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# Five-Factor Analysis of BART-Eligible Sources

## Survey of Options for Conducting BART Determinations

**Prepared by**
**NESCAUM**
***for the***
**Mid-Atlantic/Northeast Visibility Union (MANE-VU) Regional Planning Organization**

**June 1, 2007**

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# FIVE-FACTOR ANALYISIS OF BART-ELIGIBLE SOURCES

Survey of Options for Conducting BART Determinations

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# Executive Summary

The 1999 U.S. Environmental Protection Agency (USEPA) "Regional Haze Rule" [64 Fed. Reg. 35714 (July 1, 1999)] requires certain emission sources that "may reasonably be anticipated to cause or contribute" to visibility impairment in downwind Class I areas to install Best Available Retrofit Technology (BART). These requirements are intended to reduce emissions specifically from large sources that, due to age, were exempted from other control requirements of the Clean Air Act.

States are required to undertake three key steps to comply with the BART requirements of the Regional Haze Rule. 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 (subject to BART);
- Determining if additional controls or emission limits are necessary (BART determination).

This report is intended to summarize one approach to satisfy the BART requirements of the Regional Haze Rule that member states may consider. We also review BART-eligible sources in the MANE-VU region and provide – on a regional basis – an analysis of the general applicability of the five statutory factors that states must consider in determining BART controls for various source categories subject to BART. This analysis will allow MANE-VU states to place their source-specific BART determinations into the regional context of similar sources within MANE-VU. This review includes an examination of individual units' impacts on visibility at Class I areas based on CALPUFF modeling and an evaluation of existing or potential controls and feasibility of these controls relative to the statutory factors identified in the BART rule.

Ultimately, the strength of the MANE-VU BART program, as determined by individual state control decisions and informed by this analysis, will demonstrate MANE-VU's resolve to tackle visibility and related air quality problems in its region. As MANE-VU enters into consultations with other regional planning organizations (RPOs), its willingness to seek reasonable emission reductions within its own region will help set expectations for the other RPOs, and the BART program represents a cornerstone of this process.

# 1. INTRODUCTION

The 1999 U.S. Environmental Protection Agency (USEPA) "Regional Haze Rule" [64 Fed. Reg. 35714 (July 1, 1999)] requires certain emission sources that "may reasonably be anticipated to cause or contribute" to visibility impairment in downwind Class I areas to install Best Available Retrofit Technology (BART).[1] These requirements are intended to reduce emissions specifically from large sources that, due to age, were exempted from new source performance standards (NSPS) requirements of the Clean Air Act.

BART requirements pertain to 26 specified major point source categories, including power plants, industrial boilers, paper and pulp plants, cement kilns, and other large stationary sources. To be considered BART-eligible, sources from these specified categories must have the potential to emit at least 250 tons per year of any haze forming pollutant and must have commenced operation or come into existence in the 15 year period prior to August 7, 1977 (the date of passage of the 1977 Clean Air Act Amendments, which first required new source performance standards).

Because of the regional focus of the 1999 haze rule, it is likely that BART requirements will be applied to a much larger number of sources across a broader geographic region than has been the case historically (i.e., through reasonably attributable visibility impairment requirements in the 1980 haze regulations). In addition, USEPA has for the first time introduced the possibility that source-by-source, command and control type BART implementation may be replaced by more flexible state initiatives (e.g. market-based approaches), provided such alternatives can be shown to achieve greater progress toward visibility objectives than the source by source BART approach.

## 1.1. The BART Rule

In June 2001, EPA released proposed guidelines on BART. This guidance outlined the method for determining if a facility has a BART-elgible source, if a source is subject to BART provisions, and methods for conducting a BART control review for such sources.

In 2002, industry groups challenged the method EPA outlined in the Regional Haze Rule to determine the degree of visibility improvement resulting from application of BART controls. Under EPA's interpretation of the statute, a state would deem sources subject to BART if they emitted into a geographic area or region from which pollutants are likely transported downwind into a protected area. In May 2002, the D.C. Circuit Court of Appeals agreed with industry petitioners that this interpretation impermissibly constrained the authority of any state that wanted to provide an exemption mechanism from BART requirements. The Court vacated those portions of the Regional Haze Rule dealing with BART.

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[1] There are seven designated Class I areas in the Northeast and Mid-Atlantic States. They include Acadia National Park and Moosehorn Wilderness Area in Maine; Roosevelt Campobello International Park in New Brunswick and Maine; the Lye Brook Wilderness Area in Vermont; the Great Gulf and Presidential Range-Dry River Wilderness Areas in New Hampshire; and the Brigantine Wilderness Area in New Jersey.

In June 2005, EPA released the final BART guidelines that also addressed the remanded portions of the Regional Haze Rule dealing with BART. 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 conducting a BART control analysis;
- Provided presumptive control 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 great degree of flexibility in how they choose to implement the BART program. The following section summarizes the core requirements for state compliance with BART regulations.

## 1.2. Overview of State BART Requirements

As finally promulgated, States are required to undertake three key steps to comply with the BART requirements of the Regional Haze Rule. 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 (subject to BART);
- Determining if additional controls or emission limits are necessary (BART determination).

As stated earlier, eligibility is limited to sources 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 "eligible" for the BART program, states must determine if that source is "subject to BART," that is, if it 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 is subject to BART. 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.[2] The rule, however, gave states discretion to set lower thresholds for contribution.

[2] Impacts are based on the difference in deciviews (delta deciview) calculated between the best twenty percent natural visibility conditions (states have the option to use annual average conditions as an alternative) at a Class I site with and without individual source contributions included.

- ***Cumulative assessment of all BART "eligible sources"*** – Under this method, a state can choose to find that all eligible sources within a geographic area or region 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.

Once a source has been identified as BART-eligible and "subject" to BART, it must conduct an engineering review to determine if the installation of new control requirements is appropriate.[3] This review takes into consideration five factors:

- Cost of controls
- Energy and non-air quality environmental impacts
- Existing controls at source
- Remaining useful life of source
- Visibility improvement reasonably expected from application of the controls.

## 1.3. Overview of Report

This report is intended to summarize an approach to satisfy the BART requirements of the Regional Haze Rule based on the "cumulative assessment of contribution" option for determining if eligible sources are subject to BART. We also review BART-eligible sources in the MANE-VU region and provide – on a regional basis – an analysis of the general applicability of the five factors for various source categories subject to BART. This analysis should not be viewed as preventing states from exercising their flexibility in structuring their own approach to BART or in applying the five factors to that approach. Rather, this analysis will allow MANE-VU states to place their source-specific BART determinations into the regional context of similar sources within MANE-VU. This review includes an examination of individual units' impacts on visibility at Class I areas, based on CALPUFF modeling and an evaluation of existing or potential controls and feasibility of these controls relative to the statutory factors identified in the BART rule[4].

To that end, Section 2 of this report first develops a list of all BART-eligible sources in the MANE-VU region. Section 3 provides an overview of the region's approach to determining BART eligibility. Finally, Section 4 presents observations on the regional and sectoral differences among control options and the applicability of the five-factor analysis.

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[3] A possible exception to this requirement would exist in the case where a state has adopted a "better than BART" alternative program that would take the place of a source-specific BART determination. The RPO is not aware of any MANE-VU states that are adopting such programs at this time.

[4] Throughout this report we refer to the collection of sources at a stationary facility potentially subject to BART as a "BART-eligible source." Individual emitting units at these BART-eligible sources will be referred to as "units" when emissions are modeled and descriptions of possible control strategies are offered.

