

BART Resource Guide

**Prepared by
NESCAUM**

**For the Mid-Atlantic/Northeast Visibility Union (MANE-VU)
Regional Planning Organization**

August 23, 2006

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Executive Summary

This report was prepared by the Northeast States for Coordinated Air Use Management (NESCAUM) as part of an effort to assist states and tribes in implementing the Best Available Retrofit Technology (BART) requirements of the Regional Haze Rule. The Regional Haze Rule requires states to determine the most stringent technologically feasible system of controls that can reasonably be installed at each facility determined to be BART-eligible. Criteria that determine whether a specific control technology is deemed reasonable include: cost of the controls, other control technology in use at the source, energy and other non-air quality environmental impacts, remaining useful life of the source, and the degree of visibility improvement anticipated to result from installation of the controls.

This report provides information designed to assist states as they determine what emission limits and controls are necessary for the December 17, 2007 SIP submittal. This SIP submittal requires that states submit a list of sources eligible for BART, a BART determination for each source, and a compliance schedule for installing controls. This report seeks to provide states with resources to complete this task. The report provides information on BART requirements, BART determination, BART modeling and other resources to assist states in the BART process. States will need to conduct an individual analysis for each facility prior to making a BART determination. This information is intended to facilitate that process by collecting available information into a single reference document.

The report finds that the BART program could represent a significant emission reduction opportunity for the Northeast and Mid-Atlantic States if implemented strictly. Electrical generation units (EGUs) represent the greatest potential single source category for emission reductions but due to EPA's determination that CAIR will serve as BART for covered facilities there may be a reduction in BART effectiveness from this category. BART may yield particulate matter emission reductions from EGUs however, since CAIR only applies to nitrogen oxides (NO_x) and sulfur dioxide (SO₂) emissions. In addition, states that choose to use the flexibility provided in the BART rule may be able to "harvest" the emissions reductions from several other source sectors in that refinery, cement plant and ICI boiler RACT programs being considered for NAAQS compliance to maximize emission reductions under the BART program.

1. INTRODUCTION

1.1. Overview of Regional Haze Program

In 1977, Congress outlined goals in the federal Clean Air Act (CAA) to restore pristine visibility conditions in national parks and wilderness areas. Section 169 of the CAA calls for the prevention of any future, and the remedying of “any” existing, man-made visibility impairment in all Class I areas.¹ Upon adoption of this legislation, EPA took relatively modest steps to remedy visibility impairment at Class I areas around the country. Control measures were largely confined to addressing plume blight from specific pollution sources near Class I areas. However, these actions did little to address the pervasive, regional nature of haze throughout the eastern United States. Most of the regional emission reductions occurred through implementation of other CAA programs, such as the National Acid Rain Program.

Subsequent to the adoption of the 1977 goals, visibility in the nation’s Class I areas continued to deteriorate. In eastern areas, average visual range decreased from 90 miles to 15-25 miles. In the West, visual range decreased from 140 miles to 35-90 miles.² Given the lack of improvement in visibility, the US EPA issued a new set of regulations in 1999 (64 Fed. Reg. 35,714, July 1, 1999) aimed at achieving visibility goals by 2064. These rules, commonly known as the “Regional Haze Rule,” developed a program to restore natural visibility conditions at Class I areas across the country. Under the Regional Haze Rule states or tribes are required to develop and submit State Implementation Plans (SIPs) or Tribal Implementation Plans (TIPs) to EPA by December 17, 2007. EPA requires these plans to:

- Demonstrate states’ efforts to make reasonable progress towards the 2064 national visibility goals.
- Create a long-term strategy for achieving the national regional haze goal with an implementation period to 2018 and reassessment every ten years thereafter.
- Identify sources subject to the Best Available Retrofit Technology (BART) provisions and determine controls for those units. BART provisions provide a mechanism for achieving visibility improvements in haze SIPs.

1.2. Overview of BART Rule

In June 2001, EPA released a proposed rule on BART. This rule outlined the method for determining if a facility is eligible for BART, subject to BART provisions, and methods for conducting a BART control review.

In 2002, industry groups challenged the method EPA outlined in the Regional Haze Rule to determine the degree of visibility improvement resulting from application

¹ The Class I designation applies to national parks exceeding 6,000 acres; wilderness areas and national memorial parks exceeding 5,000 acres; and all international parks that were in existence prior to 1977.

² <http://epa.gov/oar/visibility/what.html>

of BART controls. Under EPA's interpretation of the statute, a state would deem sources subject to BART if they emitted emissions into a geographic area or region that likely transports pollutants downwind into a protected area. In May 2002, the D.C. Circuit Court of Appeals agreed with industry petitioners and vacated those portions of the Regional Haze Rule dealing with BART.

In June 2005, EPA released the final BART rule. Under the final rule, the BART program requires states to develop an inventory of sources within each state or tribal jurisdiction that could be subject to control. Specifically, the rule:

- Outlined methods to determine if a source is “reasonably anticipated to cause or contribute to haze;”
- Defined the methodology for conduction of a BART control analysis;
- Provided presumptive limits for electricity generating units (EGUs) larger than 750 Megawatts;
- Provided a justification for the use of the Clean Air Interstate Rule (CAIR) as BART for CAIR state EGUs.

Beyond the specific elements listed above, EPA provided the states with a large amount of latitude to implement the BART program. The following section provides information on the BART eligibility determination and control review process.

1.3. Overview of BART Process

The BART program applies to facilities in one of 26 source categories that have units installed and operating between 1962 and 1977 with the potential to emit more than 250 tons per year of a visibility impairing pollutant. Once a source is found to be BART-eligible it must undergo a case-by-case analysis to determine if what emission controls are appropriate. The BART process has three steps. These steps include:

- Determining if a source is BART-eligible;
- Determining if a source reasonably causes or contributes to visibility impairment in any Class I area;
- Determining if additional controls or emission limits are necessary (BART determination).

