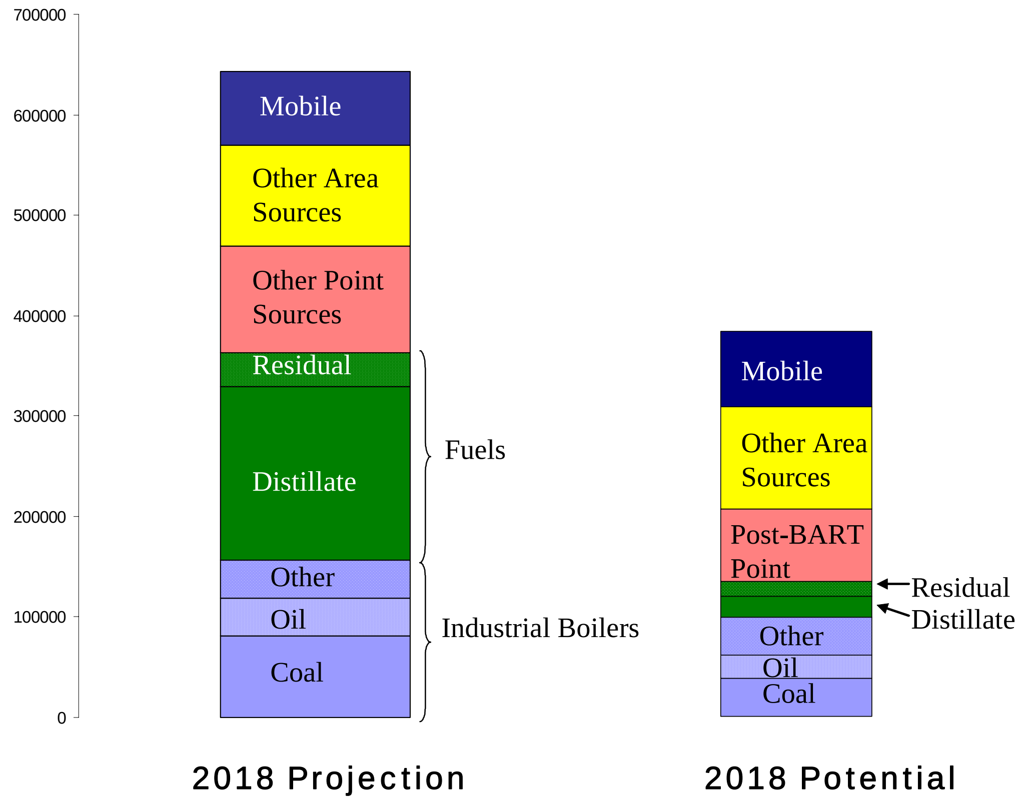
- The 643,000 tons in non-EGU SO_2 emissions can be broken down into the following categories: Industrial Boilers (156,000 tons), Other oil combustion sources (206,000 tons), Other non-oil point sources (includes many BART emissions reduction candidates; 106,000 tons), Other area sources (100,000 tons), and other mobile sources (74,000 tons). See **Figure 3**.

Figure 3: 2018 Projected Non-EGU SO_2 Emissions in the MANE-VU Region



- Coal burning industrial boilers have non-FGD control options including Hydrate Boiler Injection, and Lime Slurry Duct Injection. These methods have been shown to achieve between 20 and 60 percent and 35 to 90+ percent control at reasonable costs in the range of $500 to $1000 per ton of SO_2 removed. A conservative assumption of 50% control could achieve a 40,500 ton reduction.
- Limits on the fuel-sulfur content of oil-burning industrial boilers could also yield reductions on the order of 50% from this category by requiring the use of 0.5 percent S residual oil. Such a strategy might yield a 19,000 ton reduction.
- Low-sulfur fuel requirements would offer significant additional reduction from non-EGU, non-industrial boiler sources. Requiring 500 and/or 15 ppm distillate (relative to current 2000+ ppm baseline) could result in between 140,000 and 167,000 tons of SO_2 reduction annually.
- The use of 0.5 percent (5000 ppm) residual oil (relative to current residual oil that has sulfur content of 1 percent or higher) could result in ~19,000 tons reduction.
- Preliminary findings from our BART analysis suggest additional emissions reduction potential in the 35,000 ton range from several MANE-VU BART-eligible sources.
- The combined emission reduction of all these measures would result in nearly a 40 percent reduction in SO_2 emissions from the non-EGU sources in MANE-VU relative to projected 2018 levels. See **Figure 4**.
- The MANE-VU four-factor analysis has identified several large non-EGUs (both within and outside MANE-VU) with significant impact on MANE-VU Class I visibility during 2002. Control options for these sources are being considered.

Figure 4: 2018 Potential Non-EGU SO_2 Emission Reductions in the MANE-VU Region



Long-term Emissions Management Options for MANE-VU

MANE-VU is considering (1) a CAIR+ EGU program for SO_2, (2) measures to reduce non-EGU emissions in MANE-VU by up to 40 percent or 250,000 tons of SO_2, and (3) programs to reduce wood combustion-related emissions in MANE-VU.

Mid-Atlantic/Northeast Visibility Union
MANE-VU

MANE-VU Reasonable Progress Project Summary

PURPOSE

The Clean Air Act requires states to consider the following four factors to determine which emission control measures are needed to make reasonable progress in improving visibility: 1) costs of compliance, 2) time necessary for compliance, 3) energy and non-air quality environmental impacts of compliance, and 4) remaining useful life of any existing source subject to such requirements. The plan must include reasonable measures and identify the visibility improvement that will result from those measures (i.e., the reasonable progress goal).

EPA issued draft guidance for implementing the reasonable progress requirement (dated 11/28/2005). The guidance recommends the following process for developing reasonable progress goals: 1) identify pollutants and associated source categories affecting visibility in Class I areas, 2) list possible control measures for these pollutants and source categories, 3) apply the four statutory factors to each control measure for each source category, and 4) assess the visibility improvement resulting from various combinations of strategies and select the Reasonable Progress Goals.

MANE-VU has developed information about the pollutants and sources affecting visibility and has developed a list of possible control measures for consideration. In order to assist MANE-VU in applying the four statutory factors, in January 2007, MARAMA signed a contract with MACTEC Federal Programs Inc., to prepare a technical support document. The report MACTEC is preparing under this project summarizes MANE-VU's assessment of pollutants and associated source categories affecting visibility in Class I areas in and near MANE-VU, lists possible control measures for those pollutants and source categories, and develops the requisite four factor analysis. NESCAUM will assist MANE-VU by conducting air quality and visibility modeling to address the fourth step of the process described in EPA's guidance.

POLLUTANTS AND SOURCE CATEGORIES AFFECTING VISIBILITY

<u>What Pollutants Affect Visibility?</u>
The MANE-VU Contribution Assessment (NESCAUM 2006) and the MANE-VU Conceptual Model for Fine Particles and Regional Haze Air Quality Problems (NESCAUM 2006) identify sulfate as the largest contributor to visibility impairment in Mid-Atlantic and Northeastern Class I areas. Organic carbon is typically the second-largest contributor to regional haze in the MANE-VU region.

<u>What are the Major Source Categories of these Pollutants?</u>
The largest source category of sulfur dioxide in the region is electric generating units (EGUs). Additional SO_2 source categories analyzed include oil-fired installations at residential, commercial, institutional, or industrial facilities; industrial, commercial, and institutional (ICI) boilers; and cement and lime kilns.

According to Appendix B of the MANE-VU Contribution Assessment (NESCAUM 2006), woodsmoke also contributes to visibility impairment, with contributions typically higher in rural areas than urban areas, winter peaks in northern areas from residential wood burning, and occasional large summer impacts at all sites from wildfires. The MANE-VU *Technical Support Document on Agricultural and Forestry Smoke Management in the MANE-VU Region* concluded that fire from land management activities was not a major contributor to regional haze in MANE-VU Class I areas, and that the majority of emissions from fires were from residential wood combustion.

Based on available information, the MANE-VU Reasonable Progress Workgroup selected the following source categories for analysis:

- Coal and oil-fired Electric Generating Units, (EGUs);
- Point and area source industrial, commercial and institutional boilers;
- Cement kilns;
- Lime kilns;
- The use of heating oil; and
- Residential wood combustion and open burning.

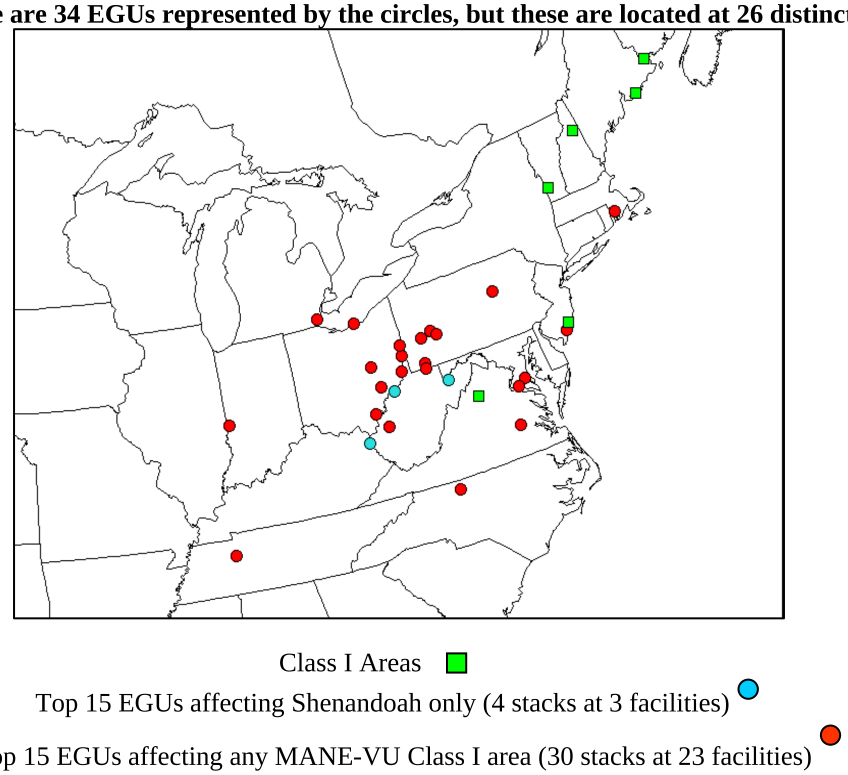
WHERE DO THESE POLLUTANTS ORIGINATE?