# 2. DETERMINING BART-ELIGIBLE SOURCES

To assist MANE-VU states and tribes with BART implementation efforts, MANE-VU developed a list of BART-eligible sources in the region (NESCAUM, 2001; NESCAUM, 2003). Since then, the preliminary list developed in these documents was refined through consultation with state permitting staff to verify completeness and accuracy of the list. Emissions of $SO_2$, $NO_X$, and $PM_{10}$ as well as stack information were compiled through either consultation with state permitting staff or the 2002 MANE-VU emissions inventory. The final list of sources (as well as associated 2002 emissions and stack parameters) was developed in consultation with state staffs (see Appendix A for a complete list of BART-eligible sources and units in the MANE-VU region).

# 3. MANE-VU APPROACH TO "SUBJECT TO BART"

Based on the MANE-VU contribution assessment (NESCAUM, 2006b), every MANE-VU state with BART-eligible sources contributes to visibility impairment at a Class I area to a significant degree. Therefore, MANE-VU staff continues to support the policy decision made by the MANE-VU Board in June 2004, that ***if a source is eligible for BART, it is subject to BART***. (i.e., no exemption test will be used). The reasons why MANE-VU has chosen to pursue this option for demonstrating its sources are reasonably anticipated to cause or contribute to visibility impairment at Class I areas are threefold: (1) the BART sources represent an opportunity to achieve greater reasonable progress, (2) additional public health and welfare benefits will accrue from resulting decreases in fine particulate matter, and (3) to demonstrate its commitment to federal land managers (FLMs) and other RPOs as it seeks emissions reductions wherever it is reasonable to do so.

This recommendation is not equivalent, however, to the statement that every BART-eligible source must install controls. The approach presented for MANE-VU state consideration – starting with this document and continuing with their own source specific analyses – requires the consideration of each of the five factors required by statute before determining whether or not controls are warranted.

# 4. REGIONAL FIVE FACTOR ANALYSIS

## 4.1. The Degree of Visibility Improvement That May Reasonably be Anticipated from the Use of BART

BART emission limits must be determined subject to an evaluation of the five statutory factors. These factors include:

(a) the costs of compliance,
(b) the energy and non-air quality environmental impacts of compliance,
(c) any existing pollution control technology in use at the source,
(d) the remaining useful life of the source, and

(e) the degree of visibility improvement which may reasonably be anticipated from the use of BART.

To begin its regional analysis of these factors, MANE-VU staff first considered the degree of visibility improvement that could result from the installation of BART controls. This is slightly different than the statutory language and is meant to reflect our first-order approach to estimating the maximum visibility benefit that could be achieved by eliminating all emissions from the source. While this is not a realistic approach to fully satisfying the intent of factor (e) above, it does provide the states a useful metric for determining which sources are unlikely to warrant BART controls based on consideration of this factor.

This analysis was achieved by first modeling 2002 emissions of $SO_2$, $NO_X$, and $PM_{10}$ from all BART-eligible units in the region.[5] A total of 136 BART-eligible sources were identified in the MANE-VU region and modeled on the two CALPUFF platforms. Table 4-1 displays the types and numbers of sources modeled in the region.

**Table 4-1. Types of BART-eligible sources modeled in the region**

| Source Type | Number of Sources | Number of Units/MM5* | Number of Units/NWS |
|---|---|---|---|
| Chemical Manufacturer | 12 | 48 | 107 |
| Chemical Plant | 1 | 4 | 18 |
| Coal Cleaning | 1 | 1 | 1 |
| EGU | 59 | 139 | 296 |
| Glass Fiber | 3 | 14 | 33 |
| Incinerator | 1 | 2 | 2 |
| Industrial Boilers | 2 | 6 | 8 |
| Lime Plant | 2 | 4 | 14 |
| Metal Production | 13 | 64 | 140 |
| Mineral Products | 1 | 4 | 13 |
| Paper and Pulp | 14 | 39 | 63 |
| Petroleum Storage | 4 | 6 | 10 |
| Portland Cement | 13 | 49 | 228 |
| Refinery | 9 | 70 | 497 |
| **Total** | **136** | **455** | **1449** |

* Units with very small emissions were grouped together and modeled as one stack for the MM5-based CALPUFF runs.

The two CALPUFF modeling platforms are described in greater detail elsewhere (NESCAUM, 2006b) and are driven by two respective meteorological datasets: 1) a wind field based on National Weather Service (NWS) observations and 2) a wind field based on output from the MM5 meteorological model (MM5, 2006). Environmental Resources Management (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

[5] Emissions information was gathered from the MANE-VU 2002 Version 2 (Base A) emissions inventory. Since then, the MANE-VU 2002 Version 3 (Base B) emissions inventory has been developed which includes several changes made by the OTC modeling committee.

on a 12-km horizontal grid by the University of Maryland for the OTC modeling committee and MANE-VU. The Vermont Department of Environmental Conservation (VT DEC) developed CALMET meteorology (for the identical domain) driven by the NWS'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.

Modeling results from both NWS and MM5 platforms have been made available to the states involved in this process. Results include each BART-eligible unit's maximum 24-hr, 8$^{th}$ highest 24-hr, and annual average impact at the Class I area most heavily impacted, as well as the total impact from all BART sources on each Class I area. These visibility impacts were modeled relative to 20 percent best, 20 percent worst, and annual average natural background conditions. For the purposes of this analysis, we examined the 24-hr maximum visibility impact relative to the 20 percent best days. On July 19, 2006, EPA provided clarification to guidance that states may use either estimates of 20 percent best or annual average natural background visibility conditions as the basis for calculating the deciview difference that individual sources would contribute for BART exemption modeling purposes. MANE-VU has opted to use the best conditions estimates for their consideration of the "degree of visibility improvement" modeling because it is more protective to the region.

Given that no modeling of 2018 "post-BART" emission levels has been conducted yet, the 2002 modeling, in essence, provides MANE-VU with an estimate of the maximum improvement in visibility that could result from installation of BART controls at Class I areas in the region (i.e., if the source was zeroed out). In virtually all instances, the installation of BART controls would result in less visibility improvement than what is represented by a source's 2002 impact, but this does provide a consistent means of identifying those sources whose emissions represent a more significant contribution to visibility impairment than others.

In July of 2004, MANE-VU submitted comments to EPA that included visibility impact analysis of a representative sample of EGUs across the country. Based on that representative sample, MANE-VU determined that the value of the maximum 24-hour impact relative to natural conditions that would include 98 percent of the cumulative visibility impact on MANE-VU sites was likely between 0.1 and 0.2 dv. However, this dataset was limited in that it only explored the relationship of EGUs and did not provide an indication of how the total frequency impact might change with numerous smaller, non-EGU, BART-eligible sources. With this new CALPUFF modeling data, we were able to repeat this analysis for the dataset that included all BART-eligible units in the region. This analysis remains limited that in that it includes only MANE-VU sources. It is likely that the additional sources from VISTAS and MWRPO would add to the total visibility impairment experienced at MANE-VU class I areas and, to some extent, to the top 98 percent of the visibility impacts. Without knowing the exact contribution of extra-regional BART sources to impairment at our Class I sites, it is impossible to determine the cumulative 98$^{th}$ percentile frequency precisely.

Notwithstanding this limitation, the results of this new analysis showed that 98 percent of the cumulative frequency visibility impact from all MANE-VU BART-eligible

sources corresponds to a maximum 24-hr impact of 0.22 dv from the NWS-driven data and 0.29 dv from the MM5 data. We therefore concluded that a range of 0.2 to 0.3 dv would represent a "significant" impact at MANE-VU Class I areas on an average basis. Given the analysis and the limitation due to exclusion of sources outside of MANE-VU, we decided to place increased weight on sources with an individual visibility impact greater than 0.1 dv for this 1st order regional 5-factor analysis. This threshold is overly inclusive relative to exemption processes being conducted by other RPOs, but still provides MANE-VU states flexibility in choosing the weight to be given to the first of the five factors considered (i.e., the degree of visibility improvement that could result from BART).

