

Guidance for Facilities Conducting a BART Analysis

This is a guidance document only. It does not have the force and effect of a rule and is not intended to supersede statutory and regulatory requirements. Questions on the guidance or the BART analysis process should be addressed to KDHE early on.

This guidance is for facilities performing a BART analysis. In June 2006, KDHE will be sending letters notifying facilities if they must complete a BART analysis. KDHE will use modeling to determine which units contribute to visibility impairment in a Class I area and are therefore “subject to BART.” Facilities with emission units that are subject to BART are requested to complete a BART analysis by January 1, 2007.

*Section IV of EPA’s “Guidelines for BART Determinations under the Regional Haze Rules” [40 CFR Part 51, Appendix Y] is reprinted below. EPA’s Guidelines were written for **States** to use in making BART determinations; however, KDHE is asking facilities to follow these Guidelines in completing their individual BART analyses.*

KDHE has inserted notes (in shaded areas) into the Guidelines text below to clarify expectations for your BART analysis. KDHE will use the analysis to make the actual BART determination, subject to EPA approval.

In each step of the analysis, please clearly document your rationale, data sources, etc.

IV. The BART Determination: Analysis of BART Options

This section describes the process for the analysis of control options for sources subject to BART.

A. What factors must I address in the BART review?

The visibility regulations define BART as follows:

Best Available Retrofit Technology (BART) means an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant which is emitted by . . . [a BART-eligible source]. The emission limitation must be established on a case-by-case basis, taking into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts of compliance, any pollution control equipment in use or in existence at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology.

The BART analysis identifies the best system of continuous emission reduction taking into account:

- (1) The available retrofit control options,
- (2) Any pollution control equipment in use at the source (which affects the availability of options and their impacts),
- (3) The costs of compliance with control options,
- (4) The remaining useful life of the facility,
- (5) The energy and non-air quality environmental impacts of control options

(6) The visibility impacts analysis.

B. What is the scope of the BART review?

Once you determine that a source is subject to BART for a particular pollutant, then for each affected emission unit, you must establish BART for that pollutant. The BART determination must address air pollution control measures for each emissions unit or pollutant emitting activity subject to review.

Example: Plantwide emissions from emission units within the listed categories that began operation within the “time window” for BART ¹¹ are 300 tons/yr of NO_x, 200 tons/yr of SO₂, and 150 tons/yr of primary particulate. Emissions unit A emits 200 tons/yr of NO_x, 100 tons/yr of SO₂, and 100 tons/yr of primary particulate. Other emission units, units B through H, which began operating in 1966, contribute lesser amounts of each pollutant. For this example, a BART review is required for NO_x, SO₂, and primary particulate, and control options must be analyzed for units B through H as well as unit A.

¹¹ That is, emission units that were in existence on August 7, 1977 and which began actual operation on or after August 7, 1962.

C. How does a BART review relate to Maximum Achievable Control Technology (MACT) Standards under CAA section 112, or to other emission limitations required under the CAA?

For VOC and PM sources subject to MACT standards, States may streamline the analysis by including a discussion of the MACT controls and whether any major new technologies have been developed subsequent to the MACT standards. We believe that there are many VOC and PM sources that are well controlled because they are regulated by the MACT standards, which EPA developed under CAA section 112. For a few MACT standards, this may also be true for SO₂. Any source subject to MACT standards must meet a level that is as stringent as the best-controlled 12% of sources in the industry. Examples of these hazardous air pollutant sources which effectively control VOC and PM emissions include (among others) secondary lead facilities, organic chemical plants subject to the hazardous organic NESHAP (HON), pharmaceutical production facilities, and equipment leaks and wastewater operations at petroleum refineries. We believe that, in many cases, it will be unlikely that States will identify emission controls more stringent than the MACT standards without identifying control options that would cost many thousands of dollars per ton. Unless there are new technologies subsequent to the MACT standards which would lead to cost-effective increases in the level of control, you may rely on the MACT standards for purposes of BART.

We believe that the same rationale also holds true for emissions standards developed for municipal waste incinerators under CAA section 111(d), and for many NSR/PSD determinations and NSR/PSD settlement agreements. However, we do not believe that technology determinations from the 1970s or early 1980s, including new source performance standards (NSPS), should be considered to represent best control for existing sources, as best control levels for recent plant retrofits are more stringent than these older levels.

Where you are relying on these standards to represent a BART level of control, you should provide the public with a discussion of whether any new technologies have subsequently become available.

KDHE note: As recommended above, KDHE intends to streamline the analysis of PM and VOC sources subject to MACT standards in a BART analysis. KDHE will rely on MACT standards to represent BART level of control for those visibility-impairing pollutants addressed by the MACT standard. For example, if a BART-eligible emissions unit emits PM₁₀ and NO_x and the unit is subject to a MACT limit for PM₁₀, then a full BART analysis need only address NO_x.

If you have a BART eligible unit(s) emitting visibility-impairing pollutants that are addressed by a MACT standard(s), then please list that unit(s) or groups of units in the BART analysis. Please include the MACT standard and the limit, in lbs/day, imposed on the unit(s). KDHE will evaluate the unit(s) and MACT standard to see if further analysis is needed of those unit(s) for that visibility-impairing pollutant.

If you believe that recent application of a BACT or NSPS standard represents BART for an emission unit, please consult with KDHE staff early in the BART analysis process for further guidance on the expected level of analysis.

D. What Are the Five Basic Steps of a Case-by-Case BART Analysis?

The five steps are:

STEP 1—Identify All ¹² Available Retrofit Control Technologies,

¹² In identifying “all” options, you must identify the most stringent option and a reasonable set of options for analysis that reflects a comprehensive list of available technologies. It is not necessary to list all permutations of available control levels that exist for a given technology—the list is complete if it includes the maximum level of control each technology is capable of achieving.

STEP 2— Eliminate Technically Infeasible Options,

STEP 3— Evaluate Control Effectiveness of Remaining Control Technologies,

STEP 4— Evaluate Impacts and Document the Results, and

STEP 5—Evaluate Visibility Impacts.

1. STEP 1: How do I identify all available retrofit emission control techniques?

1. Available retrofit control options are those air pollution control technologies with a practical potential for application to the emissions unit and the regulated pollutant under evaluation. Air pollution control technologies can include a wide variety of available methods, systems, and techniques for control of the affected pollutant. Technologies required as BACT or LAER are available for BART purposes and must be included as control alternatives. The control alternatives can include not only existing controls for the source category in question but also take into account technology transfer of controls that have been applied to similar source categories and gas streams. Technologies which have not yet been applied to (or permitted for) full scale operations need not be considered as available; we do not expect the source owner to purchase or construct a process or control device that has not already been demonstrated in practice.