1.3.1. BART eligibility

There are three factors used to determine if a source is BART-eligible under the CAA. Applicability is limited to those sources that:

1. Are in one of 26 specific source categories as identified in the Clean Air Act (see Table 2.1 for a list of these categories);

2. Have units that were in existence on August 7, 1977,³ but had not been in operation for more than fifteen years as of that date (prior to August 7, 1962);
3. Have a potential to emit (PTE) 250 tons per year (TPY) or more of any single visibility impairing pollutant from units that satisfy criterion #2. These pollutants include SO₂, NO_x, VOCs, PM₁₀ and ammonia. EPA in the final Regional Haze rule, however, allowed states flexibility in addressing ammonia and VOC sources.

Appendix B contains detailed information on MANE-VU's BART eligibility process.

1.3.2. Cause or contribute to visibility impairment in a Class I area

Once a facility is found to be "eligible" for the BART program, states must determine if that facility causes haze or contributes to the formation of haze at any Class I area. EPA's 2005 rule outlines three options to determine if a source reasonably causes or contributes to regional haze in any Class I area. These options include:

- **Individual source assessment (Exemption Modeling)** – This assessment uses CALPUFF or other EPA approved modeling methods. Results of modeling would be compared to natural background conditions. EPA defined "cause" as an impact of 1.0 deciview or more and "contribute" as an impact of 0.5 deciview or more. The rule, however, gave states discretion to set lower thresholds for contribution.
- **Cumulative assessment of all BART "eligible sources"** – Under this method, a state can choose to find that all eligible sources are subject to BART. This method could also be used to analyze an area's contribution to visibility impairment and demonstrate that *no* sources are subject, based on cumulative modeling.
- **Assessment based on model plants** – This method provides a mechanism to exempt sources with common characteristics that are found not to impair visibility at Class I areas.

1.3.3. BART determinations

Once a facility has been identified as BART-eligible and found to cause or contribute to haze in a Class I area, it must conduct an engineering review to determine if the installation of new control requirements is appropriate. This review takes into consideration five factors:

- Cost
- Energy and non-air environmental impacts
- Existing controls at source

³August 7, 1977 is the date that Congress adopted the 1977 Clean Air Act Amendments.

- Remaining useful life of source
- Visibility improvement reasonably expected from the technology.

1.4. Overview of Report

This report is intended to integrate all the information states could use to finalize their BART information for the December 2007 SIP submittal. This report provides an overview of MANE-VU's BART process, BART determinations, BART modeling, and BART resources. A brief review of the findings and their implications can be found in Appendix G, which, at this time, is only available to the individual state agency charged with conducting BART reviews for the specific facilities.

2. MANE-VU BART PROCESS

The following sections provide an overview of BART activities undertaken by MANE-VU and guiding actions for the region.

2.1. BART Workgroup

MANE-VU formed the BART workgroup as part of an effort to assist states and tribes as they prepare to comply with the Best Available Retrofit Technology (BART) requirements of the Regional Haze Rule. Membership in the MANE-VU BART workgroup is open to states and tribes in the MANE-VU region, EPA regional offices and the Federal Land Management agencies. This group worked together to refine the BART-eligible identification process. In addition, the group has developed recommendations to the MANE-VU Directors on assumptions for identifying BART-eligible sources and in making BART control determinations. To date, states have made substantial progress in identifying sources that are BART-eligible. This, however, is only the first step in the process. Once a source is identified as “BART-eligible,” an analysis must be conducted to determine what will constitute BART for each facility.

2.2. BART Recommendations

The Regional Haze Rule requires states to determine the most stringent technologically feasible system of controls that can reasonably be installed at each facility eligible for BART. The BART workgroup developed a list of recommendations for the BART control process that have been approved by the MANE-VU Directors. The recommendations include overall BART policies and specific “presumptive” levels and types of control. These recommendations will serve as a regional foundation for conducting BART engineering reviews on a state-by-state basis. The recommendations have been grouped by the three steps of the BART process that they affect.

2.2.1. Recommendations regarding BART eligibility:

- ***Any BART-eligible facility may “cap-out” of BART via a permit emission limit, however all permit modifications must be finalized prior to December 16, 2006 in order to eliminate BART eligibility.*** Caps must limit emissions from BART-eligible units below 250 tons per year of any visibility impairing pollutant. Caps must be in place prior to December 16, 2006 in order to enable states to take action to get permit limitations in place and achieve emission limits prior to SIP public notice and hearing processes.
- ***If data do not exist to accurately determine the installation date for emission unit(s) within a facility, then the unit will be treated as though it is within the BART date range unless the facility can provide proof otherwise (i.e., proof that the unit was in operation prior to 1962).*** Many states are having difficulty identifying installation dates for pre-1977 units. All states felt they could easily identify post-1977 units. Therefore, the workgroup supported a policy position that when the state could not accurately determine the “in existence” date, the

burden of proof lay with the facility in proving that the unit was installed prior to 1962.