As an additional demonstration that sources whose impact were below the 0.1 dv level were too small to warrant BART controls, the entire MANE-VU population of these units was modeled together to examine their cumulative impacts on each Class I site. The result of this simulation showed that the maximum 24-hr impact at any Class I area of *all* modeled sources with individual impacts below 0.1 dv was only a 0.35 dv change relative to the estimated best days natural conditions at Acadia National Park. This value is below the 0.5 dv impact recommended by EPA for exemption modeling and we can be fairly certain that sources below the 0.1 dv level have very small individual impacts on visibility at Class I areas.

Among the sources with a greater than 0.1 dv total impact at any Class I area were 29 EGUs with 95 BART-eligible units that are located in states subject to CAIR. These CAIR-eligible EGU units may use the CAIR program to satisfy BART for $SO_2$ and in most cases $NO_X$ BART. We did not consider these sources further with the exception of the three EGU sources (eight units) that had greater than 0.1 dv contribution for PM alone. These three EGU sources, along with 14 additional EGU sources in states that are not subject to CAIR (17 EGUs total), and 36 additional non-EGU sources with visibility impacts that may warrant BART controls are listed in Table 4-2 by type.

**Table 4-2. Types of sources in MANE-VU region with greater than 0.1 dv impact at any Class I area (non year-round CAIR states).**

| Source Type | Number of Sources | Number of Units/MM5* |
|---|---|---|
| Chemical Manufacturer | 1 | 3 |
| Coal Cleaning | 1 | 1 |
| EGU | 17 | 30 |
| Glass Fiber | 1 | 6 |
| Incinerator | 1 | 2 |
| Metal Production | 2 | 7 |
| Paper and Pulp | 12 | 30 |
| Portland Cement | 12 | 25 |
| Refinery | 5 | 37 |
| **Total** | 53 | 142 |

*Only MM5 Data were used for this analysis.

## 4.2. Cost and Availability of Controls and Controls Already in Place

The second and third steps of the MANE-VU five-factor analysis involved evaluating current controls at sources and costs of additional controls at these sources – factors (a) and (c) above. To address these factors, the list of these 53 highest impacting sources, including all the BART-eligible units at these sources (142 units), was sent out to state permitting staff for feedback on possible controls recommendations for these types of units and cost information for typical installation of these controls. Several states informed us that some of the eligible sources are subject to future controls under existing state regulations that will achieve "BART-like" levels of control. In these cases, we have listed the control level where applicable, or designated the control as "Currently Controlled" if the controls are already in place. Other states are considering a cost threshold to determine whether controls are feasible. If potential additional controls are above any known cost thresholds, then it is likely that a state would not feel that additional controls beyond those currently in place are warranted and we have therefore designated such units as "No Further Controls Warranted." In situations where we did not have sufficient information to assess current or potential future controls, the unit has been designated as "No Known Further Controls." In cases where other control programs such will satisfy BART, the control program is listed. Finally, we have listed the control technology as "No Known Further Controls" for BART-eligible sources where no information was available on possible control options.

NESCAUM compiled the available survey results provided by state staffs on expected or potential controls on these units and projected 2018 emissions from these units. Summaries of these results are found in Table 4-3 to Table 4-5. Cost information for various control options was obtained from a variety of sources including individual states, previous NESCAUM reports (NESCAUM, 2005), and other RPO analyses. Cost estimates from NESCAUM (2005) as well as the low, medium, and high cost designations described in the Tables 4.3-4.5 are summarized in Appendix B. Obviously, more detailed analysis of the cost of various control options will have to be conducted at the source-specific level by the states as they conduct source-specific BART determinations.

**Table 4-3. 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 ($/Ton SO2)* | *Notes* |
|---|---|---|---|---|---|---|---|
| Chemical Manufacturer | 3 | SO2 Scrubber | 1 | 24000 | 9600 | 400-8000 | Mid Range (1) |
| | | Currently Controlled | 2 | 80 | NA | 0 | |
| Glass Fiber | 6 | Currently Controlled | 6 | 17 | 0 | 0 | |
| Coal Cleaning | 1 | No Known Further Controls | 1 | 68 | 0 | 0 | |
| EGU/Coal | 5 | Dry Scrubber | 4 | 58000 | 52600 | 200-500 | Mid Range, assume 90% scrubber efficiency |
| | | 0.33 lb/MMBtu | 1 | 4000 | 1200 | NA | |
| EGU/Oil (Resid and Dist) | 17 | 0.3% fuel sulfur limit | 3 | 1400 | 340 | 0 | Switch to 0.3% has already occurred for 3 boilers. |
| | | 0.56 lb/MMBtu | 1 | 85 | NA | NA | |
| | | 2.0 % Fuel Sulfur Limit | 1 | 600 | 300 | NA | |
| | | 1.5% Fuel Sulfur Limit | 1 | 5200 | 3900 | NA | |
| | | 0.33 lb/MMBtu | 1 | 4000 | 3100 | NA | |
| | | 3.0 lb/MWh | 5 | 31000 | NA | NA | |
| | | 1.1-1.2 lb/MMBtu | 2 | 480 | NA | NA | |
| | | Currently Controlled | 3 | 1200 | 0 | 0 | |
| Incinerator | 2 | Currently Controlled | 2 | 84 | 0 | 0 | |
| Metal Production | 7 | No Further Controls Warranted | 5 | 2200 | 0 | 0 | |
| | | Increased efficiency of the facility's wet scrubber | 2 | 3000 | 300 | Limited Cost | Low Range |
| Paper and Pulp | 30 | FGD ($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.

**Table 4-4. 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 (3) |
| | | 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 (3) |
| 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
(3) Cost estimate from NESCAUM 2005, Portland Cement Kilns
NA-No information currently available.

**Table 4-5. 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.

Table 4-3 through Table 4-5 display general summary information from state surveys on possible BART control efforts as well as cost information gathered from several sources. The sections below will describe the contents of these tables in further detail.

### 4.2.1. Chemical Manufacturers

In the MANE-VU region, one chemical manufacturing source showed visibility impacts greater than 0.1 dv at a Class I area. At this source the state is considering $SO_2$ scrubber installation at one boiler unit (emission unit containing three oil and coal fired boilers) that could result in a decrease of 9600 tons of $SO_2$ emitted from this source annually. The State is also considering an installation of an SCR (Selective Catalytic Reduction) at this unit that could result in a decrease of 3400 tons of $NO_x$ emissions annually from the three boilers. This unit currently has an ESP installed for PM control which is expected to satisfy BART.

### 4.2.2. Glass Fiber

There is one glass fiber source in the region with a significant visibility impact on a Class I area in MANE-VU. Recent conversion from air/natural gas firing to oxygen/natural firing in 2000 has led to to an 85% reduction from the previous configuration which adequately satisfies BART.

### 4.2.3. Coal Cleaning

One coal cleaning source in the region showed a significant visibility impact at Class I areas. Low $NO_X$ burners for $NO_X$ control are considered a low-cost option for the thermal coal dryer unit at this source (Appendix B).. Additional control options for $SO_2$ and PM may not be warranted based on a survey of state staff. Low $NO_X$ burners could result in approximately 24 tons of $NO_X$ reduced annually.