2. Where a NSPS exists for a source category (which is the case for most of the categories affected by BART), you should include a level of control equivalent to the NSPS as one of the control options. ¹³ The NSPS standards are codified in 40 CFR part 60. We note that there are situations where NSPS standards do not require the most stringent level of available control for all sources within a category. For example, post-combustion NO_x controls (the most stringent controls for stationary gas turbines) are not required under subpart GG of the NSPS for Stationary Gas Turbines. However, such controls must still be considered available technologies for the BART selection process.

¹³ In EPA's 1980 BART guidelines for reasonably attributable visibility impairment, we concluded that NSPS standards generally, at that time, represented the best level sources could install as BART. In the 20 year period since this guidance was developed, there have been advances in SO₂ control technologies as well as technologies for the control of other pollutants, confirmed by a number of recent retrofits at Western power plants. Accordingly, EPA no longer concludes that the NSPS level of controls automatically represents “the best these sources can install.” Analysis of the BART factors could result in the selection of a NSPS level of control, but you should reach this conclusion only after considering the full range of control options.

3. Potentially applicable retrofit control alternatives can be categorized in three ways.

- Pollution prevention: use of inherently lower emitting processes/practices, including the use of control techniques (e.g., low-NO_x burners) and work practices that prevent emissions and result in lower “production-specific” emissions (note that it is not our intent to direct States to switch fuel forms, e.g., from coal to gas);

- Use of (and where already in place, improvement in the performance of) add-on controls, such as scrubbers, fabric filters, thermal oxidizers and other devices that control and reduce emissions after they are produced; and
- Combinations of inherently lower-emitting processes and add-on controls.

Pollutant		Description	Comments
NO _x	<i>Control Technologies:</i>	SCR	
		IFGR Burners	
		Low-NO _x burners	Including ultra-low NO _x burners
		Ported Kiln	Only for rotary kilns
		LoTOx	
	<i>Work Practices/ Operational Changes:</i>	NO _x CEM	Also investigate other forms of monitoring to ensure combustion efficiency
Alternative fuels		Evaluate use of biomass as fuel	
SO ₂	<i>Control Technologies:</i>	High efficiency wet scrubber (≥ 90% removal)	
		Low efficiency wet scrubber (≥ 50% removal)	
		Lime/limestone wet slurry scrubbing	Look at various alternatives to enhance SO ₂ collection efficiency of existing wet scrubbers
	<i>Work Practices/ Operational Changes:</i>	Alternative fuels	

4. In the course of the BART review, one or more of the available control options may be eliminated from consideration because they are demonstrated to be technically infeasible or to have unacceptable energy, cost, or non-air quality environmental impacts on a case-by-case (or site-specific) basis. However, at the outset you should identify all control options with potential application to the emissions unit under review.

5. We do not consider BART as a requirement to redesign the source when considering available control alternatives. For example, where the source subject to BART is a coal-fired electric generator, we do not require the BART analysis to consider building a natural gas-fired electric turbine although the turbine may be inherently less polluting on a per unit basis.

6. For emission units subject to a BART review, there will often be control measures or devices already in place. For such emission units, it is important to include control options that involve improvements to existing controls and not to limit the control options only to those measures that involve a complete replacement of control devices.

Example: For a power plant with an existing wet scrubber, the current control efficiency is 66%. Part of the reason for the relatively low control efficiency is that 22% of the gas stream bypasses the scrubber. A BART review identifies options for improving the performance of the wet scrubber by redesigning the internal components of the scrubber and by eliminating or reducing the percentage of the gas stream that bypasses the scrubber. Four control options are identified: (1) 78% control based upon improved scrubber performance while maintaining the 22% bypass, (2) 83% control based upon improved scrubber performance while reducing the bypass to 15%, (3) 93% control based upon improving the scrubber performance while eliminating the bypass entirely, (this option results in a "wet stack" operation in which the gas leaving the stack is saturated with water) and (4) 93% as in option 3, with the addition of an indirect reheat system to reheat the stack gas above the saturation temperature. You must consider each of these

four options in a BART analysis for this source.

7. You are expected to identify potentially applicable retrofit control technologies that represent the full range of demonstrated alternatives. Examples of general information sources to consider include:

- The EPA's Clean Air Technology Center, which includes the RACT/BACT/LAER Clearinghouse (RBLC);
- State and Local Best Available Control Technology Guidelines—many agencies have online information—for example South Coast Air Quality Management District, Bay Area Air Quality Management District, and Texas Natural Resources Conservation Commission;
- Control technology vendors;
- Federal/State/Local NSR permits and associated inspection/performance test reports;
- Environmental consultants;
- Technical journals, reports and newsletters, air pollution control seminars; and
- The EPA's NSR bulletin board—<http://www.epa.gov/ttn/nsr>;
- Department of Energy's Clean Coal Program—technical reports;
- The NO_x Control Technology “Cost Tool”—Clean Air Markets Division web page—<http://www.epa.gov/airmarkets/arp/nox/controltech.html>;
- Performance of selective catalytic reduction on coal-fired steam generating units—final report. OAR/ARD, June 1997 (also available at <http://www.epa.gov/airmarkets/arp/nox/controltech.html>);
- Cost estimates for selected applications of NO_x control technologies on stationary combustion boilers. OAR/ARD June 1997. (Docket for NO_x SIP Call, A-96-56, item II-A-03);
- Investigation of performance and cost of NO_x controls as applied to group 2 boilers. OAR/ARD, August 1996. (Docket for Phase II NO_x rule, A-95-28, item IV-A-4);
- Controlling SO₂ Emissions: A Review of Technologies. EPA-600/R-00-093, USEPA/ORD/NRMRL, October 2000; and
- The OAQPS Control Cost Manual.

You are expected to compile appropriate information from these information sources.

8. There may be situations where a specific set of units within a facility constitutes the logical set to which controls would apply and that set of units may or may not all be BART eligible. (For example, some units in that set may not have been constructed between 1962 and 1977.)

9. If you find that a BART source has controls already in place which are the most stringent controls available (note that this means that all possible improvements to any control devices have been made), then it is not necessary to comprehensively complete each following step of the BART analysis in this section. As long as these most stringent controls available are made federally enforceable for the purpose of implementing BART for that source, you may skip the remaining analyses in this section, including the visibility analysis in step 5. Likewise, if a source commits to a BART determination that consists of the most stringent controls available, then there is no need to complete the remaining analyses in this section.