Specific EGUs are Important

Roughly 70% of the 2.3 million tons of SO_2 emission in the 2002 MANE-VU emissions inventory (2002 MANE-VU Emission Inventory Version 3) were from EGUs, making them the largest SO_2 source category in terms of visibility impairing emissions. Figure 1 shows the locations of 34 EGU stacks that have impacts on at least one Class I area in MANE-VU or Shenandoah (a nearby Class I area). Many of these EGUs are in MANE-VU but some are outside of the region.

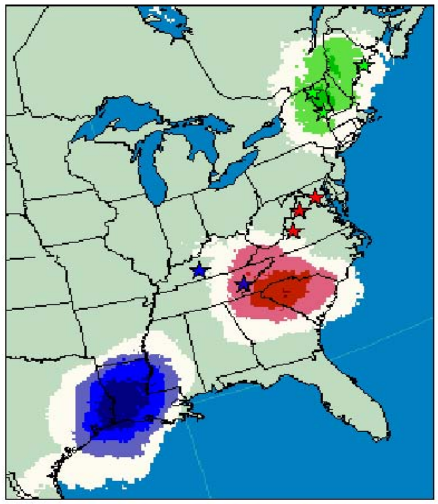
Figure 1: Key EGUs affecting Class I area(s) (Moosehorn, Acadia, Great Gulf, Lye Brook, or Shenandoah)

Note: There are 34 EGUs represented by the circles, but these are located at 26 distinct facilities



Wood Smoke is More Local in Origin
Figure 2 is from Appendix B of the MANE-VU Contribution Assessment (NESCAUM 2006) and represents the results of source apportionment and trajectory analyses. It illustrates that the impacts of woodsmoke on MANE-VU Class I areas are more likely due to emissions from within MANE-VU and Canada. The green highlighted section of the map shows the woodsmoke source region for several MANE-VU Class I areas represented by the green stars. (Brigantine was not analyzed for this map.)

Figure 2: Woodsmoke Source Regional Aggregations



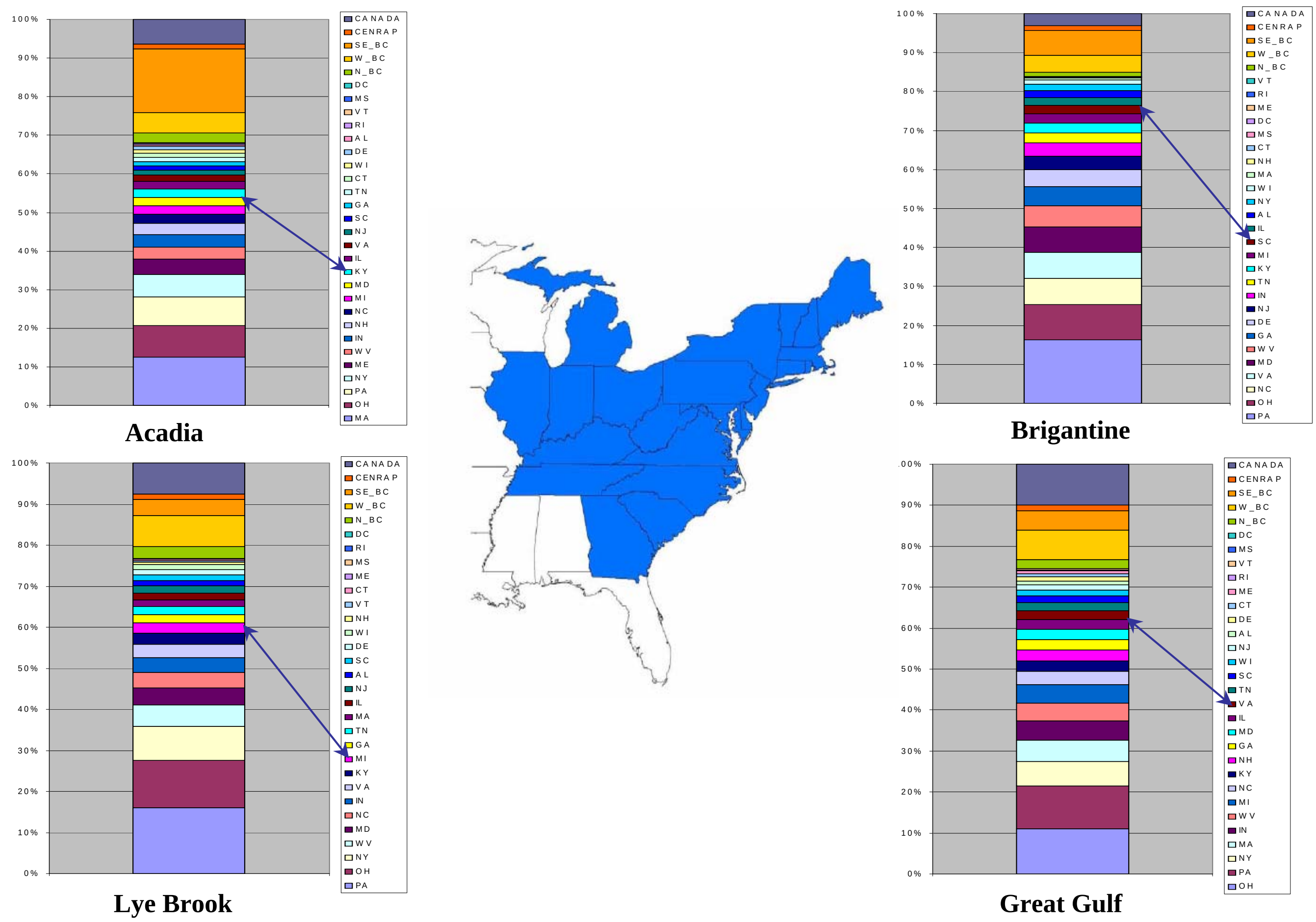
NE: ACAD, PMRC, LYBR
MA: WASH, SHEN, JARI
SE: GRSM, MACA

Defining the Area of Influence
In order to identify states where emissions are most likely to influence visibility in MANE-VU Class I areas, analyses such as represented in Figure 1 and 2 above as well as other analyses documented in the MANE-VU Contribution Assessment were considered.

The MANE-VU States concluded that it was appropriate to include in the area of influence all of the states participating in MANE-VU plus other states that modeling showed contributed at least 2% of the sulfate ion at MANE-VU Class I areas in 2002.

Figure 3 shows for Acadia, Brigantine, Lye Brook, and Great Gulf the modeled percent of sulfate ion impact from specific states. The state with the largest individual sulfate impact at that Class I area is shown at the bottom of the bar and the list to the right. The size of the bar slice is proportional to the modeled impact (using the REMSAD model). The percentages at the left of the bar refer to the percent of SO_4 impact within the modeling domain. Each of the states at and below the arrow contributes more than 2% of modeled sulfate ion to that Class I area.

Figure 3: States Contributing to Sulfate in MANE-VU in 2002



Source: NESCAUM, MANE-VU Contribution Assessment 2006

POTENTIAL CONTROL MEASURES AND FOUR FACTOR ANALYSIS

In consultation with the MANE-VU Reasonable Progress Workgroup, MACTEC has developed a report that identifies potential control measures and assesses costs, time needed for compliance, energy and non-air quality impacts, and the remaining useful life of affected sources. Table 1 presents a summary of the four factor analysis for the source categories analyzed; more detailed information is available in the draft final report document, which may be found on MARAMA's website at http://www.marama.org/visibility/RPG/index.html

Table 1: Summary of Results from the Four Factor Analysis

Source Category	Primary Regional Haze Pollutant	Average Cost in 2006 dollars (per ton of pollutant reduction)	Compliance Timeframe	Energy and Non-Air Quality Environmental Impacts	Remaining Useful Life
Electric Generating Units	SO_2	IPM* v.2.1.9 predicts $775-$1,690 $170-$5,700 based on available literature	2-3 years following SIP submittal	Fuel supply issues, potential permitting issues, reduction in electricity production capacity, wastewater issues	50 years or more
Industrial, Commercial, Institutional Boilers	SO_2	$130-$11,000 based on available literature	2-3 years following SIP submittal	Fuel supply issues, potential permitting issues, control device energy requirements, wastewater issues	10-30 years
Cement and Lime Kilns	SO_2	$1,900-$73,000 based on available literature	2-3 years following SIP submittal	Control device energy requirements, wastewater issues	10-30 years
Heating Oil	SO_2	$550-$750 based on available literature. There is a high uncertainty associated with this cost estimate.	Currently feasible. Capacity issues may influence timeframe for implementation of new fuel standards	Increases in furnace/boiler efficiency, Decreased furnace/boiler maintenance requirements	18-25 years
Residential Wood Combustion	PM	$0-$10,000 based on available literature	Several years - dependent on mechanism for emission reduction	Reduce greenhouse gas emissions, increase efficiency of combustion device	10-15 years

* EPA's Integrated Planning Model

MANE-VU invited all interested parties to submit comments on the draft report by May 4th to Angela Crenshaw at MARAMA (acrenshaw@marama.org). Additional comments will be considered if time permits.