### 4.2.4. Electric Generation Units

Of the 58 EGUs modeled in the region, 40 sources are located in states implementing a year-round CAIR program, while 15 sources are located in states implementing an ozone season CAIR program. Units covered in a year-round CAIR program were removed from further $SO_2$ and $NO_X$ analysis because BART would likely be satisfied through CAIR requirements. Visibility modeling was conducted for all EGUs in the region and of the 18 EGU sources in MANE-VU states without a year-round CAIR program under development, 13 showed a significant impact at Class I areas in the region. In addition, three sources in states with a year-round CAIR program showed a significant PM impact, and were included in the PM control and cost analysis.

#### *Coal-Fired Units*

States with coal-fired EGU units are considering two options for $SO_2$ control; dry scrubber installation (a mid level cost option) and a 0.33 lb/mmBTU capacity limit. A dry scrubber could result in over 90 percent $SO_2$ decrease while a capacity limit of 0.33

lb/mmBTU could result in a decrease of 1200 tons $SO_2$ at one unit considering this option.

In terms of $NO_X$ control, two boilers in the region have current controls of Low-NOx concentric firing systems and SCR that are being considered sufficient for BART. Two units are looking at SCR controls to achieve a 1.5 lb/MWh emission rate, a mid level cost option for this source. One unit's control level under the $NO_X$ Budget Program will simultaneously control for BART.

The majority of coal-fired units at EGUs in the region are currently fit with ESPs and further PM control recommendations are not warranted. For the units without ESPs, one state was looking at baghouse installation as a possible option and another expects sufficient reductions due to a PM co-benefit from the installation of an FGD (Fluid Gas Desulfurization) scrubber for $SO_2$ control.

### *Oil-Fired Units*

The majority of BART-eligible oil-fired EGU boilers in the region were found in one state. For these units, input- and output-based capacity limits established under other programs for which the BART-eligible units were covered may satisfy $SO_2$ BART control requirements. The levels of those programs are 0.56 and 1.1 lb/MMBtu for two different EGUs respectively, and 3.0 lb/MWh output-based limit for several other EGUs.

Another control option being considered by other states is a fuel sulfur limit (0.3 percent) or an equivalent 0.33 lb/MMBtu emissions rate. Four BART-eligible units in the region have been controlled at this level since 2002 and would consider this level of control appropriate for BART. This BART control option has reduced total $SO_2$ emissions by 3100 tons annually at the one controlled sources, but is not anticipated to achieve as great a reduction at the other three BART-eligible sources, which are smaller. One unit is considering a 1.5 percent fuel sulfur limit that could result in approximately 3900 tons (or approximately 75 percent reduction) of $SO_2$ emissions from the one candidate for this option. We have no information on potential controls for two other BART-eligible units in the region.

Regarding $NO_X$ controls on oil-fired boilers, possible technologies being considered for BART include SNCR (Selective Non-Catalytic Reduction) installation. Several units in the region are either currently controlled, with further controls considered unwarranted, or are under a $NO_X$ budget program that would serve as BART. Current controls on oil-fired boilers at EGUs include SNCR, boiler excess air control, and Low-$NO_x$ burners. For several of these units, information on BART recommendations was unavailable.

As with the coal-fired units, the majority of oil-fired boilers in the region have existing PM control technologies like ESPs, multicyclones, and mechanical collectors.

## 4.2.5. Incinerators

The lone BART-eligible incinerator source in the region has already achieved an approximately 75 percent reduction in $SO_2$ emissions through the installation of a dry scrubber. This source already has SNCR $NO_X$ controls and reverse air fabric filters for PM controls and therefore further controls are not warranted. The air pollution controls

on this source are the same controls required by new municipal waste combustion facilities MACT requirements.

### 4.2.6. Metal Production

Two metal production sources consisting of seven BART eligible units showed significant visibility impact on the region For one source, the state was looking at low cost, better efficiency measures for the $SO_2$ scrubber that would result in an increase of $SO_2$ control efficiency by 10 percent at two aluminum ore reduction units. A preliminary cost analysis conducted by the state at another source showed that $SO_2$ controls were not warranted at the sources BART eligible units (baking furnaces and potlines). The survey of state staff indicated that current controls for PM would likely satisfy BART for all metal production units in the region. Two units in the region are currently controlled for NOx while a cost analysis for $NO_x$ controls at 5 units indicated that no further controls were warranted.

### 4.2.7. Paper and Pulp

There are 30 eligible units at paper and pulp sources with significant visibility impact in the region. While the majority of these units are industrial boilers, this category also contains lime kilns, smelt tanks, and other process units. States are contemplating FGD scrubber installations for $SO_2$ control for at least three industrial boiler units as possible BART control options. This is a mid-range cost technology for typical installations that could result in an estimated 20,000 fewer tons of $SO_2$ for these three units alone. At three industrial boiler units, a fuel switching option is being considered by the state. Two boilers switching to 1.8% Sulfur fuel oil could result in 3000 tons of $SO_2$ being reduced while one boiler switching to 2.0% sulfur fuel oil could result in 1400 tons of $SO_2$ reduced. Twenty-one units are currently controlled at a level such that existing controls are likely to satisfy BART, while no known further controls are expected for three units in this category. Current controls on these boiler units are generally wet scrubbers.

For the majority of paper and pulp units, either the existing Low $NO_X$ burner controls or current capacity limits may satisfy BART or we did not have information about possible controls for units. Possible control options being considered for uncontrolled sources include SCR or SNCR technologies on boilers that could achieve 60 to 80 percent $NO_X$ control. This is a mid to high cost control option, depending on the source. Installation of these technologies is estimated to result in a decrease of 430 tons of $NO_X$ emissions at two units considering this option.

Most of the units at paper and pulp sources with significant visibility impacts in the region have existing PM controls including ESPs, baghouses, multicyclones, and venturi scrubbers and were therefore not viewed as candidates for further controls. One state is considering upgrading ESPs on two coal fired industrial boilers to baghouses that would result in a decrease of 7 tons of PM emitted per year.

### 4.2.8. Portland Cement Plants

Twenty-five Portland cement units in MANE-VU are located at BART-eligible sources with significant visibility impacts on Class I areas in the region. At these

sources, states are considering installation of $SO_2$ scrubbers at 10 cement kilns at these sources, which would significantly reduce the amount of $SO_2$ emitted from this sector. If installed, scrubbers at these kilns would result in a decrease in emissions of 19,000 tons of $SO_2$ annually.

Another BART control option being considered for cement kilns in the region is fuel switching. Units considering this option for kilns could decrease annual $SO_2$ emissions by 230 tons. Twelve units in this sector either have existing controls that will likely satisfy BART, or control information for $SO_2$ is currently unknown.

Control technologies under consideration for $NO_X$ at cement plants were varied according to our survey information. Low $NO_X$ burners are a possible control option for uncontrolled cement kilns. This is a mid range cost option that could result in an annual decrease of 430 tons of $NO_X$ emitted from three units. Another possible control option is Low $NO_X$ burners with mid-kiln firing. At a mid level cost, this technology could result in a decrease of 3400 annual tons of $NO_X$ emissions at units where this option is applicable. SCR installation is being considered at one unit, also a mid level cost option that could decrease emissions from unit by 480 tons annually. SNCR control technology is a mid level cost option, which if in place at units considering this option, could result in a decrease of 2900 tons of $NO_X$ emissions. Ten of the 25 units in this category either have existing controls that will likely satisfy BART or controls for $NO_X$ are currently unknown.