2.2.2. Recommendations regarding BART control reviews

- *If a source is eligible for BART, it is subject to the BART determination process* (i.e., no exemptions will be given; note this does not *necessarily* mean that controls will be required).
- *Regional performance standards or cost thresholds are appropriate* for many individual categories of BART-eligible sources. The next section contains an initial round of recommended presumptive levels of control for EGUs, industrial boilers, and cement kilns. The workgroup may develop additional presumptive levels in the future.
- *Remaining useful life* of a source will be considered in the following way: Facilities have the option to *either control a BART-eligible facility prior to 2013 or accept a federally enforceable permit limitation or retirement date prior to December 16, 2006.*
- *Control technology in place will likely have to be dealt with on a source-by-source basis* (i.e., no regional recommendation).
- *Energy and non-air quality environmental impacts will likely have to be dealt with on a source-by-source basis* (i.e., no regional recommendation). The workgroup, however, is still considering regional recommendations for non-air quality environmental impacts.

2.3. Recommended Presumptive BART Levels of Control

The workgroup reviewed other regional control initiatives and attempted to harmonize those efforts with BART. This review resulted in the development of a recommended level of presumptive control for EGUs (CAIR and non-CAIR units) and industrial boilers. In addition, the group developed a list of control technologies that must be reviewed for cement kilns. Specific information on presumptive levels is provided below:

Non-CAIR EGUs:

- SO₂ – Coal - 95% control or 0.15 lb/MMBtu*
Oil - 95% control or 0.33 lb/MMBtu (0.3% sulfur content)*
- NO_x
 - in NO_x SIP call area, extend use of controls to year-round
 - 0.1 – 0.25 lb/MMBtu, depending on boiler and fuel type
- PM – 0.02 – 0.04 lb/MMBtu**

CAIR EGUs:

- SO₂ – CAIR requirements
- NO_x – CAIR requirements
- PM – 0.02- 0.04 lb/MMBtu**

If an EGU is only enrolled in CAIR for one or two pollutants, it still must complete an analysis for the remaining visibility impairing pollutants such as particulate matter.

Industrial Boilers

- SO₂ – 90% control, MACT acid gas control level, ICI-RACT, or 0.55 lb/MMBtu (0.5% fuel sulfur limit)
- NO_x
 - 0.1 – 0.4 lb/MMBtu, depending on boiler and fuel type***
- PM – 0.02 - 0.07 lb/MMBtu

Cement Kilns

No common emission threshold has been identified. The following lists, however, recommend control technologies to evaluate.

- SO₂
 - in process removal
 - wet or dry scrubbers
 - conversion from wet kiln to dry kiln
- NO_x
 - Combustion optimization
 - Low NO_x burners
 - Secondary combustion control (SNCR/SCR)
 - Mid-Kiln firing
 - Flame shape adjustment
- PM
 - baghouse
 - electrostatic precipitator
 - baghouse/ESP upgrades of existing controls

*Consistent with EPA presumptive BART for EGUs and OTC Control Strategy

** PM measures are based on front-half (Method 5) particulate matter measures

*** Consistent with OTC Control Strategies and NO_x SIP call emission limits

2.4. BART Trading

EPA proposed rules regarding BART trading in July 2005. As of the writing of this report, final rules had not been promulgated. The 2005 EPA proposal (see Appendices) requires that a trading program demonstrate results better than those achieved by the source-by-source BART program and that all BART sources in a sector participate. The MANE-VU BART workgroup continues to be interested in and investigate the possibility of developing a BART trading program but several significant barriers exist, including limited resources to manage a trading program.

3. BART DETERMINATIONS

In determining what system of controls constitute BART, the category of fossil-fuel fired steam-electric plants with greater than 250 MMBtu/hr heat input (hereafter Electrical Generating Units or EGUs) have been considered separately. Many options for reducing emissions from this category of sources exist and are widely available. While options for reducing emissions from the other 25 BART-eligible source categories also exist – and in many cases are the same options used by EGUs – they are often more source-specific with respect to their applicability or capital costs. We begin the discussion of BART determinations with EGUs.

3.1. EGUs

The BART-eligible EGUs in MANE-VU represent the largest emissions reduction potential among the various BART-eligible source categories. The population of BART-eligible EGUs within the MANE-VU domain can be broadly divided into three groups:

- Those in states eligible for participation in the U.S. EPA Clean Air Interstate Rule (CAIR) program on a year-round basis (Delaware, District of Columbia, Maryland, New Jersey, New York and Pennsylvania for SO₂ and NO_x),
- Those in states that participate in the seasonal CAIR program (Connecticut and Massachusetts for summertime NO_x), and
- Those in states that are not eligible to participate in the CAIR program (Maine, New Hampshire, Rhode Island, and Vermont).

Given the decision by the US EPA that CAIR will satisfy the SO₂ and NO_x requirements for BART, a discussion of those CAIR facilities is separated from the non-CAIR EGUs. We then turn in section 3.1.2 to consideration of how BART determinations are conducted for other EGUs.

3.1.1. CAIR

The Clean Air Interstate Rule – or CAIR – is a cap and trade program for SO₂ and NO_x emissions intended to address interstate transport of these pollutants. By requiring a large number of eastern states to reduce emissions of these pollutants, the level of transported sulfate and nitrate fine particulate matter, as well as ground-level ozone and precursor pollutants, is anticipated to be greatly reduced. Whether this regulation will deal adequately with transported air pollution and its precursors in the context of NAAQS attainment is a larger question, but within the context of the CAIR regulation, the states' ability to seek emissions controls from upwind states beyond those required under CAIR is limited. There is an opportunity; however, for additional emission reductions through the Regional Haze Rule's Reasonable Progress Goals and the inter-RPO consultation process where addressing national visibility goals may also help achieve compliance with various other mandated Clean Air Act programs.

EPA has stated that a state's participation in the CAIR program will satisfy the BART control requirements for BART-eligible EGUs that are also subject to the CAIR

provisions. Those facilities, however, will still need to conduct an analysis for PM. This includes all BART-eligible EGUs in Delaware, District of Columbia, Maryland, New Jersey, New York, and Pennsylvania. EGUs located in Connecticut and Massachusetts are also included in the CAIR program, but only for ozone season NO_x.