THE MANE-VU REASONABLE PROGRESS WORKGROUP

This project is guided by MANE-VU's Reasonable Progress Workgroup, which reviewed draft documents and reports to MANE-VU's Technical Support Committee. The Workgroup met via conference call several times per month, with twelve calls in total. Regular participants include the MANE-VU states and tribes, VISTAS, LADCO, NESCAUM, OTC, the Environmental Protection Agency, the National Park Service, and the Forest Service. Workgroup minutes, and all related project documents are available on the MARAMA website:
http://www.marama.org/visibility/RPG/index.html

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MANE-VU's Approach to Developing Regional Haze Control Measures for the 2018 Milestone

MANE-VU's approach towards deciding which control measures to pursue for regional haze is based on technical analyses documented in the following reports:

- Contributions to Regional Haze in the Northeast and Mid-Atlantic United States (called the Contribution Assessment),
- Comparison of CAIR and CAIR Plus Proposal using the Integrated Planning Model (called the CAIR+ Report), and
- Assessment of Reasonable Progress for Regional Haze in MANE-VU Class I Areas (callsed the Reasonable Progress Report).

Pollutants of Concern

Finalized in August 2006, the Contribution Assessment reflects "a conceptual model in which sulfate emerges as the most important single constituent of haze-forming fine particle pollution and the principle cause of visibility impairment across the region. Sulfate alone accounts for anywhere from one-half to two-thirds of total fine particle mass on the 20 percent haziest days at MANE-VU Class I sites." Organic carbon was shown to be the second largest contributor to haze. As a result of the dominant role of sulfate in the formation of regional haze in the Northeast and Mid-Atlantic region, the report states that "[T]hese findings suggest that an effective emissions management approach would rely heavily on broad-based regional SO_2 control efforts in the eastern United States."

Contributing Sources

The Contribution Assessment reviewed various modeling techniques, air quality data analysis, and emissions inventory analysis to identify source categories and states that contribute to visibility impairment in MANE-VU Class I areas. With respect to sulfate, emissions from within MANE-VU in 2002 were responsible for about 25-30 percent of the sulfate at MANE-VU Class I areas. Sources in the MRPO and VISTAS regions were responsible for about 15-25 percent each. Point sources dominated the inventory of SO_2 emissions. Biomass combustion was also identified by source apportionment analysis as a local source contributing to visibility impairment.

Identifying Potential Strategies

The process by which MANE-VU arrived at a set of proposed regional haze control measures to pursue for the 2018 milestone started in late 2005. OTC selected a contracting firm to assist with the analysis of ozone and regional haze control measure options. OTC provided the contractor with a "master list' of some 900 potential control measures, based on experience and previous state implementation plan work. With the help of an internal OTC control measure workgroup, the contractor identified reasonably available regional haze control measures for MANE-VU's further consideration. MANE-VU then developed an interim list of control measures, which for regional haze included: beyond-CAIR sulfate reductions from EGUs, low-sulfur heating oil (residential and commercial), ICI boilers (both coal and oil-fired), lime and cement kilns, residential wood combustion, and outdoor burning (including outdoor wood boilers).

The next step in the regional haze control measure selection process was to further refine the interim list. The beyond-CAIR EGU strategy continued to stay on the list since EGU sulfate emissions have, by far, the largest impact on visibility in the MANE-VU Class I areas. Likewise, a low-sulfur oil strategy gained traction after a NESCAUM-initiated conference with refiners and fuel-oil suppliers concluded that such a strategy could realistically be implemented in the 2014 timeframe. Thus the low-sulfur heating oil and the oil-fired ICI boiler sector control measures merged into an overall low-sulfur oil strategy for #2, #4, and #6 residual oils for both the residential and commercial heating and oil-fired ICI boiler source sectors.

During MANE-VU's internal consultation meeting in March 2007, member states reviewed the interim list of control measures to make further refinements. States determined, for example, that there may be too few coal-fired ICI boilers in the MANE-VU states for that to be considered as a "regional" strategy, but could be a sector pursued by individual states. They also determined that lime and cement kilns, of which there are few in the MANE-VU region, would likely be handled via their BART determination process. Residential wood burning and outdoor wood boilers remain on the list for those states where localized visibility impacts may be of concern even though emissions from these sources are primarily organic carbon and direct particulate mater. Finally, outdoor wood burning was determined to also be better left as a sector to be examined further by individual states, due to issues of enforceability and penetration of existing state regulations.

The CAIR+ Report documents the analysis of the cost of additional SO_2 and NO_x controls at EGUs in the Eastern U.S. The Reasonable Progress Report documents the assessment of control measures for EGUs and the other source categories selected for analysis.

Determining What Is Reasonable

MANE-VU is guided by two primary principles in which regional control measures to pursue in reducing sulfate levels: 1) that the measures are "reasonable," and 2) that the measures are in place by 2018, the first milestone date in the Congressional goal of achieving natural visibility conditions by 2064. Reasonable progress towards meeting the 2064 goal is defined in section 169A of the Clean Air Act, and includes the mandatory consideration of four factors: 1) the cost of compliance, 2) the time necessary for compliance, 3) the energy and nonair quality environmental impacts of compliance, and 4) the remaining useful life of any existing source subject to such requirements.

Guided by these principles, MANE-VU has arrived at a suite of suggested control measures that the MANE-VU states will pursue as a region. The corollary is that the

MANE-VU Class I states (Maine, New Hampshire, Vermont, and New Jersey) will ask states outside of MANE-VU that contribute to visibility impairment to pursue similar strategies for reducing sulfate emissions from source sectors, or equivalent sulfate reductions if not from the source sectors that MANE-VU has identified for its own sulfate reductions. The guiding principle in MANE-VU's approach to consulting with states outside of MANE-VU is that we cannot ask for more equivalent reductions than we are willing to pursue ourselves.

The regional strategies to reduce SO_2 emissions that MANE-VU has identified as reasonable within and outside MANE-VU by 2018 are: 1) Best Available Retrofit Technology (BART) sulfate reductions from specific source sectors defined in the Clean air Act; and 2) a low-sulfur oil strategy for all sectors (commercial, industrial, and residential); and 3) an EGU strategy that targets a 90% sulfate reduction from each of the key stacks impacting any MANE-VU Class I area (comprising a total of 167 EGU stacks), or a reduction equivalent to that amount within each State. Individual states may also pursue additional strategies.

The strategies for reducing SO_2 emissions that MANE-VU has identified as potentially reasonable for states outside of the MANE-VU region to pursue by 2018 are: 1) Best Available Retrofit Technology (BART) sulfate reductions from specific source sectors defined in the Clean air Act); 2) an EGU strategy that targets a 90% sulfate reduction from each of the key stacks impacting any MANE-VU Class I area (comprising a total of 167 EGU stacks), or a reduction equivalent to that amount within each State; and 3) the application of reasonable controls on non-EGU sources resulting in a 28% reduction in non-EGU SO_2 emissions, relative to on-the-books, on-the-way 2018 projections used in regional haze planning, by 2018, which is comparable to the projected reductions MANE-VU will achieve through its low sulfur oil strategy.

MANE-VU has considered potential SO_2 reductions available from the coal-fired ICI sector, and has concluded that states outside of MANE-VU may find this to be a viable source sector for SO_2 reductions comparable to those obtained from oil-fired ICI boilers within MANE-VU. As noted above, additional reductions from this category within the MANE-VU region will be considered on a state-specific basis. MANE-VU states believe all contributing states should continue to seek viable and enforceable means to lower sulfur dioxide and nitrogen oxide emissions from all coal-burning facilities by 2018, relative to 2002. Finally, MANE-VU is considering how to best deal with residential wood combustion and outdoor wood boilers. Although neither have significant SO_2 emissions, both of these source categories emit volatile and semi-volatile organic carbon and direct particulate matter that also impact visibility. Regarding these and other source sectors, the contributing states should continue to evaluate additional control measures, including energy efficiency and alternative clean fuels, to determine if they are reasonable for implementation in the short or long term, including, but not limited to, new source performance standards for wood combustion.

Low-Sulfur Oil Strategy

The reasonable assumption underlying the low-sulfur fuel oil strategy is that refiners can, by 2018, produce home heating and fuel oils that contain 50% less sulfur for the heavier grades (#4 and #6 residual), and a minimum of 75% and maximum of 99.25% less sulfur in #2 fuel oil (also known as home heating oil, distillate, or diesel fuel) at an acceptably small increase in price to the end user. As much as 75% of the total sulfur reductions achieved by this strategy will come from using the low-sulfur #2 distillate for space heating in the residential and commercial sectors. While costs for these emissions reductions are somewhat uncertain, they are quite reasonable in comparison to costs of controlling other sectors as documented in the Reasonable Progres Report, estimated at $550 to $750 per ton.