Most of the units at these Portland cement plants either have existing PM controls or potential control information is unknown. Where no controls exist, possible control options include installation of a baghouse or an ESP. One state is considering a recommendation of upgrading ESPs at three units, a low cost option that would reduce annual emissions of PM by 11 tons.

### 4.2.9. Refineries

At this time, for the majority of the units in this category, control information is unknown. One possible control option for $SO_2$ is installation of a scrubber on fluid catalytic cracking units, a mid range cost option being considered for three units in the region. Nine of these units are currently subject to refinery RACT (Reasonably Available Control Technology) controls for 8-hour ozone and these control levels for $SO_2$, $NO_X$, and PM are likely to satisfy BART requirements. States are also considering SCR or SNCR controls for three fluid catalytic cracking units in the region for possible $NO_X$ control, also a mid level cost option.

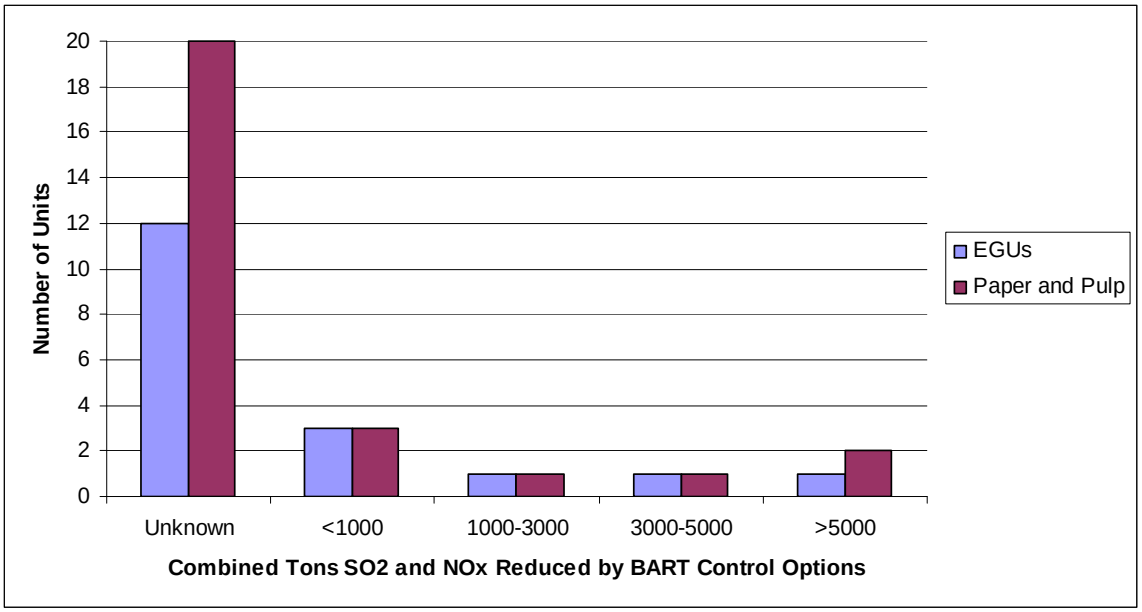
## 4.3. Energy and Non-Air Quality Environmental Impacts

While there are certain to be several issues that arise on a source-specific basis with respect to individual control technologies (e.g., water quality impacts or solid waste disposal issues), we are unable to address these issues in a regional analysis. One environmental benefit that should be considered in weighing control options for BART is the regional impact on acid deposition in MANE-VU.

An analysis of combined $SO_2$ and $NO_X$ reduction potential of BART control options by sector showed similar results for EGUs and paper and pulp sources. Figure

4-1 shows the amount of $SO_2$ and $NO_X$ that could be reduced if BART control options were implemented at the units for which likely control options are known. Figure 4-1 shows that generally, when emission reduction options are known, the emissions reduction potential is evenly distributed across the range of sources in the region. This is important as states are weighing whether controls are warranted or not for EGUs or paper and pulp boilers. However, for the majority of units with significant visibility impact in these sectors, the amount of $SO_2$ and $NO_X$ reduction potential is currently unknown, limiting the power of this analysis.

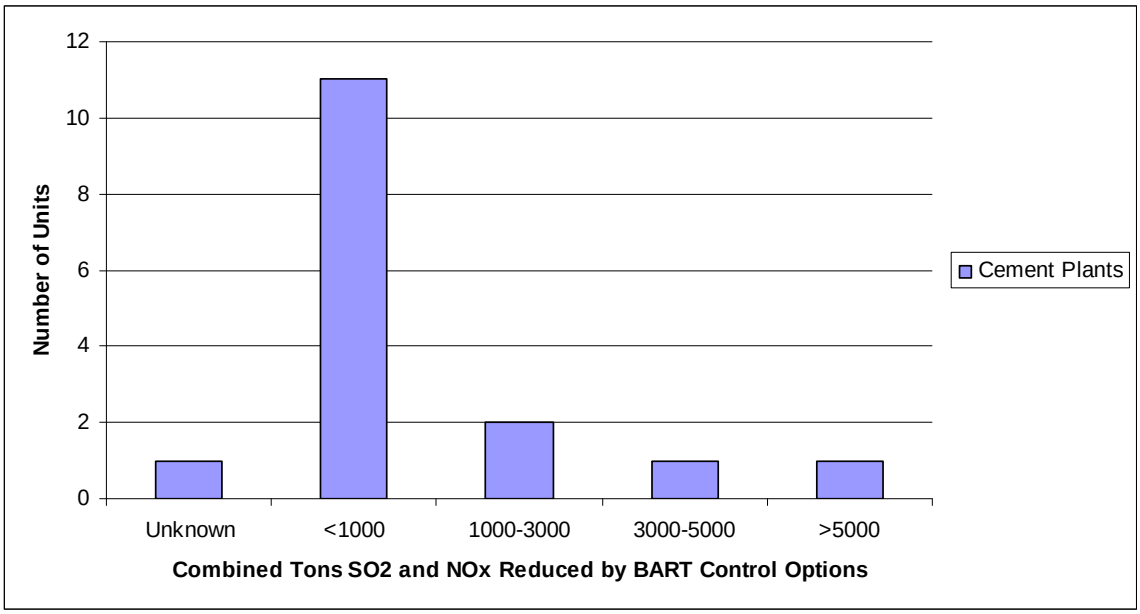
**Figure 4-1. Reduction potential of BART control options at EGUs and Paper and Pulp Sources**




For Portland cement plants, possible emissions reduction data were more complete and allowed for a clearer analysis of $SO_2$ and $NO_X$ control. Figure 4-2 shows the emissions reduction potential that would be achieved by BART if the survey control options were implemented for units in this sector. While several units would benefit from BART control options with emissions being reduced by greater than 3,000 tons of combined $SO_2$ and $NO_X$, the majority of the cement plant units would reduce emissions by less than 1,000 tons. As states weigh whether additional controls are warranted for cement plants, this non air-quality environmental factor may play less of a role for these sources.

For other source categories, the statistics are generally too small to make an analysis meaningful, but as a general rule, the remaining source categories tend to have lower overall emissions and lower overall reduction potential, which may factor into control decisions accordingly.

**Figure 4-2. Reduction potential of BART control options at Cement Plants**




## 4.4. Remaining Useful Life

The MANE-VU BART Workgroup has considered what weight to give to this factor in conducting BART determinations and has recommended that remaining useful life of a source will be addressed in the following way. A BART-eligible source that is found to have reasonable control options available to it should either control emissions from that BART-eligible source prior to 2013 or accept a federally enforceable permit limitation or retirement date prior to each state's public notice and hearing processes and FLM review of BART SIP elements.