KDHE note: KDHE will consider on a case-by-case basis whether a BACT determination or NSPS limit for a particular pollutant at a BART-eligible unit satisfies BART requirements. KDHE will take into account the age of the BACT determination or NSPS limit, whether any new technologies have subsequently become available (including work practices that reduce emissions), and the visibility analysis that was performed for the BACT determination. KDHE encourages facilities to consult with KDHE staff during the development of their BART analysis if they believe a BACT determination or NSPS limit represents BART and that no further analyses are required for a particular visibility-impairing pollutant.

2. STEP 2: How do I determine whether the options identified in Step 1 are technically feasible?

In Step 2, you evaluate the technical feasibility of the control options you identified in Step 1. You should document a demonstration of technical infeasibility and should explain, based on physical, chemical, or engineering principles, why technical difficulties would preclude the successful use of the control option on the emissions unit under review. You may then eliminate such technically infeasible control options from further consideration in the BART analysis.

In general, what do we mean by technical feasibility?

Control technologies are technically feasible if either (1) they have been installed and operated successfully for the type of source under review under similar conditions, or (2) the technology could be applied to the source under review. Two key concepts are important in determining whether a technology could be applied: “availability” and “applicability.” As explained in more detail below, a technology is considered “available” if the source owner may obtain it through commercial channels, or it is otherwise available within the common sense meaning of the term. An available technology is “applicable” if it can reasonably be installed and operated on the source type under consideration. A technology that is available and applicable is technically feasible.

What do we mean by “available” technology?

1. The typical stages for bringing a control technology concept to reality as a commercial product are:

- Concept stage,
- Research and patenting,
- Bench scale or laboratory testing,
- Pilot scale testing,
- Licensing and commercial demonstration, and
- Commercial sales.

2. A control technique is considered available, within the context presented above, if it has reached the stage of licensing and commercial availability. Similarly, we do not expect a source owner to conduct extended trials to learn how to apply a technology on a totally new and dissimilar source type. Consequently, you would not consider technologies in the pilot scale testing stages of development as “available” for purposes of BART review.

3. Commercial availability by itself, however, is not necessarily a sufficient basis for concluding a technology to be applicable and therefore technically feasible. Technical feasibility, as determined in Step 2, also means a control option may reasonably be deployed on or “applicable” to the source type under consideration.

Because a new technology may become available at various points in time during the BART analysis process, we believe that guidelines are needed on when a technology must be considered. For example, a technology may become available during the public comment period on the State’s rule development process. Likewise, it is possible

that new technologies may become available after the close of the State's public comment period and before submittal of the SIP to EPA, or during EPA's review process on the SIP submittal. In order to provide certainty in the process, all technologies should be considered if available before the close of the State's public comment period. You need not consider technologies that become available after this date. As part of your analysis, you should consider any technologies brought to your attention in public comments. If you disagree with public comments asserting that the technology is available, you should provide an explanation for the public record as to the basis for your conclusion.

KDHE note: For the purpose of the BART analysis, please consider all available technologies as of the date of submittal of the BART analysis. Please be aware, however, that any technologies that become available up to the close of the State's public comment period will be considered available.

What do we mean by "applicable" technology?

You need to exercise technical judgment in determining whether a control alternative is applicable to the source type under consideration. In general, a commercially available control option will be presumed applicable if it has been used on the same or a similar source type. Absent a showing of this type, you evaluate technical feasibility by examining the physical and chemical characteristics of the pollutant-bearing gas stream, and comparing them to the gas stream characteristics of the source types to which the technology had been applied previously. Deployment of the control technology on a new or existing source with similar gas stream characteristics is generally a sufficient basis for concluding the technology is technically feasible barring a demonstration to the contrary as described below.

What type of demonstration is required if I conclude that an option is not technically feasible?

1. Where you conclude that a control option identified in Step 1 is technically infeasible, you should demonstrate that the option is either commercially unavailable, or that specific circumstances preclude its application to a particular emission unit. Generally, such a demonstration involves an evaluation of the characteristics of the pollutant-bearing gas stream and the capabilities of the technology. Alternatively, a demonstration of technical infeasibility may involve a showing that there are unresolvable technical difficulties with applying the control to the source (e.g., size of the unit, location of the proposed site, operating problems related to specific circumstances of the source, space constraints, reliability, and adverse side effects on the rest of the facility). Where the resolution of technical difficulties is merely a matter of increased cost, you should consider the technology to be technically feasible. The cost of a control alternative is considered later in the process.

2. The determination of technical feasibility is sometimes influenced by recent air quality permits. In some cases, an air quality permit may require a certain level of control, but the level of control in a permit is not expected to be achieved in practice (e.g., a source has received a permit but the project was canceled, or every operating source at that permitted level has been physically unable to achieve compliance with the limit). Where this is the case, you should provide supporting documentation showing why such limits are not technically feasible, and, therefore, why the level of control (but not necessarily the technology) may be eliminated from further consideration. However, if there is a permit requiring the application of a certain technology or emission limit to be achieved for such technology, this usually is sufficient justification for you to assume the technical feasibility of that technology or emission limit.

3. Physical modifications needed to resolve technical obstacles do not, in and of themselves, provide a justification for eliminating the control technique on the basis of technical infeasibility. However, you may consider the cost of such modifications in estimating costs. This, in turn, may form the basis for eliminating a control technology (see later discussion).

4. Vendor guarantees may provide an indication of commercial availability and the technical feasibility of a control technique and could contribute to a determination of technical feasibility or technical infeasibility, depending on circumstances. However, we do not consider a vendor guarantee alone to be sufficient justification that a control option will work. Conversely, lack of a vendor guarantee by itself does not present sufficient justification that a control option or an emissions limit is technically infeasible. Generally, you should make decisions about technical feasibility based on chemical, and engineering analyses (as discussed above), in conjunction with information about vendor guarantees.

5. A possible outcome of the BART procedures discussed in these guidelines is the evaluation of multiple control technology alternatives which result in essentially equivalent emissions. It is not our intent to encourage evaluation of unnecessarily large numbers of control alternatives for every emissions unit. Consequently, you should use judgment in deciding on those alternatives for which you will conduct the detailed impacts analysis (Step 4 below). For example, if two or more control techniques result in control levels that are essentially identical, considering the uncertainties of emissions factors and other parameters pertinent to estimating performance, you may evaluate only the less costly of these options. You should narrow the scope of the BART analysis in this way only if there is a negligible difference in emissions and energy and non-air quality environmental impacts between control alternatives.