MANE-VU is cognizant of the fact that the use of #2 distillate for residential, commercial, and industrial heating and process applications is primarily a Northeast state phenomenon. The MANE-VU Class I states would then ask other states outside of MANE-VU to pursue equivalent reasonable sulfur reductions from their industrial, commercial, and institutional facilities.

Some MANE-VU states are proceeding with rulemakings to impose low-sulfur oil regulations much sooner than 2018 in order to aid their $PM_{2.5}$ attainment efforts. However, all of the MANE-VU states agree that a low-sulfur oil strategy is both reasonable and achievable by 2018.

EGU Strategy

MANE-VU has recently identified emissions from 167 stacks at EGU facilities as having visibility impacts in MANE-VU Class I areas that make controlling emissions from those stacks crucial to improving visibility at MANE-VU Class I areaas. Unfortunately, when the Clean Air Interstate Rule (CAIR) is implemented (starting in 2010 for Phase I and 2015 for Phase II), there is no guarantee that sulfate emissions will be reduced at all of these units as generators have the legal option to forgo sulfur controls in favor of allowance purchases. MANE-VU's approach for this source sector is to pursue a 90% control level on SO_2 emissions from these stacks by 2018. MANE-VU has concluded that pursuing at least this level of sulfur reduction is both reasonable and cost-effective. Even though current wet scrubber technology can achieve sulfur reductions greater than 95%, historically a 90% sulfur reduction level includes lower average reductions from dry scrubbing technology. The cost for SO_2 emissions reductions will vary by unit, and the Reasonable Progress report summarizes the various control methods and costs available, ranging from $170 to $5,700 per ton.

BART

Imposition of BART on BART-eligible facilities and units in the MANE-VU states is up to each state in its BART-determination process. MANE-VU is expecting significant sulfur reductions from this mandated control measure. Since this is a very sector and source-specific process, MANE-VU does not anticipate that the level of BART reductions achieved in one region will necessarily be the same as the level of BART reductions achieved in another region.

Notes on List of Top Electric Generating Emissions Points Contributing to Visibility Impairment in MANE-VU

A list of top stacks impacting MANE VU Class I areas was generated by MARAMA on June 12, 2007. The following approach was taken to develop that table.

As part of the MANE VU Contribution Assessment, CALPUFF modeling was performed to identify the top 100 stacks that impact three of the MANE VU Class I areas. These three areas are Acadia, Brigantine and Lye Brook. Details of the modeling are provided in Appendix D of the Contribution Assessment. The 100 top stacks for each Class I area are documented in Tables 10 and 20 from Appendix D "Dispersion Model Techniques" of the Contribution Assessment.

The modeling was performed by two independent modeling centers using two sets of meteorological data—the MM5 and the NWS observation-based meteorology. Because of the differences in meteorological input data, there are some differences in the results from the two modeling centers. The MM5 modeling identified some stacks as being in the top 100 impacting a MANE-VU Class I area that were not identified by the VTDEC modeling, and vice versa. For purposes of the table, all stacks on either list were included.

MARAMA combined the lists of the top 100 EGU stacks in Tables 10 and 20 from Appendix D of the Contribution Assessment. Because there were 100 stacks for each of the three Class I areas and there were two tables for each Class I area (one for MM5 meteorology and second table for (VTDEC) meteorology) there were 600 stacks in the initial file. There were many duplications of identical stacks, either because they impacted more than one Class I area or because they were identified by both modeling centers.

MARAMA eliminated the duplications. MARAMA also eliminated the stacks that were outside the consultation area previously identified. The consultation area includes states contributing at least 2% of the sulfate monitored at MANE-VU Class I areas in 2002. This resulted in 167 unique stacks impacting one or more MANE VU Class I areas.

The Appendix D tables did not identify the units or facilities that were modeled, only providing a CEMS Identification number. MARAMA used information contained in IPM input files to identify the plant name and type where the stack was located.

The modeling used 2002 emissions data from EPA's records of Continuous Emission Monitoring System (CEMS) data reported by the power companies. This hourly data represents actual emissions from the stack on which the CEMS is placed. A power plant may have several stacks. Each stack may vent emissions from one or more units at the plant.

Although the modeling was done on an hourly basis, the emissions data reported in the table represents the aggregate of all the hours in 2002 from a given stack. Each of the modeling centers summed hourly CEMS data over the year to get a total annual emission rate in units in tons per year (TPY). This summing exercise was performed independently as part of the two modeling efforts. Because of round-off error, the annual emission numbers generated by the two modeling efforts shown in the Contribution Assessment are slightly different. For this table, the two annual emission rates were averaged to provide a single annual emission rate for each stack.

Finally, MARAMA developed a composite ranking from the two modeling center results for the three Class I areas to get a single overall ranking for each stack. The impact of each stack on the three Class I areas using two different meteorological sets resulted in up to six impact rankings from 1 to 100, with the lowest rank being the greatest impact. These rankings were averaged to provide an average stack rank. The stacks were sorted from lowest to highest average rank and then an integer ranking ranging from 1 to 167 was assigned to each stack.

There are several differences between this list and lists distributed previously. In previous discussions, MARAMA had prepared a list of all units at each of the facilities identified as having one of the top 100 stacks by the VTDEC modeling. That list included units which may or may not be vented to the stacks that were identified in the top 100 stacks for each of the Class I areas. The previous list also included sources outside the MANE-VU consultation area, and it did not reflect sources on the list generated by the modeling center that used MM5 meteorological data.

For this list, MARAMA did not list units. As noted above, only stacks listed in the tables from the Contribution Assessment have been listed. This resulted in a list of 167 stacks, including 24 that were not previously included because they were only identified by the MM5 modeling, not the VTDEC modeling. The use of stacks rather than units or facilities was chosen as more consistent with the results of the modeling presented in the Contribution Assessment.

		TOP ELECTRIC GENERATING EMISSION POINTS CONTRIBUTING TO VISIBILITY IMPAIRMENT IN MANE-VU - MODELED BY BOTH VTDEC AND MM5														
Row number	CEMS Unit	ORIS ID	Acadia MM5	Acadia VTDEC	Brig MM5	Brig VTDEC	Lye MM5	Lye VTDEC	MM5 2002 S02 TPY	VTDEC 2002 SO2 TPY		Plant Name	Plant Type	State Name	State Code	
1	D005935	593			90	54			2,138	2,136	1	EDGE MOOR	O/G Steam	Delaware	10	
2	D005941	594				95				3,742	2	INDIAN RIVER	Coal Steam	Delaware	10	
3	D005942	594				74				3,760	2	INDIAN RIVER	Coal Steam	Delaware	10	
4	D005943	594			84	44			4,686	4,682	2	INDIAN RIVER	Coal Steam	Delaware	10	
5	D005944	594			69	21			7,390	7,384	2	INDIAN RIVER	Coal Steam	Delaware	10	
6	D007031LR	703	79			86		75	38,520	38,486	3	BOWEN	Coal Steam	Georgia	13	
7	D007032LR	703	72		89		61	68	37,289	37,256	3	BOWEN	Coal Steam	Georgia	13	
8	D007033LR	703	71	99	74	64	63	94	43,067	43,029	3	BOWEN	Coal Steam	Georgia	13	
9	D007034LR	703	69	95	86	58	60	89	41,010	40,974	3	BOWEN	Coal Steam	Georgia	13	
10	D00709C02	709		84		75	89	71	47,591	47,549	4	HARLLEE BRANCH	Coal Steam	Georgia	13	
11	D00861C01	861	28	96		65	46	62	42,355	42,318	5	COFFEEN	Coal Steam	Illinois	17	
12	D010011	1001			53				28,876	28,851	6	CAYUGA	Coal Steam	Indiana	18	
13	D010012	1001	95		46	68			26,016	25,992	6	CAYUGA	Coal Steam	Indiana	18	
14	D00983C01	983					52		19,922		7	CLIFTY CREEK	Coal Steam	Indiana	18	
15	D00983C02	983					54		18,131		7	CLIFTY CREEK	Coal Steam	Indiana	18	
16	D0099070	990		55	100	70		37	29,801	29,774	8	ELMER W STOUT	O/G Steam	Indiana	18	
17	D06113C03	6113	30	48	14	43	22	41	71,182	71,119	9	GIBSON	Coal Steam	Indiana	18	
18	D06113C04	6113	44	70	97	83	73	83	27,848	27,823	9	GIBSON	Coal Steam	Indiana	18	
19	D01008C01	1008			73		100	47	24,109	24,087	10	R GALLAGHER	Coal Steam	Indiana	18	
20	D01008C02	1008			98			55	23,849	23,828	10	R GALLAGHER	Coal Steam	Indiana	18	
21	D06166C02	6166	62	44	30	81	33	57	51,708	51,663	11	ROCKPORT	Coal Steam	Indiana	18	
22	D00988C03	988						77		15,946	12	TANNERS CREEK	Coal Steam	Indiana	18	
23	D00988U4	988	14	29	52	34	7	19	45,062	45,022	12	TANNERS CREEK	Coal Steam	Indiana	18	
24	D01010C05	1010	43	32	12	28	31	17	60,747	60,693	13	WABASH RIVER	Coal Steam	Indiana	18	
25	D067054	6705	34	60	34		44	73	40,118	40,082	14	WARRICK	Coal Steam	Indiana	18	
26	D06705C02	6705	92		75		96		27,895		14	WARRICK	Coal Steam	Indiana	18	
27	D01353C02	1353	38	30	15	26	85	29	41,545	41,508	15	BIG SANDY	Coal Steam	Kentucky	21	
28	D01384CS1	1384	22				58		21,837	21,817	16	COOPER	Coal Steam	Kentucky	21	
29	D01355C03	1355	21		51	99	68	52	38,104	38,070	17	E W BROWN	Coal Steam	Kentucky	21	
30	D060182	6018	83				39		12,083		18	EAST BEND	Coal Steam	Kentucky	21	
31	D01356C02	1356	93	71		88	50	59	25,646	25,623	19	GHENT	Coal Steam	Kentucky	21	
32	D060411	6041	61						18,375		20	H L SPURLOCK	Coal Steam	Kentucky	21	
33	D060412	6041	53		91			98	20,491	20,473	20	H L SPURLOCK	Coal Steam	Kentucky	21	
34	D013644	1364			81				7,185		21	MILL CREEK	Coal Steam	Kentucky	21	
35	D013782	1378					87		20,245		22	PARADISE	Coal Steam	Kentucky	21	