# 5. CONCLUSIONS

As MANE-VU states prepare to conduct source-specific BART determinations for the eligible units in their jurisdictions, this report provides a regional assessment of the five factors that must be considered in determining whether additional controls are warranted for an individual BART source. This information is intended to lay out a regional approach and provide regional context for individual control decisions that will be made by the MANE-VU member states. This information may also serve as an important regional basis for dialogue and internal MANE-VU consultations as states consider what level of stringency is justified and reasonable based on consideration of the five factors.

Important findings of this analysis include the identification of BART-eligible sources in the region, the numbers of units in various categories subject to BART consideration, BART control technology options being considered in the region, and

estimates of the total emissions and reduction potential from units contributing to potentially significant visibility impacts at Class I areas.

Table 4-1 and Table 4-2 indicate that 136 BART-eligible sources exist in the region with 53 contributing to potentially significant visibility impairment at a Class I area. The majority of BART-eligible sources in the region are EGUs, however, most of these sources fall under a year-round CAIR program that will satisfy BART.

Of the BART-eligible source categories with potentially significant visibility impacts, the non-CAIR EGU sector was the largest emitter of $SO_2$, $NO_X$, and $PM_{10}$ in 2002. BART-eligible EGUs with significant visibility impacts included 17 sources with 30 units emitting 110,000 tons $SO_2$, 28,000 tons $NO_X$, and 7,000 tons $PM_{10}$ in 2002. The majority of these units are anticipating controls for $SO_2$ and $NO_X$ to satisfy BART requirements. Although the amount of expected reductions is currently unknown, we can expect significant reductions in emissions from this sector given widely available control technologies for $SO_2$ and $NO_X$ with proven cost-effectiveness. Most of these units are currently controlled for particulate matter and further controls are not expected.

Portland cement plants and paper and pulp sources are sectors with many BART-eligible units that made significant contributions to visibility impairment and total pollutant emissions in the region. Paper and pulp sources with significant visibility impacts emitted 36,000 tons $SO_2$, 10,000 tons $NO_X$, and 2,000 ton $PM_{10}$ at 30 units in 2002. Although information on controls is currently unknown for many of these units, information from units considering controls indicates that significant reductions can be achieved from this sector (19,000 tons $SO_2$ reduced if scrubbers are installed at 13 units and 400 tons $NO_X$ reduced if SCR controls are introduced to two units). Portland cement sources with significant visibility impacts emitted 32,000 tons $SO_2$, 23,000 tons $NO_X$, and 850 tons $PM_{10}$ at 25 units in the region. With more complete information for cement plants, we estimated a reduction of 19,000 tons $SO_2$ at 13 units and 7,000 tons $NO_X$ at 15 units when considering controls that would satisfy BART.

Ultimately, the strength of the MANE-VU BART program, as determined by individual state control decisions and informed by this analysis, will demonstrate MANE-VU's resolve to tackle visibility and related air quality problems in its region. As MANE-VU enters into inter-RPO consultations, its willingness to seek reasonable emission reductions within its own region will help set expectations for the other RPOs, and the BART program represents a cornerstone of this process.

# 6. REFERENCES

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# Appendix A: List of BART-Eligible Sources in the MANE-VU Region

| State | Plant | Type | Number of Units |
|---|---|---|---|
| CT | Middletown Power LLC (NRG) | EGU | 2 |
| CT | Montville Power LLC (NRG) | EGU | 1 |
| CT | Norwalk Power LLC (NRG) | EGU | 1 |
| CT | PSEG Power CT Bridgeport Harbor Station | EGU | 1 |
| CT | PSEG Power CT New Haven Harbor Station | EGU | 1 |
| CT | Sprague Paperboard Caraustar | Fossil Fuel Boiler (>250 MMBtu | 1 |
| DC | Benning (PEPCO -15) | EGU | 1 |
| DC | Benning (PEPCO -16) | EGU | 1 |
| DE | City of Dover - Mckee Run | EGU | 1 |
| DE | Connectiv Edgemore | EGU | 2 |
| DE | NRG- Indian River | EGU | 1 |
| MA | Exxon Mobil Everett | Petroleum Storage | 1 |
| MA | Global Petroleum Revere | Petroleum Storage | 1 |
| MA | Gulf Oil Chelsea | Petroleum Storage | 1 |
| MA | Solutia | Chemical Process Plant | 3 |
| MA | Braintree Electric | EGU | 1 |
| MA | Brayton Point | EGU | 4 |
| MA | Eastman Gelatin (boilers only) | Chemical Process Plant/Industrial Boilers | 4 |
| MA | General Electric Lynn | EGU | 1 |
| MA | Harvard U (Blackstone) | EGU | 2 |
| MA | Mirant Kendall LLC | EGU | 3 |
| MA | Mirant-Canal Electric | EGU | 2 |
| MA | Mystic | EGU | 1 |
| MA | New Boston | EGU | 1 |
| MA | Salem Harbor | EGU | 1 |
| MA | TMLP - Cleary Flood | EGU | 3 |
| MA | Trigen - Kneeland St | EGU | 1 |
| MA | Wheelabrator -Saugus | Municipal Incinerator | 2 |
| MD | CONSTELLATION POWER SOURCE GENERATION CP CRANE | EGU | 7 |
| MD | CONSTELLATION POWER SOURCE GENERATION HERBERT WAGNER | EGU | 2 |
| MD | EASTALCO ALUMINUM | Primary Aluminum Ore Reduction Plant | 2 |
| MD | INDEPENDENT CEMENT ST LAWERENCE | Portland Cement | 1 |
| MD | LEHIGH PORTLAND CEMENT | Portland Cement | 3 |

| | | | |
|---|---|---|---|
| MD | METTIKI COAL CORPORATION | Coal Cleaning | 1 |
| MD | MILLENIUM INORGANIC CHEMICALS | Chemical Process Plants | 5 |
| MD | MIRANT MID ATLANTIC LLC MORGANTOWN | EGU | 2 |
| MD | MIRANT MID ATLANTIC DICKERSON | EGU | 1 |
| MD | PEPCO CHALK POINT | EGU | 3 |
| MD | TRIGEN LEADENHALL STREET | Fossil Fuel Boiler (>250 MMBtu | 4 |
| MD | VIENNA GENERATING STATION | EGU | 1 |
| MD | WESTVACO FINE PAPERS | Kraft Pulp Mill/Fossil Fuel Boiler (>250 MMBtu | 3 |
| ME | Domtar Ind | Industrial Boiler/Kraft Pulp Mill | 2 |
| ME | Dragon Products | Portland Cement | 1 |
| ME | Georgia Pacific Old Town | Industrial Boiler/Kraft Pulp Mill | 2 |
| ME | IP Bucksport | Fossil Fuel Boiler (>250 MMBtu | 1 |
| ME | IP Jay | Industrial Boiler/ Kraft Pulp Mill | 9 |
| ME | Katahdin Paper Millinocket | Fossil Fuel Boiler (>250 MMBtu | 1 |
| ME | Lincoln Paper and Tissue | Industrial Boiler/Kraft Pulp Mill | 2 |
| ME | Rumford Paper | Industrial Boiler | 1 |
| ME | SAPPI Somerset | Industrial Boiler/Kraft Pulp Mill | 4 |
| ME | Wyman Station | EGU | 2 |
| NH | PSNH Merrimack Station | EGU | 1 |
| NH | PSNH Newington Station | EGU | 1 |
| NJ | Amerada Hess Corporation-Port Reading Re | Petroleum Refinery | 13 |
| NJ | Bayway Refinery | Petroleum Refinery | 257 |
| NJ | Chevron Products Company | Petroleum Refinery | 22 |
| NJ | COASTAL EAGLE POINT OIL COMPANY | Petroleum Refinery | 145 |
| NJ | Hudson Generation Station | EGU | 4 |
| NY | 3M TONAWANDA | Chemical Process Plants/Industrial Boilers | 4 |
| NY | ALCAN ALUMINUM CORPORATION | Primary and Secondary Aluminum Production | 9 |
| NY | ALCOA MASSENA OPERATIONS (WEST PLANT) | Primary and Secondary Aluminum Production | 25 |
| NY | ARTHUR KILL GENERATING STATION | EGU | 2 |
| NY | ASTORIA GENERATING STATION | EGU | 2 |
| NY | BOWLINE POINT GENERATING STATION | EGU | 5 |