While BART determinations still must be conducted for *all* BART-eligible sources, it is anticipated that in CAIR states, adoption of the CAIR program will satisfy BART for the BART-eligible EGUs participating in the CAIR program for the specific pollutants covered under the rule. This means that all States must still consider whether PM and VOC controls are warranted at facilities where SO₂ or NO_x controls may be covered under CAIR. In addition, CAIR-participating EGUs in Delaware, New Jersey, Connecticut and Massachusetts will still have to identify appropriate SO₂ controls to serve as BART, as well as controls for NO_x in the non-ozone season (October through April). Identification of controls for these pollutants, however, must be done with proper consideration of the statutory factors contained in the BART regulations as for any other pollutant. Discussion of issues related to this determination for potential PM, VOC, or non-ozone season NO_x controls is in the following section and is germane for all controls – including SO₂ and ozone season NO_x – being considered by the non-CAIR states of Rhode Island, New Hampshire and Maine.⁴

3.1.2. Statutory factors

The BART determination process includes an engineering review, which requires the identification of the most stringent technologically feasible system of controls that can be installed at a facility. An engineering review for each facility in the MANE-VU region will be time-consuming and labor intensive. For states like New York or Pennsylvania, which have a large number of BART-eligible sources, it may be more efficient to conduct the mandatory review of statutory factors – and here we are primarily thinking of energy and non-air quality environmental factors, other controls already in place, and degree of visibility improvement that could result from installation of controls – prior to conducting a detailed engineering review for some facilities. The degree of visibility improvement must be considered in conjunction with the other statutory factors, but this analysis can be done before the engineering review. For many facilities, these statutory considerations could eliminate the reasonable installation of controls and obviate the need for an engineering review.

Regardless of which system of controls or control strategy is identified as meeting the objectives of the BART program, states are required to consider (1) the cost of compliance, (2) any energy or non-air quality impacts of compliance, (3) any existing pollution control technology in use at the source, (4) the remaining useful life of the source, and (5) the degree of visibility improvement that may reasonably be anticipated from the use of BART. Given that EPA has established a presumptive level of SO₂ control for previously uncontrolled EGUs greater than 750 MW that is consistent with the MANE-VU recommendation for all EGUs, if a state feels that the MANE-VU

⁴ Note that Vermont has no known BART-Eligible sources.

presumptive levels of control are appropriate at an individual EGU facility, states will not necessarily have to justify the imposition of SO₂ controls, but may have to justify why NO_x and PM controls are reasonable at the levels specified through a statutory factor analysis as described in EPA guidance. If, after review of the statutory factors, a state still believes that controls on the BART-eligible facilities are reasonable, then a full engineering review should be conducted in order to establish the most stringent technologically feasible system of controls that is appropriate for that facility. Resources to assist in this process are discussed in the following section.

3.1.3. Engineering reviews

The engineering reviews should consider control technologies that have been discussed in the MANE-VU document: *Assessment of Control Technology Options for BART-Eligible Sources* (Appendix C1). Chapter 2 of that document provides a detailed listing of pre-combustion, combustion and post-combustion options for a variety of EGU types that are prevalent in the MANE-VU region. Information regarding the typical installation costs for these facilities has also been included. States, however, are responsible for reviewing these data to ensure they represent facility-specific installation costs. Other sources of control technology information can be found in US EPA guidance documents (especially its RACT/BACT/LAER clearinghouse). In addition, other RPOs have developed information beyond what is included in the MANE-VU Assessment. Finally, STAPPA/ALAPCO has also developed a control technology assessment for particulate matter that reviews EGUs and many other categories of point, area, and mobile source emissions (see Chapter 5 for additional resources).

3.1.4. MANE-VU staff BART recommendations

MANE-VU staff developed preliminary BART control recommendations, where possible, based upon review of facility data, including their emission characteristics and controls already in place. Complete data for many facilities are still not available and thus MANE-VU staff was limited in its ability to develop recommendations for many facilities in some states. For each state, a separate spreadsheet has been created with all of the relevant information compiled along with technology or program recommendations for states to consider as a starting point. These are based on consideration of control technologies in place and the presumptive levels established by the MANE-VU BART workgroup. These spreadsheets are available to the state agencies and are not public at this time. These data will continue to evolve as states and MANE-VU staff continues the process of conducting BART determinations over the next several months.

3.2. Other Industrial Sources

In addition to EGUs, there are 25 BART-eligible categories including cement plants, paper and pulp facilities, and industrial boilers. These three categories are prevalent in the MANE-VU region and represent the greatest emission reduction

possibilities for the BART program outside the EGU sector. Because the CAIR rule is limited to EGUs, there are no special considerations with respect to CAIR that must be considered when conducting BART determinations. There are, however, other programs with may interact with BART and these are discussed below.

3.2.1. RACT

The MANE-VU member states are also members of the Ozone Transport Commission. At present time, the Ozone Transport Commission is coordinating the development of an integrated set of control strategies that will meet state needs for emission reductions under 8-hour ozone and fine particulate national ambient air quality standards (NAAQS) as well as regional haze regulations. Among the strategies being discussed is the application of Reasonably Achievable Control Technologies (RACT) at industrial, commercial, and institutional (ICI) boilers, refineries, and cement plants. In instances where a BART-eligible boiler or other facility is being considered for RACT, it is anticipated that RACT controls will already be in place by 2009, and that no additional control will be needed under BART for the pollutants covered by the RACT analysis. Thus for those sources brought into an OTC RACT program, the BART determination would consist of documenting the controls that will be installed and then justifying that no further controls for the relevant pollutants are reasonable in light of the statutory factors.