3. STEP 3: How do I evaluate technically feasible alternatives?

Step 3 involves evaluating the control effectiveness of all the technically feasible control alternatives identified in Step 2 for the pollutant and emissions unit under review.

Two key issues in this process include:

- (1) Making sure that you express the degree of control using a metric that ensures an “apples to apples” comparison of emissions performance levels among options, and
- (2) Giving appropriate treatment and consideration of control techniques that can operate over a wide range of emission performance levels.

What are the appropriate metrics for comparison?

This issue is especially important when you compare inherently lower-polluting processes to one another or to add-on controls. In such cases, it is generally most effective to express emissions performance as an average steady state emissions level per unit of product produced or processed.

Examples of common metrics:

- Pounds of SO₂ emissions per million Btu heat input, and
- Pounds of NO_x emissions per ton of cement produced.

KDHE note: For EGUs, please provide emissions values in units of pounds per million Btu heat input.

How do I evaluate control techniques with a wide range of emission performance levels?

1. Many control techniques, including both add-on controls and inherently lower polluting processes, can perform at a wide range of levels. Scrubbers and high and low efficiency electrostatic precipitators (ESPs) are two of the many examples of such control techniques that can perform at a wide range of levels. It is not our intent to require analysis of each possible level of efficiency for a control technique as such an analysis would result in a large number of options. It is important, however, that in analyzing the technology you take into account the most stringent emission control level that the technology is capable of achieving. You should consider recent regulatory decisions and performance data (e.g., manufacturer's data, engineering estimates and the experience of other sources) when identifying an emissions performance level or levels to evaluate.

2. In assessing the capability of the control alternative, latitude exists to consider special circumstances pertinent to the specific source under review, or regarding the prior application of the control alternative. However, you should explain the basis for choosing the alternate level (or range) of control in the BART analysis. Without a showing of differences between the source and other sources that have achieved more stringent emissions limits, you should conclude that the level being achieved by those other sources is representative of the achievable level for the source being analyzed.

3. You may encounter cases where you may wish to evaluate other levels of control in addition to the most stringent level for a given device. While you must consider the most stringent level as one of the control options, you may consider less stringent levels of control as additional options. This would be useful, particularly in cases where the selection of additional options would have widely varying costs and other impacts.

4. Finally, we note that for retrofitting existing sources in addressing BART, you should consider ways to improve the performance of existing control devices, particularly when a control device is not achieving the level of control that other similar sources are achieving in practice with the same device. For example, you should consider requiring those sources with ESPs performing below currently achievable levels to improve their performance.

4. STEP 4: For a BART review, what impacts am I expected to calculate and report? What methods does EPA recommend for the impacts analysis?

After you identify the available and technically feasible control technology options, you are expected to conduct the following analyses when you make a BART determination:

Impact analysis part 1: Costs of compliance,

Impact analysis part 2: Energy impacts,

Impact analysis part 3: Non-air quality environmental impacts, and

Impact analysis part 4: Remaining useful life.

In this section, we describe how to conduct each of these three analyses. You are responsible for presenting an evaluation of each impact along with appropriate supporting information. You should discuss and, where possible, quantify both beneficial and adverse impacts. In general, the analysis should focus on the direct impact of the control alternative.

KDHE note: The Guidelines do not explicitly mention how to deal with collateral increases in another regulated pollutant as a result of a control alternative. For example, use of furnace sorbent injection to control SO₂ in a boiler could result in an increase in PM emissions. This increase could trigger other air quality requirements such as NSPS or NSR. KDHE asks that you identify any collateral increases in other regulated pollutants in your analysis. If you select a control that has collateral increases as proposed BART, then KDHE asks that your BART analysis also identify any regulatory requirements that are triggered.

a. Impact analysis part 1: how do I estimate the costs of control?

1. To conduct a cost analysis, you:

(1) Identify the emissions units being controlled,

(2) Identify design parameters for emission controls, and

(3) Develop cost estimates based upon those design parameters.

2. It is important to identify clearly the emission units being controlled, that is, to specify a well defined area or process segment within the plant. In some cases, multiple emission units can be controlled jointly. However, in other cases, it may be appropriate in the cost analysis to consider whether multiple units will be required to install separate and/or different control devices. The analysis should provide a clear summary list of equipment and the associated control costs. Inadequate documentation of the equipment whose emissions are being controlled is a potential cause for confusion in comparison of costs of the same controls applied to similar sources.

3. You then specify the control system design parameters. Potential sources of these design parameters include equipment vendors, background information documents used to support NSPS development, control technique

guidelines documents, cost manuals developed by EPA, control data in trade publications, and engineering and performance test data. The following are a few examples of design parameters for two example control measures:

Control device	Examples of design parameters
Wet Scrubbers.....	Type of sorbent used (lime, limestone, etc.) Gas pressure drop Liquid/gas ratio
Selective Catalytic Reduction.....	Ammonia to NO _x molar ratio Pressure drop Catalyst life

4. The value selected for the design parameter should ensure that the control option will achieve the level of emission control being evaluated. You should include in your analysis documentation of your assumptions regarding design parameters. Examples of supporting references would include the EPA *OAQPS Control Cost Manual* (see below) and background information documents used for NSPS and hazardous pollutant emission standards. If the design parameters you specified differ from typical designs, you should document the difference by supplying performance test data for the control technology in question applied to the same source or a similar source.

5. Once the control technology alternatives and achievable emissions performance levels have been identified, you then develop estimates of capital and annual costs. The basis for equipment cost estimates also should be documented, either with data supplied by an equipment vendor (*i.e.*, budget estimates or bids) or by a referenced source (such as the *OAQPS Control Cost Manual*, Fifth Edition, February 1996, EPA 453/B-96-001).¹⁴ In order to maintain and improve consistency, cost estimates should be based on the *OAQPS Control Cost Manual*, where possible.¹⁵ The *Control Cost Manual* addresses most control technologies in sufficient detail for a BART analysis. The cost analysis should also take into account any site-specific design or other conditions identified above that affect the cost of a particular BART technology option.

¹⁴ The *OAQPS Control Cost Manual* is updated periodically. While this citation refers to the latest version at the time this guidance was written, you should use the version that is current as of when you conduct your impact analysis. This document is available at the following web site: <http://www.epa.gov/ttn/catc/dir1/cs1ch2.pdf>.

¹⁵ You should include documentation for any additional information you used for the cost calculations, including any information supplied by vendors that affects your assumptions regarding purchased equipment costs, equipment life, replacement of major components, and any other element of the calculation that differs from the *Control Cost Manual*.