| | | | |
|---|---|---|---|
| NY | BUFFALO COLOR CORP - LEE ST PLANT | Chemical Process Plants/Industrial Boilers | 5 |
| NY | CON ED-59TH ST STA | EGU | 4 |
| NY | DANSKAMMER GENERATING STATION | EGU | 2 |
| NY | EF BARRETT POWER STATION | EGU | 44 |
| NY | ERWIN MANUFACTURING COMPLEX | Glass Fiber Processing Plants | 3 |
| NY | GENERAL ELECTRIC SELKIRK PLASTICS PLT | Chemical Process Plants/Industrial Boilers | 16 |
| NY | GLENS FALLS LEHIGH CEMENT COMPANY | Portland Cement | 46 |
| NY | INTERFACE SOLUTIONS INC | Kraft Pulp Mill/Industrial Boilers | 9 |
| NY | INTERNATIONAL PAPER TICONDEROGA MILL | Kraft Pulp Mill/Industrial Boilers | 11 |
| NY | KODAK PARK DIVISION | Chemical Process Plants/Industrial Boilers | 20 |
| NY | LACKAWANNA PLANT- REPUBLIC ENG PROD INC | Primary Metal Production/Industrial Boilers | 3 |
| NY | LAFARGE BUILDING MATERIALS INC | Portland Cement | 31 |
| NY | LOVETT GENERATING STATION | EGU | 4 |
| NY | NORTHPORT POWER STATION | EGU | 17 |
| NY | OSWEGO HARBOR POWER | EGU | 3 |
| NY | OWENS-CORNING DELMAR PLANT | Glass Fiber Processing Plants | 27 |
| NY | RAVENSWOOD GENERATING STATION | EGU | 60 |
| NY | REVERE SMELTING & REFINING CORP | Primary Metal Production/Industrial Boilers | 8 |
| NY | RIVERBAY CORP-CO-OP CITY | Industrial Boilers | 4 |
| NY | RIVERHEAD TERMINAL-CONOCOPHILLIPS | Petroleum Storage/Industrial Boilers | 7 |
| NY | ROSETON GENERATING STATION | EGU | 4 |
| NY | SAMUEL A CARLSON GENERATING STATION | EGU | 2 |
| NY | SCHENECTADY INTERNATIONAL ROTT JCT FAC | Chemical Plant/Industrial Boilers | 18 |
| NY | ST LAWRENCE CEMENT CORP-CATSKILL QUARRY | Portland Cement | 37 |
| NY | WASHINGTON MILLS ELECTRO MINERALS | Glass Fiber Processing Plants | 3 |
| PA | ALLEGHENY_LUDLUM_CORP_BRACKENRIDGE | EGU | 8 |
| PA | EASTMAN_CHEMICAL_RESINS_INC | Chemical Process Plants/Industrial Boilers | 2 |
| PA | ESSROC/BESSEMER | Portland Cement | 14 |

| | | | |
|---|---|---|---|
| PA | NEVILLE_CHEMICAL_COMPANY | Chemical Process Plants | 5 |
| PA | ORION_POWER_MIDWEST_CHESWICK_STATION | EGU | 2 |
| PA | USS_CLAIRTON_WORKS | Metal Production/Industrial Boilers | 4 |
| PA | AK STEEL CORP BUTLER WORKS | Iron and Steel Mill Plants | 16 |
| PA | ALLEGHENY ENERGY SUPPLY CO HATFIELDS FER | EGU | 5 |
| PA | ALLEGHENY ENERGY SUPPLY CO MITCHELL POWE | EGU | 19 |
| PA | AMER REF GROUP BRADFORD | Petroleum Refinery | 4 |
| PA | APPLETON PAPERS SPRING MILL | Kraft Pulp Mill/Industrial Boilers | 9 |
| PA | CARMEUSE LIME INC MILLARD LIME PLT | Lime Plant | 8 |
| PA | CEMEX INC WAMPUM CEMENT PLT | Portland Cement | 9 |
| PA | CONOCOPHILLIPS CO TRAINER REF | Petroleum Refinery | 10 |
| PA | DUFERCO FARRELL CORP FARRELL PLT | Iron and Steel Mill Plants | 1 |
| PA | DYNO NOBEL INC DONORA | Chemical Process Plants | 9 |
| PA | ESSROC NAZARETH LOWER CEMENT PLT 1 | Portland Cement | 1 |
| PA | EXELON GENERATION CO EDDYSTONE | EGU | 6 |
| PA | EXIDE TECH READING SMELTER | Secondary Metal Production | 9 |
| PA | HOMER CITY OL HOMER CITY GEN STA | EGU | 6 |
| PA | HORSEHEAD CORP MONACA SMELTER | Primary Zinc Smelter | 25 |
| PA | INDSPEC CHEM CORP PETROLIA | Chemical Process Plants | 17 |
| PA | INMETCO ELLWOOD CITY | Iron and Steel Mill Plants | 6 |
| PA | ISG PLATE LLC COATESVILLE | Iron and Steel Mill Plants | 20 |
| PA | KEYSTONE PORTLAND CEMENT EAST ALLEN | Portland Cement | 4 |
| PA | LAFARGE CORP WHITEHALL PLT | Portland Cement | 28 |
| PA | LEHIGH CEMENT CO EVANSVILLE CEMENT PLT | Portland Cement | 42 |
| PA | LEHIGH CEMENT CO YORK OPERATIONS | Portland Cement | 11 |
| PA | LWB REFRACTORIES CO W MANCHESTER | Mineral Products | 13 |
| PA | MERCER LIME & STONE BRANCHTON | Lime Plant | 6 |
| PA | NEW CASTLE POWER PLT | EGU | 2 |
| PA | PA POWER CO BRUCE MANSFIELD PLT | EGU | 18 |
| PA | PH GLATFELTER CO SPRING GROVE | Paper and Pulp/Industrial Boilers | 8 |
| PA | PPL BRUNNER ISLAND L BRUNNER ISLAND | EGU | 4 |
| PA | PPL MARTINS CREEK LLC MARTINS CREEK | EGU | 2 |
| PA | PPL MONTOUR LLC MONTOUR SES | EGU | 4 |
| PA | RELIANT ENERGY NORTHEAST CONEMAUGH PLT | EGU | 6 |
| PA | RELIANT ENERGY NORTHEAST MGMT KEYSTONE POWER PLT | EGU | 2 |
| PA | RELIANT ENERGY PORTLAND GENERATING STATION | EGU | 2 |
| PA | SUNOCO CHEMICALS (FORMER ALLIED SIGNAL) | Chemical Process | 17 |

| | | | |
|---|---|---|---|
| | | Plants | |
| PA | SUNOCO INC (R&M) MARCUS HOOK REFINERY | Refinery | 10 |
| PA | SUNOCO INC (R&M) | Refinery | 26 |
| PA | TRIGEN - EDISON | EGU | 4 |
| PA | TRIGEN - SCHUYLKILL | EGU | 1 |
| PA | UNITED REFINING CO WARREN PLT | Refinery | 10 |
| PA | VICTAULIC CO AMER FORKS FACILITY | Secondary Metal Production | 12 |

# Appendix B: Costs of Technologies

From NESCAUM, 2005.