3.2.2. Permit limitations

Many BART-eligible facilities in the MANE-VU region are relatively small emission sources with potential emissions that exceed the statutory threshold of 250 tons per year or more, but with actual emissions below 250 tons in any year. These facilities may wish to accept a permit limitation that restricts their emissions by law to less than 250 tons per year. The MANE-VU BART workgroup has recommended that if a facility accepts such a permit limitation prior to December 16, 2006, that facility will no longer be BART-eligible and may be eliminated from the BART list for that state. The 2006 date was selected in order to give state agencies one full year to submit their regulatory package to a full public hearing and adoption process prior to submitting their SIP to the US EPA.

3.2.3. Statutory factors

In the event that a non-EGU source is *not* brought into an OTC control program being contemplated for 8-hour ozone or fine particulate NAAQS compliance, and is *not* able to accept a permit limitation rendering a facility ineligible for BART, then full BART determinations must be conducted. A starting point would be to consider any controls in place and the degree of visibility impairment that could be achieved by the installation of controls, followed by engineering reviews to identify the most stringent technologically feasible system of controls to satisfy BART.

This process is very similar to that described above for EGUs, but many of the technology options and resources identified for EGUS may not be applicable for several of the specific source categories within the MANE-VU states (e.g., FGD/scrubbers may be appropriate for EGU or large ICI boilers, but may not be appropriate for a chemical plant with many small emission units). MANE-VU has explored technology options for EGUs, ICI boilers, paper and pulp facilities, and cement plants in the 2005 technology assessment (Appendix C1). Beyond that assessment, the American Forest & Paper Association (AFPA) and the Council of Industrial Boiler Owners (CIBO) have submitted their own documentation for technology options and other considerations to take into account when conducting BART determinations. MANE-VU has provided this information as submitted for the states' consideration in Appendix F.

As with EGUs, other sources of control technology information are available as listed in the US EPA guidance document (note especially its RACT/BACT/LAER clearinghouse) and other RPOs may have additional information beyond what is included in the MANE-VU Assessment. STAPPA/ALAPCO has also undertaken a control technology assessment for particulate matter and a draft report is now available. This report reviews EGUs and many other categories of point, area and mobile source emissions (See Chapter 5 for additional resources).

For many facilities that are not within the EGU, industrial boiler, cement, or paper industrial sectors, states will need to develop facility-specific technology assessments of which controls are feasible and cost estimates for such controls. EPA guidance suggests methods for determining which control option (among several possibilities) will serve as BART for a given source.

3.2.4. MANE-VU staff BART recommendations

As in the case of EGUs, MANE-VU has developed preliminary BART recommendations based on a review of actual facility characteristics, emission characteristics, and controls already in place. Complete data for many facilities – particularly in the non-EGU source categories – are still not available at this time and thus MANE-VU staff was limited in its ability to develop recommendations for many facilities in some states. Detailed spreadsheets for each state have been developed and are available to the state agencies (they are not public at this time) and will continue to evolve as MANE-VU states and staff continue the process of conducting BART determinations over the next several months.

4. MODELING

US EPA guidance suggests several detailed modeling approaches for exemption modeling. Given that MANE-VU states have opted to consider all BART-eligible sources as subject to BART, no exemption modeling needs to be conducted for MANE-VU BART-eligible sources. The US EPA is less specific about modeling methods that must be employed in order to determine the degree of visibility improvement that will result from installation of controls or how to consider that improvement, but they do discuss modeling approaches for performing this “visibility improvement determination” and it is worth repeating the following excerpt from the US EPA’s guidance here:

“When making this determination, we believe you have flexibility in setting absolute thresholds, target levels of improvement, or de minimis levels since the decision improvement must be weighed among the five factors, and you are free to determine the weight and significance to be assigned to each factor.”

While the US EPA goes on to describe a basic visibility improvement determination modeling approach involving the same basic CALPUFF platform described for exemption modeling, it is less specific about how the results are used in concert with other factors to determine what level of control should be considered BART.⁵

Given this flexibility, MANE-VU feels comfortable in its approach of developing multiple modeling and data analysis platforms for the analysis of single source impacts and providing these (along with a protocol explaining the development of each platform and results) to each state for their own consideration of how to weight the results relative to the other factors that must be considered in making BART determinations.

4.1. Modeling Methods

A separate requirement of the Regional Haze Regulation requires the development of a contribution assessment, or a pollution apportionment for visibility impairment. As a part of the technical effort supporting the development of the MANE-VU contribution assessment, several modeling platforms and data analysis methods were developed that are capable of distinguishing *single source impacts* and are now available to support BART modeling in the context of the visibility improvement determination. In addition, a number of additional modeling and data analysis platforms have been developed that are appropriate only for more aggregated (generally state-by-state) contributions and thus are not included here. All methods and how they are used to develop a weight-of-evidence approach to geographic and regional contribution

⁵ US EPA suggests a default approach of relying on the CALPUFF modeling platform with parameter settings taken from the Interagency Workgroup on Air Quality Modeling (IWAQM) Phase II recommendations (US EPA, 1998). Any deviations or departures from these recommendations should be identified and explained in the modeling protocol.

determinations are described in the MANE-VU contribution assessment.⁶ Each of the methods for single source contribution assessment is described briefly below and references are provided to more detailed descriptions of each platform. This is followed by discussion of the results from this set of modeling exercises.