Notes:
Plants in Red are added as a result of MM5 met modeling.
List does not include sources in states that do not contribute 2% of visibility impact to MANE VU Class I areas.
MM5 by ERM for Maryland

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Row number	CEMS Unit	ORIS ID	Acadia MM5	Acadia VTDEC	Brig MM5	Brig VTDEC	Lye MM5	Lye VTDEC	MM5 2002 S02 TPY	VTDEC 2002 SO2 TPY		Plant Name	Plant Type	State Name	State Code
36	D013783	1378	76	100	11	84	55	42	46,701	46,660	22	PARADISE	Coal Steam	Kentucky	21
37	D015074	1507	78						1,170		23	WILLIAM F WYMAN	O/G Steam	Maine	23
38	D006021	602	90		38			100	20,014	19,996	24	BRANDON SHORES	Coal Steam	Maryland	24
39	D006022	602	99		29			99	19,280	19,263	24	BRANDON SHORES	Coal Steam	Maryland	24
40	D015521	1552			63				17,782	17,767	25	C P CRANE	Coal Steam	Maryland	24
41	D015522	1552			68				14,274	14,262	25	C P CRANE	Coal Steam	Maryland	24
42	D01571CE2	1571	42	47	1	4	20	28	48,566	48,522	26	CHALK POINT	Coal Steam	Maryland	24
43	D01572C23	1572	73	79	47	45	69	32	32,188	32,159	27	DICKERSON	Coal Steam	Maryland	24
44	D015543	1554			77				10,084	10,075	28	HERBERT A WAGNER	O/G Steam	Maryland	24
45	D015731	1573	67	50	16	12	56	38	36,823	36,790	29	MORGANTOWN	Coal Steam	Maryland	24
46	D015732	1573	59	53	10	13	51	39	30,788	30,761	29	MORGANTOWN	Coal Steam	Maryland	24
47	D016191	1619	37	80					9,252	9,244	30	BRAYTON POINT	Coal Steam	Massachusetts	25
48	D016192	1619	35	66					8,889	8,881	30	BRAYTON POINT	Coal Steam	Massachusetts	25
49	D016193	1619	4	14	65	56	79		19,325	19,308	30	BRAYTON POINT	Coal Steam	Massachusetts	25
50	D015991	1599	5	36			65		13,014	13,002	31	CANAL	O/G Steam	Massachusetts	25
51	D015992	1599	7	27			74		8,980	8,971	31	CANAL	O/G Steam	Massachusetts	25
52	D016061	1606						48		5,249	32	MOUNT TOM	Coal Steam	Massachusetts	25
53	D016261	1626	85						3,430		33	SALEM HARBOR	Coal Steam	Massachusetts	25
54	D016263	1626	91	78					4,971	4,966	33	SALEM HARBOR	Coal Steam	Massachusetts	25
55	D016264	1626	32	25					2,880	2,878	33	SALEM HARBOR	O/G Steam	Massachusetts	25
56	D016138	1613	94						4,376		34	SOMERSET	Coal Steam	Massachusetts	25
57	D01702C09	1702						96		4,565	35	DAN E KARN	Coal Steam	Michigan	26
58	D01733C12	1733	49	24	80	80	45	22	46,081	46,040	36	MONROE	Coal Steam	Michigan	26
59	D01733C34	1733	27	26		76	26	27	39,362	39,327	36	MONROE	Coal Steam	Michigan	26
60	D017437	1743		91						15,805	37	ST CLAIR	Coal Steam	Michigan	26
61	D017459A	1745					76	61	18,341	18,324	38	TRENTON CHANNEL	Coal Steam	Michigan	26
62	D023641	2364	2	57					9,356	9,348	39	MERRIMACK	Coal Steam	New Hampshire	33
63	D023642	2364	1	17	99		28	87	19,453	19,435	39	MERRIMACK	Coal Steam	New Hampshire	33
64	D080021	8002	45	74					5,033	5,028	40	NEWINGTON	O/G Steam	New Hampshire	33
65	D023781	2378		81	2	15			9,747	9,738	41	B L ENGLAND	Coal Steam	New Jersey	34
66	D024032	2403	63	97	25	50	40	44	18,785	18,768	42	HUDSON	O/G Steam	New Jersey	34
67	D024081	2408			95				8,076		43	MERCER	Coal Steam	New Jersey	34
68	D024082	2408			60				5,675		43	MERCER	Coal Steam	New Jersey	34
69	D02549C01	2549		64	41		42	72	25,343	25,320	44	C R HUNTLEY	Coal Steam	New York	36
70	D02549C02	2549					99		12,317		44	C R HUNTLEY	Coal Steam	New York	36
71	D024804	2480					71		7,720		45	DANSKAMMER	O/G Steam	New York	36

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MM5 by ERM for Maryland

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Row number	CEMS Unit	ORIS ID	Acadia MM5	Acadia VTDEC	Brig MM5	Brig VTDEC	Lye MM5	Lye VTDEC	MM5 2002 S02 TPY	VTDEC 2002 SO2 TPY		Plant Name	Plant Type	State Name	State Code
72	D02554C03	2554	33	51	62		27	51	30,151	30,125	46	DUNKIRK	Coal Steam	New York	36
73	D02526C03	2526					78		14,929		47	WESTOVER	Coal Steam	New York	36
74	D025276	2527					80		12,650		48	GREENIDGE	Coal Steam	New York	36
75	D025163	2516			96				7,359		49	NORTHPORT	O/G Steam	New York	36
76	D025945	2594		76						1,747	50	OSWEGO	O/G Steam	New York	36
77	D02642CS2	2642					91		14,086		51	ROCHESTER 7	Coal Steam	New York	36
78	D080061	8006						93		3,817	52	ROSETON	O/G Steam	New York	36
79	D080062	8006						88		2,840	52	ROSETON	O/G Steam	New York	36
80	D080421	8042	13	12	18	5	10	34	57,820	57,769	53	BELEWS CREEK	Coal Steam	North Carolina	37
81	D080422	8042	23	15	32	10	15	49	45,296	45,256	53	BELEWS CREEK	Coal Steam	North Carolina	37
82	D027215	2721	98	45	87	39	97	85	19,145	19,128	54	CLIFFSIDE	Coal Steam	North Carolina	37
83	D027133	2713		61						14,460	55	L V SUTTON	Coal Steam	North Carolina	37
84	D027093	2709				97				9,390	56	LEE	Coal Steam	North Carolina	37
85	D027273	2727	100	40		48	75	84	26,329	26,305	57	MARSHALL	Coal Steam	North Carolina	37
86	D027274	2727	89	39	83	51	66	82	27,308	27,284	57	MARSHALL	Coal Steam	North Carolina	37
87	D06250C05	6250	60	59		35	37		27,395	27,371	58	MAYO	Coal Steam	North Carolina	37
88	D027121	2712				59			12,031	12,020	59	ROXBORO	Coal Steam	North Carolina	37
89	D027122	2712	82	41	54	23	94		29,337	29,310	59	ROXBORO	Coal Steam	North Carolina	37
90	D02712C03	2712	56	37	57	24	21	78	30,776	30,749	59	ROXBORO	Coal Steam	North Carolina	37
91	D02712C04	2712	88	72		47	47		22,962	22,941	59	ROXBORO	Coal Steam	North Carolina	37
92	D0283612	2836	55	20	48	89	29	35	41,432	41,395	60	AVON LAKE	Coal Steam	Ohio	39
93	D028281	2828	29	9	31	30	24	8	37,307	37,274	61	CARDINAL	Coal Steam	Ohio	39
94	D028282	2828						56	20,598	20,580	61	CARDINAL	Coal Steam	Ohio	39
95	D028283	2828						80		15,372	61	CARDINAL	Coal Steam	Ohio	39
96	D028404	2840	3	1	6	2	2	3	87,801	87,724	62	CONESVILLE	Coal Steam	Ohio	39
97	D02840C02	2840	84	73			81	63	22,791	22,771	62	CONESVILLE	Coal Steam	Ohio	39
98	D028375	2837		86	56		35	70	35,970	35,938	63	EASTLAKE	Coal Steam	Ohio	39
99	D081021	8102			23	71	59	95	18,207	18,191	64	GEN J M GAVIN	Coal Steam	Ohio	39
100	D081022	8102				78			12,333	12,322	64	GEN J M GAVIN	Coal Steam	Ohio	39
101	D028501	2850	36	67	39	53		45	30,798	30,771	65	J M STUART	Coal Steam	Ohio	39
102	D028502	2850	24	65	40	49	98	46	28,698	28,673	65	J M STUART	Coal Steam	Ohio	39
103	D028503	2850	26		72	62			27,968	27,944	65	J M STUART	Coal Steam	Ohio	39
104	D028504	2850	20	77	45	52	88	54	27,343	27,319	65	J M STUART	Coal Steam	Ohio	39
105	D060312	6031			67	77		90	19,517	19,500	66	KILLEN STATION	Coal Steam	Ohio	39
106	D02876C01	2876	40	7	3	9	30	10	72,593	72,529	67	KYGER CREEK	Coal Steam	Ohio	39
107	D028327	2832	65	28	59	22	48	20	46,991	46,950	68	MIAMI FORT	Coal Steam	Ohio	39