KDHE note: Please reflect all costs in year 2005 dollars.

b. What do we mean by cost effectiveness?

Cost effectiveness, in general, is a criterion used to assess the potential for achieving an objective in the most economical way. For purposes of air pollutant analysis, “effectiveness” is measured in terms of tons of pollutant emissions removed, and “cost” is measured in terms of annualized control costs. We recommend two types of cost-effectiveness calculations—average cost effectiveness, and incremental cost effectiveness.

c. How do I calculate average cost effectiveness?

Average cost effectiveness means the total annualized costs of control divided by annual emissions reductions (the difference between baseline annual emissions and the estimate of emissions after controls), using the following formula:

Average cost effectiveness (dollars per ton removed) = *Control option annualized cost*¹⁶

¹⁶ Whenever you calculate or report annual costs, you should indicate the year for which the costs are estimated. For example, if you use the year 2000 as the basis for cost comparisons, you would report that an annualized cost of \$20 million would be: \$20 million (year 2000 dollars).

Baseline annual emissions—Annual emissions with control option

Because you calculate costs in (annualized) dollars per year (\$/yr) and because you calculate emissions rates in tons per year (tons/yr), the result is an average cost-effectiveness number in (annualized) dollars per ton (\$/ton) of pollutant removed.

d. How do I calculate baseline emissions?

1. The baseline emissions rate should represent a realistic depiction of anticipated annual emissions for the source. In general, for the existing sources subject to BART, you will estimate the anticipated annual emissions based upon actual emissions from a baseline period.

2. When you project that future operating parameters (e.g., limited hours of operation or capacity utilization, type of fuel, raw materials or product mix or type) will differ from past practice, and if this projection has a deciding effect in the BART determination, then you must make these parameters or assumptions into enforceable limitations. In the absence of enforceable limitations, you calculate baseline emissions based upon continuation of past practice.

3. For example, the baseline emissions calculation for an emergency standby generator may consider the fact that the source owner would not operate more than past practice of 2 weeks a year. On the other hand, baseline emissions associated with a base-loaded turbine should be based on its past practice which would indicate a large number of hours of operation. This produces a significantly higher level of baseline emissions than in the case of the emergency/standby unit and results in more cost-effective controls. As a consequence of the dissimilar baseline emissions, BART for the two cases could be very different.

KDHE note: In estimating the baseline tons per year emitted, KDHE asks that you use the average hourly emission rate, as calculated from the maximum 24-hour emission rate, multiplied by the utilization rate of the highest year during the 3-year period from 2002 to 2004. KDHE is suggesting this method so that the baseline tons value is closer to the upper bound of expected future emissions in any given year. If this method results in an unrealistic depiction of future annual emissions, then please consult with KDHE staff to develop an alternative acceptable method.

e. How do I calculate incremental cost effectiveness?

1. In addition to the average cost effectiveness of a control option, you should also calculate incremental cost effectiveness. You should consider the incremental cost effectiveness in combination with the average cost effectiveness when considering whether to eliminate a control option. The incremental cost effectiveness calculation compares the costs and performance level of a control option to those of the next most stringent option, as shown in the following formula (with respect to cost per emissions reduction):

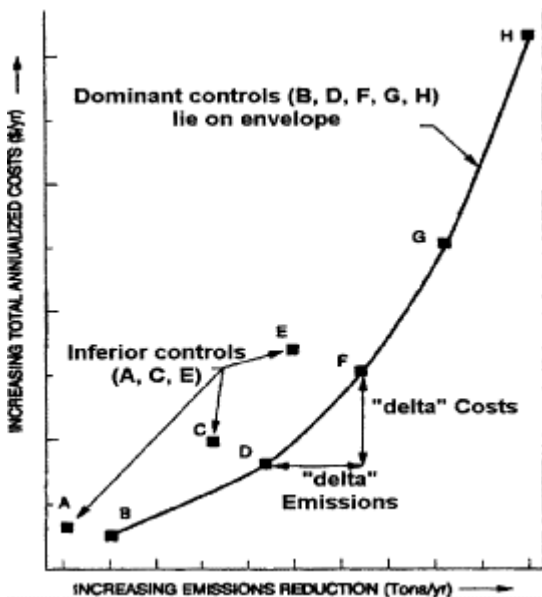
Incremental Cost Effectiveness (dollars per incremental ton removed) = [(Total annualized costs

of control option) – (Total annualized costs of next control option)] ÷ [(Control option annual emissions) – (Next control option annual emissions)]

Example 1: Assume that Option F on Figure 2 has total annualized costs of \$1 million to reduce 2000 tons of a pollutant, and that Option D on Figure 2 has total annualized costs of \$500,000 to reduce 1000 tons of the same pollutant. The incremental cost effectiveness of Option F relative to Option D is (\$1 million – \$500,000) divided by (2000 tons – 1000 tons), or \$500,000 divided by 1000 tons, which is \$500/ton.

Example 2: Assume that two control options exist: Option 1 and Option 2. Option 1 achieves a 1,000 ton/yr reduction at an annualized cost of \$1,900,000. This represents an average cost of (\$1,900,000/1,000 tons) = \$1,900/ton. Option 2 achieves a 980 tons/yr reduction at an annualized cost of \$1,500,000. This represents an average cost of (\$1,500,000/980 tons) = \$1,531/ton. The incremental cost effectiveness of Option 1 relative to Option 2 is (\$1,900,000 – \$1,500,000) divided by (1,000 tons – 980 tons). The adoption of Option 1 instead of Option 2 results in an incremental emission reduction of 20 tons per year at an additional cost of \$400,000 per year. The incremental cost of Option 1, then, is \$20,000 per ton – 11 times the average cost of \$1,900 per ton. While \$1,900 per ton may still be deemed reasonable, it is useful to consider both the average and incremental cost in making an overall cost-effectiveness finding. Of course, there may be other differences between these options, such as, energy or water use, or non-air environmental effects, which also should be considered in selecting a BART technology.

2. You should exercise care in deriving incremental costs of candidate control options. Incremental cost-effectiveness comparisons should focus on annualized cost and emission reduction differences between “dominant” alternatives. To identify dominant alternatives, you generate a graphical plot of total annualized costs for total emissions reductions for all control alternatives identified in the BART analysis, and by identifying a “least-cost envelope” as shown in Figure 2. (A “least-cost envelope” represents the set of options that should be dominant in the choice of a specific option.)