4.1.1. REMSAD: SO₂ tagging

A principal method for assessing the contributions of individual sources to observed sulfate at Federal Class I areas is based on the REMSAD model. REMSAD is a computationally efficient grid model that has simplified photochemistry (this represents a limitation for calculating ozone concentrations with accuracy) but has good performance for many components of PM_{2.5}, including sulfate. Newer versions of REMSAD incorporate an emission tagging feature that allows for the apportionment of simulated sulfate, nitrate, or mercury among different tagged emission components. MANE-VU has used this platform to tag SO₂ emissions from each state in the eastern U.S. as part of the pollution apportionment. This tagging feature can also be used to assess the contribution of individual BART-eligible facilities to the measured sulfate at Class I sites before and after controls for a visibility improvement determination. Full details on the REMSAD platform, including emissions inventory development and processing, meteorological data, meteorological model performance, and overall model performance are included in the MANE-VU contribution assessment (Appendix C in footnote 6) and are not repeated here.

Given the time required to process emissions for an annual run and the time required for an annual REMSAD simulation itself, we do not anticipate running each and every BART-eligible source as an independent tag through REMSAD, but will work with the BART workgroup to identify the priority sources and attempt to model as many of these sources as possible.

4.1.2. CALPUFF approaches: NWS observation-based and MM5-based meteorology

In addition to the REMSAD modeling platform, MANE-VU has also developed two different CALPUFF modeling systems. The Vermont Department of Environmental Conservation and the Maryland Department of the Environment (through their contractor ERM) have jointly developed a set of emissions input files for CALPUFF based on the MANE-VU emission inventory version 2 (MARAMA, 2006), and supplemented these data with Continuous Emission Monitoring System (CEMS) data for 869 large power plants that reported SO₂ emissions to that system for the full year in 2002.

⁶ NESCAUM, *Contributions to Regional Haze in the Northeast and Mid-Atlantic United States: the Mid-Atlantic/Northeast Visibility Union (MANE-VU) Contribution Assessment*, August, 2006.

The primary difference between the two CALPUFF platforms involves different meteorological datasets developed by each team. ERM developed CALMET-processed meteorology on a large domain (extending from Oklahoma City, OK up to Prince Edward Island, Canada). The CALMET meteorology was processed directly from the MM5 model output developed on a 12-km horizontal grid by the University of Maryland for the OTC modeling committee and MANE-VU. The Vermont team developed CALMET meteorology (for the identical domain) driven by the National Weather Service's surface observation network, rawinsonde network, and supplemented by the Airport Surface Observation System (ASOS) network. This observation-based dataset provides an alternative to the gridded wind fields generated by the diagnostic model MM5.

Both data sets have been used to estimate contributions of individual states and large facilities within states to the sulfate burden observed at MANE-VU Class I areas for the purposes of the MANE-VU pollution apportionment.⁷ The platforms are now ready to be used for estimating source contributions of individual BART-eligible facilities as states provide modeling parameters for those facilities. Details on the platform are available in the MANE-VU contribution assessment (Appendix D in footnote 6).

4.1.3. Empirical approaches: emissions divided by distance or Q/d

As one of the screening approaches suggested by the US EPA in its guidance for exemption modeling, it describes a very simple approach involving a review of the ratio of a source's emissions divided by the distance to a receptor of interest. Based on a review of a memorandum from the North Carolina Department of Natural Resources, the US EPA suggests that a ratio of 20 may be an appropriate level of significance to use as a threshold level of impact (when emissions are expressed in tons per year of the sum of NO_x and SO_x and distance is expressed in kilometers).

MANE-VU has modified and included this basic approach as one method for inclusion in visibility improvement determinations. The basic approach is extremely simplistic, ignoring meteorological and chemical dynamics of the real atmosphere. Nonetheless, it can be a fairly reliable predictor of relative impact. By comparing the emissions divided by distance, or Q/d, ratio to CALPUFF-calculated source impacts, a strong linear relationship can be established for a given wind sector. Thus by scaling our Q/d results within a given wind sector to CALPUFF-modeled impacts for sources within that wind sector, we develop a metric that represents the functional empirical approach of the emissions divided by distance method, but takes into account the relative importance of some sources given prevailing winds. The metric is also scaled according to CALPUFF calculated chemical loss rates (see footnote 6 for details). While this method is dependent on the CALPUFF platform for establishing the absolute magnitude of estimated impacts, it is a completely independent empirical method for establishing the relative importance of individual sources within a given wind-sector. As such, it can provide evidence of *relative* improvement with respect to visibility in Class I sites.

⁷ A pollution apportionment is a required element of the long term emissions management strategy required by EPA for compliance with the Regional Haze Rule.

4.1.4. Data analysis approach: percent time upwind

MANE-VU has developed one additional data analysis approach that can also be used in a relative sense (i.e., to identify potential improvement relative to current impacts on Class I areas) on an individual facility basis. By using back trajectories to identify the “upwind residence time” or the fraction of time that a selected location spent upwind of a Class I area, and multiplying that time by the total emissions from a facility at that location, we can develop a crude metric for relative source impact. Again, by comparing this measure of impact before and after an emissions reduction, we can estimate the degree of visibility improvement.

4.2. Anticipated Visibility Improvement as a Result of BART

The preceding section lays out several potential modeling and data analysis approaches for assessing the degree of visibility improvement anticipated to result from installation of BART controls. MANE-VU will apply these techniques to an individual state’s BART-eligible sources and provide results in the spreadsheets that have been developed for state reference as the states conduct their final BART determinations. While these analyses are being provided to states as a resource, they are not necessarily the final word on modeling or data analysis for BART determinations. Rather, these methods are provided as a regionally consistent foundation for assessing the degree of visibility improvement that could result from installation of controls at each BART source. Each state will then have the opportunity to supplement these data with its own modeling or require individual sources within a state to conduct modeling of their own, thus enabling each state to tailor its BART determination process to individual state needs.