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Row number	CEMS Unit	ORIS ID	Acadia MM5	Acadia VTDEC	Brig MM5	Brig VTDEC	Lye MM5	Lye VTDEC	MM5 2002 S02 TPY	VTDEC 2002 SO2 TPY		Plant Name	Plant Type	State Name	State Code
108	D02832C06	2832				60	43	64	23,694	23,673	68	MIAMI FORT	Coal Steam	Ohio	39
109	D028725	2872	74	92	78		90	36	30,079	30,052	69	MUSKINGUM RIVER	Coal Steam	Ohio	39
110	D02872C04	2872	6	19	13	6	19	15	83,134	83,060	69	MUSKINGUM RIVER	Coal Steam	Ohio	39
111	D02864C01	2864	70	56	61	63	49	24	35,193	35,162	70	R E BURGER	Coal Steam	Ohio	39
112	D07253C01	7253		89	58	57		33	30,977	30,949	71	RICHARD GORSUCH		Ohio	39
113	D028665	2866		82				53	19,796	19,779	72	W H SAMMIS	Coal Steam	Ohio	39
114	D028667	2866	57	16	42	41	41	16	33,601	33,572	72	W H SAMMIS	Coal Steam	Ohio	39
115	D02866C01	2866	97	54	93	96	92	30	24,649	24,627	72	W H SAMMIS	Coal Steam	Ohio	39
116	D02866C02	2866		69	92			50	26,022	25,999	72	W H SAMMIS	Coal Steam	Ohio	39
117	D02866M6A	2866		85				58	19,564	19,546	72	W H SAMMIS	Coal Steam	Ohio	39
118	D060191	6019		93		72		60		21,496	73	W H ZIMMER	Coal Steam	Ohio	39
119	D028306	2830	46	38	70	40	12	69	30,466	30,439	74	WALTER C BECKJORD	Coal Steam	Ohio	39
120	D031782	3178	77	63				81	16,484	16,469	75	ARMSTRONG	Coal Steam	Pennsylvania	42
121	D031403	3140	31	34	9	46	18	18	38,801	38,767	76	BRUNNER ISLAND	Coal Steam	Pennsylvania	42
122	D03140C12	3140	52	46	49	69	25	23	29,736	29,709	76	BRUNNER ISLAND	Coal Steam	Pennsylvania	42
123	D082261	8226	25	21	33	42	36	9	40,268	40,232	77	CHESWICK	Coal Steam	Pennsylvania	42
124	D03179C01	3179	16	10	5	8	5	4	79,635	79,565	78	HATFIELD'S FERRY	Coal Steam	Pennsylvania	42
125	D031221	3122	11	6	26	38	17	14	45,754	45,714	79	HOMER CITY	Coal Steam	Pennsylvania	42
126	D031222	3122	9	4	37	92	13	11	55,216	55,167	79	HOMER CITY	Coal Steam	Pennsylvania	42
127	D031361	3136	8	2	4	14	6	1	87,434	87,357	80	KEYSTONE	Coal Steam	Pennsylvania	42
128	D031362	3136	18	3	8	19	8	2	62,847	62,791	80	KEYSTONE	Coal Steam	Pennsylvania	42
129	D03148C12	3148			71		84		17,214		81	MARTINS CREEK	Coal Steam	Pennsylvania	42
130	D031491	3149	19	8	35	7	1	6	60,242	60,188	82	MONTOUR	Coal Steam	Pennsylvania	42
131	D031492	3149	15	5	21	20	3	5	50,276	50,232	82	MONTOUR	Coal Steam	Pennsylvania	42
132	D031131	3113			82				9,674		83	PORTLAND	Coal Steam	Pennsylvania	42
133	D031132	3113			36		93		14,294		83	PORTLAND	Coal Steam	Pennsylvania	42
134	D03131CS1	3131	54	31	79		32	65	22,344	22,324	84	SHAWVILLE	Coal Steam	Pennsylvania	42
135	D033193	3319				100				11,045	85	JEFFERIES	O/G Steam	South Carolina	45
136	D033194	3319		90		87				11,838	85	JEFFERIES	O/G Steam	South Carolina	45
137	D03297WT1	3297		68		61				17,671	86	WATEREE	Coal Steam	South Carolina	45
138	D03297WT2	3297		83		73				17,199	86	WATEREE	Coal Steam	South Carolina	45
139	D03298WL1	3298		35	94	37			25,170	25,148	87	WILLIAMS	Coal Steam	South Carolina	45
140	D062491	6249		58		82				17,920	88	WINYAH	Coal Steam	South Carolina	45
141	D03403C34	3403			85				20,314		89	GALLATIN	Coal Steam	Tennessee	47
142	D03405C34	3405	39						19,368		90	JOHN SEVIER	Coal Steam	Tennessee	47
143	D03406C10	3406	10	11	27	33	4	43	104,523	104,431	91	JOHNSONVILLE	Coal Steam	Tennessee	47

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MM5 by ERM for Maryland

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144	D03407C15	3407	64	87		66	67	76	37,308	37,274	92	KINGSTON	Coal Steam	Tennessee	47
145	D03407C69	3407	48	98		91	82	91	38,645	38,611	92	KINGSTON	Coal Steam	Tennessee	47
146	D038033	3803				55				9,493	93	CHESAPEAKE	Coal Steam	Virginia	51
147	D038034	3803		94		16				10,806	93	CHESAPEAKE	Coal Steam	Virginia	51
148	D037974	3797				90				9,293	94	CHESTERFIELD	Coal Steam	Virginia	51
149	D037975	3797		88	44	27	86		19,620	19,602	94	CHESTERFIELD	Coal Steam	Virginia	51
150	D037976	3797	66	18	7	3	34	66	40,570	40,534	94	CHESTERFIELD	Coal Steam	Virginia	51
151	D03775C02	3775	47						16,674		95	CLINCH RIVER	Coal Steam	Virginia	51
152	D038093	3809		52	64	29			10,477	10,468	96	YORKTOWN	Coal Steam	Virginia	51
153	D03809CS0	3809	96	43	19	17	62		21,219	21,201	96	YORKTOWN	Coal Steam	Virginia	51
154	D039423	3942						79		10,126	97	ALBRIGHT	Coal Steam	West Virginia	54
155	D039431	3943	51	23	20	32	16	13	42,385	42,348	97	FORT MARTIN	Coal Steam	West Virginia	54
156	D039432	3943	50	22	22	31	14	12	45,850	45,809	97	FORT MARTIN	Coal Steam	West Virginia	54
157	D039353	3935	41	33	28	11	64	26	42,212	42,174	98	JOHN E AMOS	Coal Steam	West Virginia	54
158	D03935C02	3935	17	42	43	1	11	21	63,066	63,010	98	JOHN E AMOS	Coal Steam	West Virginia	54
159	D03947C03	3947	86	62	55		57	25	38,575	38,541	99	KAMMER	Coal Steam	West Virginia	54
160	D03936C02	3936				98			15,480	15,467	100	KANAWHA RIVER	Coal Steam	West Virginia	54
161	D03948C02	3948	58	13	17	36	9	7	55,405	55,356	101	MITCHELL	Coal Steam	West Virginia	54
162	D062641	6264	75	49	50	18	77	40	42,757	42,719	102	MOUNTAINEER	Coal Steam	West Virginia	54
163	D03954CS0	3954	68		24	25	23	67	20,130	20,112	103	MT STORM	Coal Steam	West Virginia	54
164	D0393851	3938				79		97	12,948	12,936	104	PHILIP SPORN	Coal Steam	West Virginia	54
165	D03938C04	3938				94			26,451	26,427	104	PHILIP SPORN	Coal Steam	West Virginia	54
166	D060041	6004			66		83	31	21,581	21,562	105	PLEASANTS	Coal Steam	West Virginia	54
167	D060042	6004			88			92	20,550	20,532	105	PLEASANTS	Coal Steam	West Virginia	54

Notes:
Plants in Red are added as a result of MM5 met modeling.
List does not include sources in states that do not contribute 2% of visibility impact to MANE VU Class I areas.
MM5 by ERM for Maryland

PROJECT RESULTS

EVALUATION OF TIGHTER FEDERAL EMISSIONS CAPS

FOR ELECTRIC GENERATING UNITS

June 4, 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 energy 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 and NO_x 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 used 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