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Example: Eight technically feasible control options for analysis are listed. These are represented as A through H in Figure 2. The dominant set of control options, B, D, F, G, and H, represent the least-cost envelope, as we depict by the cost curve connecting them. Points A, C and E are inferior options, and you should not use them in calculating incremental cost effectiveness. Points A, C and E represent inferior controls because B will buy more emissions reductions for less money than A;

and similarly, D and F will buy more reductions for less money than C and E, respectively.

3. In calculating incremental costs, you:

(1) Array the control options in ascending order of annualized total costs;

(2) Develop a graph of the most reasonable smooth curve of the control options, as shown in Figure 2. This is to show the “least-cost envelope” discussed above; and

(3) Calculate the incremental cost effectiveness for each dominant option, which is the difference in total annual costs between that option and the next most stringent option, divided by the difference in emissions, after controls have been applied, between those two control options. For example, using Figure 2, you would calculate incremental cost effectiveness for the difference between options B and D, options D and F, options F and G, and options G and H.

4. A comparison of incremental costs can also be useful in evaluating the viability of a specific control option over a range of efficiencies. For example, depending on the capital and operational cost of a control device, total and incremental cost may vary significantly (either increasing or decreasing) over the operational range of a control device. Also, the greater the number of possible control options that exist, the more weight should be given to the incremental costs vs. average costs. It should be noted that average and incremental cost effectiveness are identical when only one candidate control option is known to exist.

5. You should exercise caution not to misuse these techniques. For example, you may be faced with a choice between two available control devices at a source, control A and control B, where control B achieves slightly greater emission reductions. The average cost (total annual cost/total annual emission reductions) for each may be deemed to be reasonable. However, the incremental cost (total annual cost_{A-B}/total annual emission reductions_{A-B}) of the additional emission reductions to be achieved by control B may be very great. In such an instance, it may be inappropriate to choose control B, based on its high incremental costs, even though its average cost may be considered reasonable.

6. In addition, when you evaluate the average or incremental cost effectiveness of a control alternative, you should make reasonable and supportable assumptions regarding control efficiencies. An unrealistically low assessment of the emission reduction potential of a certain technology could result in inflated cost-effectiveness figures.

KDHE note: KDHE does not require that you develop a least-cost envelope such as that shown in the figure. KDHE expects that the top-down nature of the BART analysis and the information requested in the analysis will be sufficient for BART determination purposes.

f. What other information should I provide in the cost impacts analysis?

You should provide documentation of any unusual circumstances that exist for the source that would lead to cost-effectiveness estimates that would exceed that for recent retrofits. This is especially important in cases where recent retrofits have cost-effectiveness values that are within what has been considered a reasonable range, but your analysis concludes that costs for the source being analyzed are not considered reasonable. (A reasonable range would be a range that is consistent with the range of cost effectiveness values used in other similar permit decisions over a period of time.)

Example: In an arid region, large amounts of water are needed for a scrubbing system. Acquiring water from a distant location could greatly increase the cost per ton of emissions reduced of wet scrubbing as a control option.

g. What other things are important to consider in the cost impacts analysis?

In the cost analysis, you should take care not to focus on incomplete results or partial calculations. For example, large capital costs for a control option alone would not preclude selection of a control measure if

large emissions reductions are projected. In such a case, low or reasonable cost effectiveness numbers may validate the option as an appropriate BART alternative irrespective of the large capital costs. Similarly, projects with relatively low capital costs may not be cost effective if there are few emissions reduced.

h. Impact analysis part 2: How should I analyze and report energy impacts?

1. You should examine the energy requirements of the control technology and determine whether the use of that technology results in energy penalties or benefits. A source owner may, for example, benefit from the combustion of a concentrated gas stream rich in volatile organic compounds; on the other hand, more often extra fuel or electricity is required to power a control device or incinerate a dilute gas stream. If such benefits or penalties exist, they should be quantified to the extent practicable. Because energy penalties or benefits can usually be quantified in terms of additional cost or income to the source, the energy impacts analysis can, in most cases, simply be factored into the cost impacts analysis. The fact of energy use in and of itself does not disqualify a technology.

2. Your energy impact analysis should consider only direct energy consumption and not indirect energy impacts. For example, you could estimate the direct energy impacts of the control alternative in units of energy consumption at the source (e.g., BTU, kWh, barrels of oil, tons of coal). The energy requirements of the control options should be shown in terms of total (and in certain cases, also incremental) energy costs per ton of pollutant removed. You can then convert these units into dollar costs and, where appropriate, factor these costs into the control cost analysis.

3. You generally do not consider indirect energy impacts (such as energy to produce raw materials for construction of control equipment). However, if you determine, either independently or based on a showing by the source owner, that the indirect energy impact is unusual or significant and that the impact can be well quantified, you may consider the indirect impact.

4. The energy impact analysis may also address concerns over the use of locally scarce fuels. The designation of a scarce fuel may vary from region to region. However, in general, a scarce fuel is one which is in short supply locally and can be better used for alternative purposes, or one which may not be reasonably available to the source either at the present time or in the near future.

5. Finally, the energy impacts analysis may consider whether there are relative differences between alternatives regarding the use of locally or regionally available coal, and whether a given alternative would result in significant economic disruption or unemployment. For example, where two options are equally cost effective and achieve equivalent or similar emissions reductions, one option may be preferred if the other alternative results in significant disruption or unemployment.

KDHE note: Please report energy impacts on a dollar per ton of pollutant removed basis. Please document all assumptions made in calculating energy costs. Please reflect all costs in year 2005 dollars.
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i. Impact analysis part 3: How do I analyze “non-air quality environmental impacts?”

1. In the non-air quality related environmental impacts portion of the BART analysis, you address environmental impacts other than air quality due to emissions of the pollutant in question. Such environmental impacts include solid or hazardous waste generation and discharges of polluted water from a control device.

2. You should identify any significant or unusual environmental impacts associated with a control alternative that have the potential to affect the selection or elimination of a control alternative. Some control technologies may have potentially significant secondary environmental impacts. Scrubber effluent, for example, may affect water quality and land use. Alternatively, water availability may affect the feasibility and costs of wet scrubbers. Other examples of secondary environmental impacts could include hazardous waste discharges, such as spent catalysts or contaminated carbon. Generally, these types of environmental concerns become important when sensitive site-specific receptors exist or when the incremental emissions reductions potential of the more stringent control is only marginally greater than the next most-effective option. However, the fact that a control device creates liquid and solid waste that must be disposed of does not necessarily argue

against selection of that technology as BART, particularly if the control device has been applied to similar facilities elsewhere and the solid or liquid waste is similar to those other applications. On the other hand, where you or the source owner can show that unusual circumstances at the proposed facility create greater problems than experienced elsewhere, this may provide a basis for the elimination of that control alternative as BART.