5. BART RESOURCES

This resource book provides links and references to materials useful to states as they conduct BART determinations, in addition to clarifying the requirements for BART determinations, identifying what progress toward BART determinations has been accomplished by MANE-VU to date, and providing an outline for next steps in the BART determination process. A wide-variety of resources have been collected, including relevant regulations, technical memos and reports identifying potentially BART-eligible sources, information on and assessments of potential control technologies, modeling and data analysis protocols, the US EPA and industry provided guidance for states' consideration, as well as state workgroup recommendations representing regional consensus on specific issues. A brief description of the documents that are cited and their relevance is included here.

5.1. Regulations

The US EPA issued the Regional Haze Rule, which included BART provisions, in 1999. This regulation was subsequently litigated and the BART provisions of the rule were remanded to EPA. A revised "BART Rule" was proposed and finalized in April 2005. Both the initial Regional Haze Rule and the final BART Rule are attached here as Appendices A1 and A2. Appendix A3 includes a subsequent regulation that addresses how states can implement a trading program in lieu of BART. This is termed the "BART Trading Rule."

5.2. BART Eligibility Resources

In 2001, NESCAUM produced a report that contained a preliminary list of BART-eligible EGUs in the MANE-VU region. This was followed in 2003 with a preliminary list of BART-eligible sources from the other 25 categories of stationary sources. Both of these documents provided lists that included potential BART-eligible sources. State have subsequently reviewed the NESCAUM lists and further developed them. This has been provided to MANE-VU staff and serves as the basis for the current list of BART-eligible sources. The NESCAUM documents, which describe the methodology for developing the preliminary lists for both EGUs and non-EGUs, are attached as Appendices B1 and B2.

5.3. Control Technology Information

In 2005, NESCAUM published a report entitled *Assessment of Control Technology Options for BART-Eligible Sources* that reviews potential technology choices for EGUs, industrial boilers, cement kilns, and paper and pulp facilities. While there are clearly other types of BART-eligible sources in the region that may need controls under the BART program, the majority of potential emissions that might be reduced under BART come from these four categories. These categories also share the characteristic of

having fairly generic control options. It is likely that other facilities, like petroleum refineries or chemical plants, will require very unique control combinations given the diversity of equipment and usage at each facility. While paper and pulp facilities and industrial boilers don't necessarily have a "one-size-fits-all" control method, they do tend to have some more common control approaches that have been utilized previously, and in sufficient numbers to allow the development of a report with cost estimates for typical installations. This report has been attached as Appendix C1.

Additional control technology assessments have been developed or are under development by other groups and RPOs and are provided here for state consideration. The US EPA maintains a RACT/BACT/LAER clearinghouse with control technology options by source category available at: <http://cfpub.epa.gov/rblc/htm/bl02.cfm>. STAPPA/ALAPCO has a contract with M.J. Bradley and Associates to identify potential controls for a wide-variety of source categories, including many of the BART categories.⁸ This work should be completed in the very near future, which the states may want to consider. The Midwest RPO hired MACTEC Engineering and Consulting, Inc. to conduct a survey of control technology options for BART and its final report is available at: <http://www.ladco.org/reports/rpo/MWRPOprojects/Strategies/Final%20Control%20Measures.pdf>. The VISTAS RPO has developed an Excel spreadsheet with control technology information that may serve as a useful reference. These links and resources are attached as Appendices C2, C3 and C4, respectively.

5.4. Program Implementation Resources

MANE-VU has formed a state working group to formulate regional positions on BART program implementation to the extent that consensus exists. This workgroup has developed a list of recommendations for the air directors' consideration as BART determinations are made. These recommendations cover several aspects of program implementation and include presumptive levels of controls for some source categories. They are contained in Appendix D.

5.5. Modeling Resources

In 2005, NESCAUM published an interim contribution assessment report that contains detailed results from seven different modeling platforms or data analysis methods used to attribute sulfate pollution in MANE-VU Class I areas. The modeling platforms and analysis techniques are described in great detail in the technical appendices of that document. Each of these analysis platforms has been refined and updated with new results based on current meteorological and emission inventory inputs. A final contribution assessment is being published concurrently with this BART resource book that contains the results of that refined analysis.⁶ Insofar as four of the seven methods have been discussed here (see Chapter 4) as potential methods for visibility improvement

⁸ STAPPA/ALAPCO, *Controlling Fine Particulate Matter Under the Clean Air Act: A Menu of Options*, draft, March, 2006.

determinations for BART, the full technical descriptions of these analysis platforms are resources to be provided for state consideration. The final MANE-VU contribution assessment is attached as Appendix E.

5.6. Stakeholder Submitted Information

In addition to technical information generated by MANE-VU, the US EPA, other RPOs, and a number of interested stakeholders have provided MANE-VU with their own assessments of control technology and program implementation options. These materials are presented here as submitted by the various groups so that states can take this information into consideration when conducting their BART determinations. MANE-VU, however, provides no guarantees as to their accuracy. It has not developed these materials nor been involved with their development. MANE-VU does feel it is important for states to be aware of the perspectives of the industry associations that they are regulating.

First, a white paper from the Council of Industrial Boiler Owners (CIBO) (Appendix F1) reconciles the differences between cost estimates for control programs when developed by different groups as opposed to the regulated industry itself. The white paper is supported by a presentation from Black and Veatch that reviews cost differences between the US EPA and industry cost estimates for NO_x and SO₂ controls.

From the American Forest and Paper Association (AF&PA), MANE-VU received a number of control cost estimates, reports and statistics. The National Council for Air and Stream Improvement (NCASI) has published a paper – provided in Appendix F2 – that reviews currently available control technologies for NO_x, SO₂, and PM for the major emission sources at paper and pulp mills.