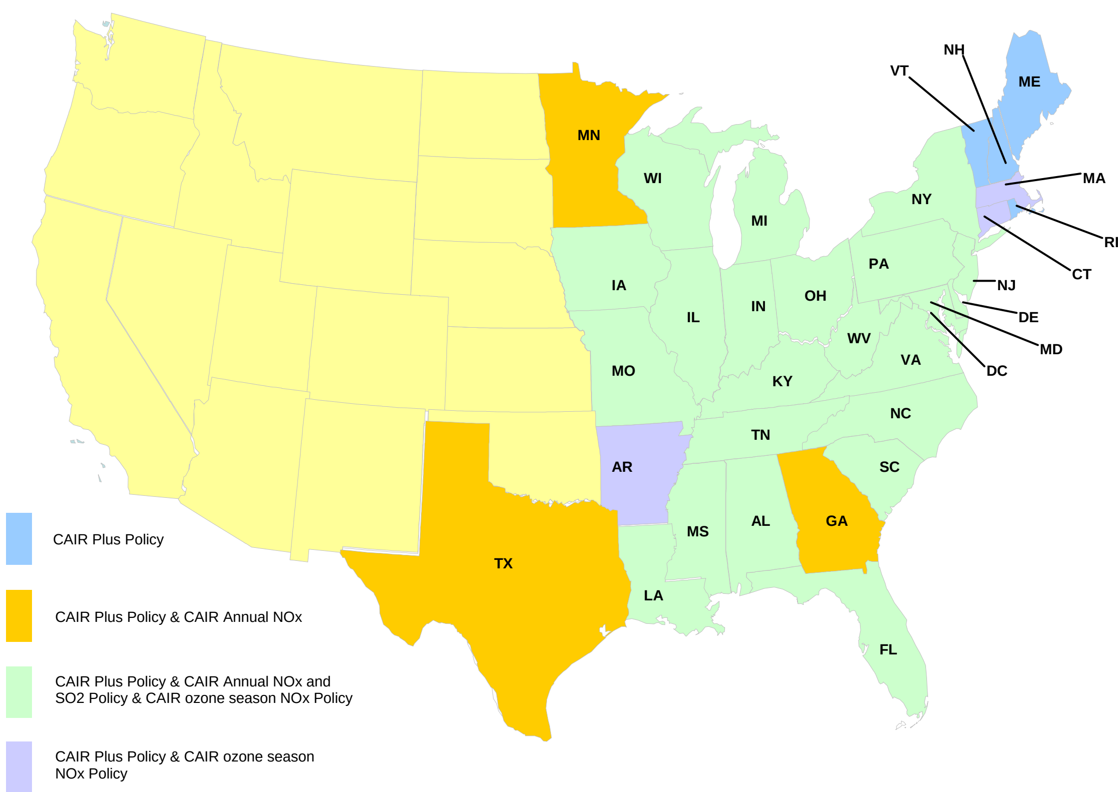
updated, (e.g., fuel prices, control constraints, etc.) to better reflect current information. The MARAMA CAIR Base Case run is also sometimes called MARAMA_5c.

- 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. This 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 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 SO_2 scrubber feasibility constraints were no longer applied in the CAIR Plus strategy. In years after 2012, the CAIR Plus SO_2 and NO_x policies continue to become more stringent resulting in an increase in natural gas-based generation. (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 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:

New Hampshire: Andy Bodnarik, Liz Nixon, Jeff Underhill
Connecticut: David Wackter
Delaware: David Fees, Mohammed Majeed
District of Columbia: Stan Tracey, Ram Tangirala
Maine: Tom Downs
Maryland: Tad Aburn, Diane Franks, Brian Hug
MARAMA: Susan Wierman, Patrick Davis, Julie McDill
New Jersey: Chris Salmi, Ray Papalski
New York: Ron Stannard, Gopal Sistla, John Kent
Pennsylvania: Dean Van Orden, Wick Havens
Rhode Island: Karen Slattery
OTC: Chris Recchia, Anna Garcia, Doug Austin
Massachusetts: Stephen Dennis
Vermont: Paul Wishinski

CONTACT INFORMATION: Susan Wierman or Julie McDill, MARAMA (swierman@marama.org or jmcdill@marama.org)

Summary of Work

Baseline, Natural Conditions, and Uniform Rate

1) Baseline and Natural Background Visibility Conditions - 12/2006
Considerations and Proposed Approach to the Calculation
of Baseline and Natural Background Visibility Conditions
at MANE-VU Class I Areas, 21 pages
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=0

2) The Nature of the Fine Particle and Regional Haze Air 11/2006
Quality Problems in the MANE-VU Region:
A Conceptual Description, 92 pages
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=0

MANE-VU Emissions Inventory Data and Documentation - June 2007

I. 2002 Emissions Inventory

MANE-VU
Contractor: Pechan – Randy Strait
Documentation and Database files can be found at **ftp.marama.org**
Subdirectory 2002 Version 3
Username: mane-vu
Password: exchange

- Version 3 of the 2002 MANE-VU Inventory

- Summaries for biogenic, Area, Point, Non-Road, and Onroad sectors of Version 3 of 2002 MANE-VU Inventory.

- Technical Support Document (TSD)

Midwest RPO
Contractor: Alpine – Greg Stella

- BaseK Emission Inventory conversion to SMOKE-ready format.

II. Non-EGU Future Year Emissions Inventory

MANE-VU
Contractor: MACTEC – Ed Sabo
Database files can be found at **ftp.marama.org**
Username: future
Password: emissions

Documentation can be found at
www.marama.org/visibility/Inventory%20Summary/FutureEmissionsInventory.htm

- OTB/OTW 2009/12/18 MANE-VU Inventory

  "On the books/On the Way" (OTB/OTW) Emissions inventories in both NIF and IDA format for Non-EGU, Point, Area, and Non-Road.

- BOTW 2009/12/18 MANE-VU Inventory

  "Beyond On the Way" (BOTW) Emissions inventories in both NIF and IDA format for non EGU Point, Area, and Non-Road were developed based on the OTC control measures matrix. For regional haze purposes, except for SO2 controls, the BOTW controls are assumed in place by 2018.

- Technical Support Document (TSD)

<u>Midwest RPO</u>
Contractor: Alpine – Greg Stella

- BaseK 2009/12/18 OTB/OTW Growth and Control Factors Conversion to produce SMOKE-ready input files for all source categories.

III. <u>EGU Future Year Emissions Inventory</u>

<u>IPM Modeling of EGU emissions for future years</u>
Contractor: ICF – Boddu Venkatesh & Alpine – Greg Stella
Database files can be found at **ftp.marama.org**
Subdirectory 2.1.9 EGUs
Username: mane-vu
Password: exchange

Documentation for this IPM run is not available

- VISTAS 2.1.9 IPM 2009/12/18 CAIR Inventory. (ICF – Boddu Venkatesh)

  > "ICF completed an IPM 2.1.9 modeling run based on the VISTAS PC_1f inventory. This run was headed by VISTAS, but has input from all RPOs. ***This is the IPM run MANE-VU is using for all of our base case CMAQ modeling.***

- 2009/12/18 VISTAS 2.1.9 IPM output was converted into NIF and IDA format for CMAQ modeling by Alpine (Greg Stella)

- 2009 Non-Fossil EGU IDA Conversion of non-Fossil EGU data into an IDA format for CMAQ modeling. All MANE-VU states were asked to submit a list of their non-fossil EGU units in the 2009 inventory. (Alpine – Greg Stella)

IV. <u>MANE VU Inventories for Sensitivity Analysis</u>

- **MANE-VU Fuel Oil sulfur content sensitivity Inventories. (Ongoing)**
  Contractor: Alpine – Greg Stella
  No documents yet available for posting online.

  Two 2018 sensitivity modeling inventories (S-1 and S-1) are being developed for use in REMSAD modeling. They will be based on the MANE-VU 2018 BOTW Emissions Inventory. The sulfur content of the #2/4/6 fuel oils will be restricted for all SCCs that use these fuels, except EGUs. EGUs are excluded because the sulfur in fuels burning in EGUs is subject to emissions trading. Therefore restrictions on the sulfur content of these fuels would free up allowances in the market that would be used elsewhere, resulting in no net emissions decrease. The sulfur content for fuel oil is restricted as follows:

Sensitivity Inventory - 2018 S-1

Home heating and #2 Distillate Oil -	500 ppm S (0.05%)
#4 Distillate/Residual Oil	2500 ppm S (0.25%)
#6 Residual Oil (Except parts of CT & NY)	5000 ppm S (0.5%)
#6 Residual Oil (For parts of CT & NY)	3000 ppm S (0.3%)

Sensitivity Inventory - 2018 S-2

Home heating and #2 Distillate Oil -	15 ppm S (0.0015%)
#4 Distillate/Residual Oil	2500 ppm S (0.25%)
#6 Residual Oil (Except parts of CT & NY)	5000 ppm S (0.5%)
#6 Residual Oil (For parts of CT & NY)	3000 ppm S (0.3%)

Alpine is tasked with developing the Growth and Control packets that can be applied to the MANE-VU 20018 BOTW Inventory to develop the S-1 and S-2 inventories.