**EGU** **Cost Effectiveness**

| *Pollutant* | *Control* | *Cost* | *Units* | *Cost Bin* |
|---|---|---|---|---|
| SO2 | Wet/Dry Scrubbers (FGD) | 200-500 | Dollars per ton SO2 | Low |
| NOx | Gas Reburn | 500-2000 | Dollars per ton NOx | Mid |
| NOx | Low-NOx Burners | 200-500 | Dollars per ton NOx | Low |
| NOx | Overfire Air | 250-600 | Dollars per ton NOx | Low |
| NOx | SCR | 1000-1500 | Dollars per ton NOx | Mid |
| NOx | SNCR | 500-700 | Dollars per ton NOx | Mid |
| PM | ESP | 15-40 | Dollars per Actual Cubic Feet per Minute | |
| PM | Fabric Filters | 12-40 | Dollars per Actual Cubic Feet per Minute | |

**Industrial Boilers** **Cost Effectiveness**

| *Pollutant* | *Control* | *Cost* | *Units* | *Cost Bin* |
|---|---|---|---|---|
| NOx | Low NOx-Burners | 200-3000 | Dollars per ton NOx | Mid |
| NOx | SNCR | 1300-10000 | Dollars per ton NOx | Mid to High |
| NOx | SCR | 4000-15000 | dollars per MMBtu/hr | High |
| SO2 | Wet/Dry Scrubbers | 400-4000 | Dollars per ton SO2 (coal) | Mid |
| SO2 | Wet/Dry Scrubbers | 800-8000 | Dollars per ton SO2 (oil) | Mid to High |
| PM | ESP | 15-40 | Dollars per Actual Cubic Feet per Minute | |
| PM | Reverse Air Fabric Filter | 15-40 | Dollars per Actual Cubic Feet per Minute | |
| PM | Pule Jet Fabric Filter | 17-40 | Dollars per Actual Cubic Feet per Minute | |
| PM | Venturi Scrubber | 12-40 | Dollars per Actual Cubic Feet per Minute | |
| PM | Cyclone | 1-5 | Dollars per Actual Cubic Feet per Minute | |

**Portland Cement Kilns** **Cost Effectiveness**

| *Pollutant* | *Control* | *Cost* | *Units* | *Cost Bin* |
|---|---|---|---|---|
| SO2 | Spray Dryer | 10.96-54.67 | dollars/ton Clinker | |
| SO2 | Wet Scrubber | 10.83-47.00 | dollars/ton Clinker | |
| NOx | Process Modifications | 3100-8800 | Dollars per ton NOx | Mid to High |
| NOx | Low NOx Burners w/Indirect Firing | 5800-8100 | Dollars per ton NOx | High |
| NOx | Low NOx Burners w/Indirect Firing and Mid-Kiln Tire Injection | 1-1800 | Dollars per ton NOx | Low to Mid |
| NOx | Mid-Kiln Injection of Fuel | 5100-11500 | Dollars per ton NOx | Mid to High |
| NOx | CemStar | 0-600 | Dollars per ton NOx | Low |
| NOx | Low NOx Precalciner | 2700-3600 | Dollars per ton NOx | Mid |
| NOx | SNCR | 900-1200 | Dollars per ton NOx | Mid |
| NOx | Biosolids Injection | 100-1800 | Dollars per ton NOx | Low to Mid |
| PM | ESP | 3.33-41.00 | dollars/ton clinker | |
| PM | Baghouse | 4.00-16.67 | dollars/ton clinker | |

**Paper and Pulp**

Cost Effectiveness Not Available

| *Cost levels* | *SO2* | *NOx* |
|---|---|---|
| Low | <800 | <500 |
| Mid | 800-2000 | 500-10000 |
| High | >2000 | >10000 |

# Appendix C: BART Workgroup Draft Recommendations

**Draft BART Recommendations**
**to MANE-VU Air Directors**
**September 7, 2006**

Under the U.S. Environmental Protection Agency's (USEPA) 1999 "regional haze rule" [64 Fed. Reg. 35714 (July 1, 1999)], certain emission sources that "may reasonably be anticipated to cause or contribute" to visibility impairment in downwind Class I areas are required to install Best Available Retrofit Technology (BART).[6] These requirements are intended to reduce emissions specifically from large sources that, due to age, were exempted from other control requirements of the Clean Air Act (CAA).

BART requirements pertain to 26 specified major point source categories, including power plants, industrial boilers, paper and pulp plants, cement kilns and other large stationary sources. To be considered BART-eligible, sources from these specified categories must have the potential to emit at least 250 tons per year of any haze forming pollutant and must have commenced operation in the fifteen year period prior to August 7, 1977 (the date of passage of the 1977 Clean Air Act Amendments (CAAA), which first required new source performance standards).

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 Requirements (BART) of the Regional Haze Rule. To date states have made substantial progress in identifying sources that are BART-eligible, however that 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 control levels. The Haze Rule requires states to determine the most stringent technologically feasible system of controls that can reasonably be installed at each source eligible for BART. The BART workgroup has developed a list of draft recommendations for the BART control process that will be submitted to the MANE-VU Directors. Feedback on these recommendations will be useful to assist the Air Directors in their review. 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 workgroup recommendations are presented below:

1. ***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

[6] There are seven designated Class I areas in the Northeast and Mid-Atlantic States. They include Acadia National Park and Moosehorn Wilderness Area in Maine; Roosevelt-Campobello International Park in New Brunswick and Maine; the Lye Brook Wilderness Area in Vermont; the Great Gulf and Presidential Range-Dry River Wilderness Areas in New Hampshire; and the Brigantine Wilderness Area in New Jersey.

* It is not clear from the final rule when a federally enforceable permit limitation would need to be in place in order to avoid BART-eligibility. We are recommending to EPA that they allow permit limits which go into place prior to December 16, 2006. This will enable states to take action to get permit limitations in place and achieve emission limits (though probably not reductions) prior to SIP submission avoiding the need for formal BART determinations. The 2006 date will give states one full year prior to the submission deadline for public notice and hearing processes on a final SIP package.

2. MANE-VU staff continues to support the policy decision made by the MANE-VU Board in June 2004, that ***if a source is eligible for BART, it is subject to BART***. (i.e. no exemptions will be given).

3. ***Regional performance standards or cost thresholds are appropriate*** for many individual categories of BART eligible sources. The attachment 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.

4. ***Remaining useful life*** of a source will be considered in the following way: Sources have the option to ***either control a BART-eligible facility prior to 2013 or accept federally enforceable permit limitation or retirement date prior to December 16, 2006.***

5. ***Control technology in place*** (other than for source categories covered by the attached list of presumptive control levels) ***will likely have to be dealt with on a source by source basis***. (i.e. no regional recommendation)

6. ***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) however the workgroup is still considering regional recommendations for non-air quality environmental impacts.

7. ***If data does 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.

**MANE-VU BART Workgroup Recommendations**
**DRAFT Presumptive Control Levels**
***Updated September 7, 2006***

**Non-CAIR EGUs:**

- $SO_2$ – 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:**

- $SO_2$ – 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**

- $SO_2$ – 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.

- $SO_2$
  - 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