3. The procedure for conducting an analysis of non-air quality environmental impacts should be made based on a consideration of site-specific circumstances. If you propose to adopt the most stringent alternative, then it is not necessary to perform this analysis of environmental impacts for the entire list of technologies you ranked in Step 3. In general, the analysis need only address those control alternatives with any significant or unusual environmental impacts that have the potential to affect the selection of a control alternative, or elimination of a more stringent control alternative. Thus, any important relative environmental impacts (both positive and negative) of alternatives can be compared with each other.

4. In general, the analysis of impacts starts with the identification and quantification of the solid, liquid, and gaseous discharges from the control device or devices under review. Initially, you should perform a qualitative or semi-quantitative screening to narrow the analysis to discharges with potential for causing adverse environmental effects. Next, you should assess the mass and composition of any such discharges and quantify them to the extent possible, based on readily available information. You should also assemble pertinent information about the public or environmental consequences of releasing these materials.

j. Impact analysis part 4: What are examples of non-air quality environmental impacts?

The following are examples of how to conduct non-air quality environmental impacts:

(1) Water impact

You should identify the relative quantities of water used and water pollutants produced and discharged as a result of the use of each alternative emission control system. Where possible, you should assess the effect on ground water and such local surface water quality parameters as pH, turbidity, dissolved oxygen, salinity, toxic chemical levels, temperature, and any other important considerations. The analysis could consider whether applicable water quality standards will be met and the availability and effectiveness of various techniques to reduce potential adverse effects.

(2) Solid waste disposal impact

You could also compare the quality and quantity of solid waste (e.g., sludges, solids) that must be stored and disposed of or recycled as a result of the application of each alternative emission control system. You should consider the composition and various other characteristics of the solid waste (such as permeability, water retention, rewatering of dried material, compression strength, leachability of dissolved ions, bulk density, ability to support vegetation growth and hazardous characteristics) which are significant with regard to potential surface water pollution or transport into and contamination of subsurface waters or aquifers.

(3) Irreversible or irretrievable commitment of resources

You may consider the extent to which the alternative emission control systems may involve a trade-off between short-term environmental gains at the expense of long-term environmental losses and the extent to which the alternative systems may result in irreversible or irretrievable commitment of resources (for example, use of scarce water resources).

(4) Other adverse environmental impacts

You may consider significant differences in noise levels, radiant heat, or dissipated static electrical energy of pollution control alternatives. Other examples of non-air quality environmental impacts

would include hazardous waste discharges such as spent catalysts or contaminated carbon.

k. How do I take into account a project's "remaining useful life" in calculating control costs?

1. You may decide to treat the requirement to consider the source's "remaining useful life" of the source for BART determinations as one element of the overall cost analysis. The "remaining useful life" of a source, if it represents a relatively short time period, may affect the annualized costs of retrofit controls. For example, the methods for calculating annualized costs in EPA's *OAQPS Control Cost Manual* require the use of a specified time period for amortization that varies based upon the type of control. If the remaining useful life will clearly exceed this time period, the remaining useful life has essentially no effect on control costs and on the BART determination process. Where the remaining useful life is less than the time period for amortizing costs, you should use this shorter time period in your cost calculations.

KDHE note: For units being evaluated in the *OAQPS Control Cost Manual*, any time period that is less than the lifetime of the control equipment set in the Manual (*i.e.*, the remaining life of the equipment) should be supported with a rationale that includes an assessment of why it is not reasonable to assume the facility will maintain or reconstruct for continued operation, thus allowing the control equipment to be used for an extended period.

2. For purposes of these guidelines, the remaining useful life is the difference between:

- (1) The date that controls will be put in place (capital and other construction costs incurred before controls are put in place can be rolled into the first year, as suggested in EPA's *OAQPS Control Cost Manual*); and
- (2) The date the facility permanently stops operations. Where this affects the BART determination, this date should be assured by a federally or State-enforceable restriction preventing further operation.

3. We recognize that there may be situations where a source operator intends to shut down a source by a given date, but wishes to retain the flexibility to continue operating beyond that date in the event, for example, that market conditions change. Where this is the case, your BART analysis may account for this, but it must maintain consistency with the statutory requirement to install BART within 5 years. Where the source chooses not to accept a federally enforceable condition requiring the source to shut down by a given date, it is necessary to determine whether a reduced time period for the remaining useful life changes the level of controls that would have been required as BART.

If the reduced time period does change the level of BART controls, you may identify, and include as part of the BART emission limitation, the more stringent level of control that would be required as BART if there were no assumption that reduced the remaining useful life. You may incorporate into the BART emission limit this more stringent level, which would serve as a contingency should the source continue operating more than 5 years after the date EPA approves the relevant SIP. The source would not be allowed to operate after the 5-year mark without such controls. If a source does operate after the 5-year mark without BART in place, the source is considered to be in violation of the BART emissions limit for each day of operation.

5. Step 5: How should I determine visibility impacts in the BART determination?

The following is an approach you may use to determine visibility impacts (the degree of visibility improvement for each source subject to BART) for the BART determination. Once you have determined that your source or sources are subject to BART, you must conduct a visibility improvement determination for the source(s) as part of the BART determination. When making this determination, we believe you have flexibility in setting absolute thresholds, target levels of improvement, or *de minimis* levels, since the deciview improvement must be weighed among the five factors, and you are free to determine the weight and significance to be assigned to each factor. For example, a 0.3 dv improvement may merit a stronger weighting in one case versus another, so one "bright line" may not be appropriate. [Note that if sources have elected to apply the most stringent controls available, consistent with the discussion in section E step 1 below, you need not conduct, or require the source to conduct, an air quality modeling analysis for the purpose of determining its visibility

impacts.]

Use CALPUFF¹⁷ or other appropriate dispersion model to determine the visibility improvement expected at a Class I area from the potential BART control technology applied to the source. Modeling should be conducted for SO₂, NO_x, and direct PM emissions (PM_{2.5} and/or PM₁₀). If the source is making the visibility determination, you should review and approve or disapprove of the source's analysis before making the expected improvement determination. There are several steps for determining the visibility impacts from an individual source using a dispersion model:

¹⁷ The model code and its documentation are available from <http://www.epa.gov/scram001/tt22.htm#calpuff>.

• **Develop a modeling protocol.**

Some critical items to include in a modeling protocol are meteorological and terrain data, as well as source-specific information (stack height, temperature, exit velocity, elevation, and allowable and actual emission rates of applicable pollutants), and receptor data from appropriate Class I areas. We recommend following EPA's *Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts*¹⁸ for parameter settings and meteorological data inputs; the use of other settings from those in IWAQM should be identified and explained in the protocol.