- **MANE-VU Additional Limits on EGU NOx and SOx Sensitivity IPM Modeling Run Comparing CAIR with CAIR+**
  Contractor: ICF – Boddu Venkatesh
  Database files are not yet available.

  Draft technical support documentation and fact sheets can be found at:
  www.marama.org/visibility/Inventory%20Summary/FutureEmissionsInventory.htm

  - 2.1.9 IPM 2009/12/18 MANE-VU Base Case EGU Inventory S.T.E.T.

    This IPM run is known as the MANE-VU Base Case or MARAMA_5c. It was developed by MANE-VU based on the VISTAS 2.1.9 framework with updated natural gas prices and a few other adjustments to the input specifications. This Base Case was run to allow a comparison to the MANE-VU CAIR+ run described below. It has not been used for regional air quality modeling.
    State level results are available for this run.
    2009/12/18 NIF and IDA files are available.

- 2.1.9 IPM 2009/12/18 MANE-VU CAIR+ Inventory S.T.E.T.

  This IPM run is known as the MANE-VU CAIR+ or MARAMA_4c. It was developed by MANE-VU based on the VISTAS 2.1.9 framework with updated natural gas prices and a few other adjustments to the input specifications. The results of this CAIR+ can be compared to the to the MANE-VU Base Case run described above. It has not been used for regional air quality modeling.

  State level results are available for this run.

IV. Inter-RPO EI Warehouse System

Contractor: ERG – Grace Kitzmiller/William Gerber
Warehouse can be found at:
http://app2.erg.com:8080/rpoapp/

MARAMA has uploaded the Version 3 2002 MANE-VU Emissions Inventory. VISTAS has also uploaded data. Problems with the uploaded data and the warehouse system are currently being worked out.

V. Additional Data

Contractor: EH Pechan
OMNI

Documentation and Database files can be found at
http://www.marama.org/visibility/ResWoodCombustion/

MARAMA has provided two updates of the National Emissions Inventory for residential wood combustion. Some states have chosen to use some of these results in preparing their 2002 inventories. In general, these updates are part of an ongoing process to refine information about this source category as it is a large source of emissions with very uncertain emission estimates.

BART

1) Five-Factor Analysis of BART-Eligible Sources: 2/2007
Survey of Options for Conducting BART Determinations
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=0

2) BART Resource Guide, 34 pages 8/2006
http://www.nescaum.org/documents/bart-resource-guide

3) Assessment of Control Technology 3/2005
Options for BART-Eligible Sources, 102 pages
http://www.nescaum.org/documents/bart-resource-guide

4) Development of a List of BART-Eligible Sources in the 5/2003
MANE-VU Region: Interim Report, 74 pages
http://www.nescaum.org/documents/bart-resource-guide

5) A Basis for Control of BART-Eligible Sources, 168 pages 7/2001
http://www.nescaum.org/documents/bart-resource-guide

Areas of Influence

1) Contributions to Regional Haze in the Northeast and Mid-Atlantic United States, 122 pages + Appendices A-D — 8/2006
http://www.nescaum.org/documents/contributions-to-regional-haze-in-the-northeast-and-mid-atlantic--united-states

2) Regional Aerosol Intensive Network (RAIN), Preliminary Data Analysis, 63 pages — 5/2006
www.manevu.org/document.asp?FView+reports#

3) UMD Data Analysis Subcontract: Manuscripts on Data from the 2002 MANE-VU UMD Flights — 2/2006
www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=0

4) Upper Air Balloon Study – Millersville, PA, Winter 2004 — 2/2006
www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=0

5) Source Apportionment Analysis of Air Quality Monitoring Data: Phase II, 102 pages — 3/2005
http://www.marama.org/visibility/SA_phase2/index.html

6) Wintertime Tethered Balloon Measurements of Meteorological Variables and Aerosol Characterization in Support of MANE-VU, 17 pages — 1/2005
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=0

7) Review of Speciation Trends Network and IMPROVE Chemically Speciated Data, Technical Memo #7, 71 pages — 3/2003
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=50

8) REMSAD Platform Intercomparison Experiments, Technical Memo #5, 25 pages — 2/2002
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=50

9) Trajectory Analysis of Potential Source Regions Affecting Class I Areas in the MANE-VU Region, Technical Memo #3, 32 pages — 2/2002
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=50

10) REMSAD Modeling Exercises, Technical Memo #2, 44 pages — 2/2002
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=50

11) GIS Mapping of Regional Haze-Related Data in the MANE-VU Region, Technical Memo #4, 41 pages — 2/2002
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=50

12) Updated Visibility Statistics for the MANE-VU Region, Technical Memo #1, 50 pages — 2/2002
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=50

13) Source Apportionment Analysis of Air Quality Monitoring Data: Phase 1, 110 pages — 2/2002
http://www.marama.org/visibility/SA_report/

14) Meteorological Data Archive Feasibility Assessment, 3 pages — 1/2002
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=50

15) Determination of Fine Particle and Coarse Particle Concentrations in the Northeast United States, 1995, 85 pages — 12/1999
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=50

Reasonable Progress and Long Term Strategy

1) Reasonable Progress Goal Project Summary, 5 pages 4/2007

http://www.marama.org/visibility/RPG/index.html#products

2) Assessing Reasonable Progress for Regional Haze in the Mid-Atlantic North Eastern Class I Areas Draft Final Report, 140 pages 4/2007

http://www.marama.org/visibility/RPG/index.html#products

3) Assessing Reasonable Progress for Regional Haze in the Mid-Atlantic North Eastern Class I Areas (Revised Draft Final Technical Memorandum #3), 129 pages 3/2007

http://www.marama.org/visibility/RPG/index.html#products

4) Methods for Evaluations Technical Memorandum #2 Final, 5 pages 2/2007

http://www.marama.org/visibility/RPG/index.html#products

5) Control Scenarios Technical Memorandum #1 Final, 4 pages 2/2007

http://www.marama.org/visibility/RPG/index.html#products

6) Final Work Plan, 11 pages 1/2007

http://www.marama.org/visibility/RPG/index.html#products

Communications and Outreach

1) MANE-VU Newsletter — Fall 2006
http://www.manevu.org/document.asp?fview=Fact%20Sheets#

2) MANE-VU's Comments on EPA / Bill Harnett Memorandum entitled "Process for Interstate Consultation on Regional Haze SIP Development," 3 pages — 8/2006
http://www.manevu.org/document.asp?fview=Correspondence#

3) MANE-VU's Comments on Proposed IMPROVE Network Reduction Plan, 7 pages — 8/2006
http://www.manevu.org/document.asp?fview=Correspondence#

4) Final Consultation Framework as approved by the MANE-VU Board on May 10, 2006, 6 pages — 5/2006
http://www.manevu.org/document.asp?fview=Correspondence#

5) MANE-VU Newsletter — Spring 2006
http://www.manevu.org/document.asp?fview=Fact%20Sheets#

6) MANE-VU's Comments on EPA's "Draft Guidance for Setting Reasonable Progress Goals Under the Regional Haze Program," 9 pages — 1/2006
http://www.manevu.org/document.asp?fview=Correspondence#

7) MANE-VU's Comments on Proposed BART Trading Rule, 5 pages — 9/2005
http://www.manevu.org/document.asp?fview=Correspondence#

8) MANE-VU Newsletter — Fall 2005
http://www.manevu.org/document.asp?fview=Fact%20Sheets#

9) MANE-VU Newsletter — Spring 2005
http://www.manevu.org/document.asp?fview=Fact%20Sheets#

10) Regional Haze – A Resource Guide for Journalists, 33 pages — 5/2005
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=0

11) Regional Haze Reduces Visibility (Tri-fold brochure) — 3/2005
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=0

12) Haze Communication Using CAMNET and IMPROVE Archives: Case Study at Acadia National Park, 13 pages — 1/2005
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=0

13) About Regional Haze: Fact Sheet, 2 pages — 1/2005
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=0

14) The Health Effects of Regional Haze: Fact Sheet, 2 pages — 1/2005
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=0

15) About MANE-VU: Fact Sheet, 2 pages — 1/2005
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=0

16) MANE-VU's Comments on Proposed BART Rule, 27 pages — 7/2004
http://www.manevu.org/document.asp?fview=Correspondence#

17) Scoping Study on Regional Haze, Initial Communications and Outreach Framework, 52 pages — 12/2002
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=50

Miscellaneous

1) TSD on Measures to Mitigate the Visibility Impacts of Construction Activities in the MANE-VU Region, 13 pages — 10/2006
http://www.marama.org/visibility/SIP%5FPlanning/

2) TSD on Agricultural and Forestry Smoke Management in the MANE-VU Region, 18 pages — 9/2006
http://www.marama.org/visibility/SIP%5FPlanning/

3) EPA Checklist for Regional Haze SIPs Submitted Under 40 CFR 51.308, 14 pages — 8/2006
http://www.marama.org/visibility/SIP%5FPlanning/

4) 2006 Interim Report, 21 pages — 5/2006
http://www.manevu.org/document.asp?Fview=Reports#

5) Draft Regional Haze SIP/TIP Template, 42 pages — 1/2005
http://www.manevu.org/document.asp?Fview=Reports

6) MANE-VU Technical Work Plan, 20 pages — 3/2003
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=50

7) Regional Haze and Visibility in the Northeast and Mid-Atlantic States, 265 pages — 1/2001
http://www.nescaum.org/topics/regional-haze/regional-haze-documents/atct_topic_view?b_start:int=50