AF&PA also provided Appendices F3, F4, F5, and F6 that contain a summary of points to consider when retrofitting boilers at paper and pulp facilities, AF&PA's own analysis of control costs for paper and pulp boilers relative to EPA's assessments, and two reports developed by consulting firms for the industry to support its cost information.

AF&PA has also submitted a discussion of emissions trading programs and what might be accomplished through the application of such a program – as opposed to a source-by-source application of BART—in the CENRAP states. The discussion and the CENRAP white paper are presented as Appendices F7 and F8.

Finally, AF&PA provided an Excel file showing the diversity of emission rates from various boilers. These data are intended to demonstrate that fixed percentage reduction targets may be difficult to achieve in many cases given the starting baselines, controls, fuels, etc. This spreadsheet is contained in Appendix F9.

6. CONCLUSION

The BART program represents a significant emission reduction opportunity for the Northeast and Mid-Atlantic States as they seek to attain 8-hour ozone and PM_{2.5} standards and demonstrate reasonable progress toward national visibility goals under the Regional Haze Rule. While the BART program is described clearly in guidance documents and regulations, there are a number of provisions that require significant analytical effort. This document is intended to assist states in navigating the requirements and completing BART determinations for each BART-eligible source in the region.

Many of the BART-eligible emissions reductions are necessarily included in the CAIR caps within states that participate in either the seasonal or annual CAIR program and the US EPA has been fairly prescriptive in how emissions reductions will be achieved from these sources. States may have flexibility with respect to how they choose to “harvest” the emissions reductions from several other source sectors. This may allow states to require controls under either the BART program or under RACT programs with fewer regulatory “hoops.” Finally, many small facilities that emit less than 250 tons per year of any visibility impairing pollutant may be capped out of the BART program if permit changes occur prior to the end of 2006.

MANE-VU has provided program recommendations, modeling resources, and preliminary control recommendations for those sources that could be, after consideration of the many interactions between BART and other regulatory programs, controlled under the BART program. This information is provided for the states’ consideration. MANE-VU is now prepared to work with individual states to provide further state-by-state assistance as they conduct detailed engineering reviews and prepare BART SIP submissions.

Appendix A: Regulations

Appendix A: Regulations

A.1. 1999 Regional Haze Rule & Preamble

A.2. 2005 Regional Haze Rule (Final BART Provisions)

A.3. 2005 Regional Haze Rule Preamble (Final BART Provisions)

A.4. 2005 Proposed BART Trading Rule

A.5. 2005 BART Trading Rule Preamble

Appendix B: BART-Eligibility Resources

Appendix B: BART-Eligibility Resources

B.1. A Basis for Control of BART-Eligible Sources, 2001 (EGUs Only)

B.2. Technical Memorandum #6 – Development of a List of BART-Eligible Sources in the MANE-VU Region: Interim Report, 2003 (non-EGUs)

Appendix C: Control Technology Options

Appendix C: Control Technology Options

C.1. Assessment of Control Technology Options for BART-Eligible Sources, 2005 (EGUs, Industrial Boilers, Cement Plants, and Paper and Pulp)

**C.2. US EPA RACT/BACT/LAER Clearinghouse (web link) (L01:
<http://cfpub.epa.gov/rblc/htm/bl02.cfm>)**

**C.3. Midwest RPO Control Technology Assessment (web link) (L02:
<http://www.ladco.org/reports/rpo/MWRPOprojects/Strategies/Final%20Control%20Measures.pdf>)**

C.4. VISTAS BART Control Spreadsheet

Appendix D: Program Implementation Resources

Appendix D: Program Implementation Resources

D.1. MANE-VU BART Workgroup – Program Recommendations

Appendix E: Modeling Resources

Appendix E: MANE-VU Final Contribution Assessment

Appendix F: Stakeholder Provided Resources

Appendix F: Stakeholder Provided Resources

F.1. CIBO: Industrial Air Pollution Control Project Costs with Control Equipment Cost Representations.

F.2. National Council on Air and Stream Improvement (NCASI): Retrofit Control Technology Assessment for NO_x, SO₂, and PM Emissions from Kraft Pulp and Paper Mill Unit Operations, by Arun V. Someshwar.

F.3. American Forest & Paper Association (AF&PA): Special Considerations for Boiler Controls at Paper and Pulp Mills.

F.4. American Forest & Paper Association (AF&PA): EPA Cost Estimates for NO_x Controls on Pulp and Paper Boilers are too Low by 100->300%.

F.5. - American Forest & Paper Association (AF&PA): Stone & Webster report on Control Technology Costs for Paper and Pulp Industry.

F.6. American Forest & Paper Association (AF&PA): BE & K report on Control Technology Costs for Paper and Pulp Industry.

F.7. American Forest & Paper Association (AF&PA): Why Emissions Trading is Important.

F.8. American Forest & Paper Association (AF&PA): CENRAP Regional Haze Emissions Trading Straw Proposal.

F.9. American Forest & Paper Association (AF&PA): Boiler Emissions - Control Distribution Figures.

Appendix G: BART-Eligible Source Information by State

**Appendix G: BART-Eligible Source Information by State
(including: Facility IDs, controls already in place, current
emissions, recommended BART, estimated post-BART
emissions, and modeling parameters)**

G.1. Connecticut

G.2. Delaware

G.3. District of Columbia

G.4. Maine

G.5. Maryland

G.6. Massachusetts

G.7. New Hampshire

G.8. New Jersey

G.9. New York

G.10. Pennsylvania

G.11. Rhode Island