¹⁸ *Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts*, U.S. Environmental Protection Agency, EPA-454/R-98-019, December 1998.

One important element of the protocol is in establishing the receptors that will be used in the model. The receptors that you use should be located in the nearest Class I area with sufficient density to identify the likely visibility effects of the source. For other Class I areas in relatively close proximity to a BART-eligible source, you may model a few strategic receptors to determine whether effects at those areas may be greater than at the nearest Class I area. For example, you might choose to locate receptors at these areas at the closest point to the source, at the highest and lowest elevation in the Class I area, at the IMPROVE monitor, and at the approximate expected plume release height. If the highest modeled effects are observed at the nearest Class I area, you may choose not to analyze the other Class I areas any further as additional analyses might be unwarranted.

You should bear in mind that some receptors within the relevant Class I area may be less than 50 km from the source while other receptors within that same Class I area may be greater than 50 km from the same source. As indicated by the *Guideline on Air Quality Models*, this situation may call for the use of two different modeling approaches for the same Class I area and source, depending upon the State's chosen method for modeling sources less than 50 km. In situations where you are assessing visibility impacts for source-receptor distances less than 50 km, you should use expert modeling judgment in determining visibility impacts, giving consideration to both CALPUFF and other EPA-approved methods.

In developing your modeling protocol, you may want to consult with EPA and your regional planning organization (RPO). Up-front consultation will ensure that key technical issues are addressed before you conduct your modeling.

KDHE note: Determining visibility impacts of the various control alternatives should conform to the modeling protocol developed by KDHE, in most cases. This KDHE protocol also relies on the CENRAP modeling guidelines, titled "CENRAP BART Modeling Guidelines." It is available at http://www.cenrap.org/modeling_document.asp. The specific emissions and stack parameter inputs used for each facility in the subject-to-BART modeling are available from KDHE. For those sources that will be performing refined CALPUFF modeling, or proposing an alternative model, you should work closely with KDHE on settings and assumptions that will be allowed. For sources that choose to follow the current KDHE protocol and data sets, no additional modeling documentation is required other than the stack and emissions changes due to the proposed controls.

Since the 2002 BART Information Request Form (sent to facilities by KDHE) requested only PM₁₀ information per EPA's then-current proposed Regional Haze Rule, KDHE has estimated a maximum 24-hour average actual PM_{2.5} emission rate using the PM₁₀ potential-to-emit (PTE) values supplied, and applying a PM_{2.5}/PM₁₀ ratio calculated by KDHE for the 2002 emissions inventory. To quantify PM_{2.5} emissions in the 2002 emissions inventory, KDHE used three different methods: (1) if the facility didn't submit PM₁₀ stack test data, KDHE estimated both the PM_{2.5} and PM₁₀ primary emissions (filterable +condensable) using uncontrolled emission factors from EPA's FIRE database and applying KDHE default control efficiencies; (2) if the facility did submit PM₁₀ stack test data, KDHE estimated the PM_{2.5} by scaling the existing ratio of PM_{2.5}/PM₁₀ primary emissions derived from method 1; or (3) if the facility's source classification codes (SCCs) were not available in FIRE, KDHE estimated the PM_{2.5} using EPA's PM Calculator (see <http://www.epa.gov/ttn/chief/software/pmcalc/index.html>).

Thus, PM_{2.5} emissions will be the scaled PM_{2.5} (fine PM) and the remainder (PM_{2.5-10}) will be assigned to PM₁₀ (coarse PM). It is possible the PM_{2.5}/PM₁₀ ratio for the control alternative will not be the same as the base case ratio. If the ratio is not the same, it is recommended that you use the method used by KDHE to estimate PM_{2.5} emissions for the various control alternatives evaluated. The National Park Service has developed PM₁₀ speciation methods for various emission units (large coal-fired boilers, thermal dryers, oil boilers, and cement kilns) with control applied. If you have a BART-eligible emission unit for which PM₁₀ speciation data is available, then you may use that method instead. *<These methods are still under development and not yet available on-line. Contact Don Sheperd at don_shepherd@nps.gov if you would like the most recent drafts.>*

- **For each source, run the model at pre-control and post-control emission rates according to the accepted methodology in the protocol.**

Use the 24-hour average actual emission rate from the highest emitting day of the meteorological period modeled (for the pre-control scenario). Calculate the model results for each receptor as the change in deciviews compared against natural visibility conditions. Post-control emission rates are calculated as a percentage of pre-control emission rates. For example, if the 24-hr pre-control emission rate is 100 lb/hr of SO₂, then the post control rate is 5 lb/hr if the control efficiency being evaluated is 95%.

KDHE note: Provide tables with the pre-control and post-control stack and emissions inputs used for the modeling runs.

- **Make the net visibility improvement determination.**

Assess the visibility improvement based on the modeled change in visibility impacts for the pre-control and post-control emission scenarios. You have flexibility to assess visibility improvements due to BART controls by one or more methods. You may consider the frequency, magnitude, and duration components of impairment. Suggestions for making the determination are:

- *Use of a comparison threshold*, as is done for determining if BART-eligible sources should be subject to a BART determination. Comparison thresholds can be used in a number of ways in evaluating visibility improvement (e.g., the number of days or hours that the threshold was exceeded, a single threshold for determining whether a change in impacts is significant, or a threshold representing an x% change in improvement).

KDHE note: KDHE is recommending that for each Class I area you were shown to impact in the subject-to-BART modeling, compare the highest modeled delta-deciview value from all modeled receptors at a given Class I area for each year simulated, compare the number of days of impacts > 0.5 dv, and compare the number of days impacts > 1.0 dv. These comparisons should be performed for pre- and post-control runs. You may also recommend additional comparison thresholds to evaluate visibility improvement.

- *Compare the 98th percentile days for the pre- and post-control runs*, noting that each of the

modeling options may be supplemented with source apportionment data or source apportionment modeling.

E. How do I select the “best” alternative using the results of Steps 1 through 5?

1. Summary of the impacts analysis

From the alternatives you evaluated in Step 3, we recommend you develop a chart (or charts) displaying for each of the alternatives:

- (1) Expected emission rate (tons per year, pounds per hour);
- (2) Emissions performance level (e.g., percent pollutant removed, emissions per unit product, lb/MMBtu, ppm);
- (3) Expected emissions reductions (tons per year);
- (4) Costs of compliance—total annualized costs (\$), cost effectiveness (\$/ton), and incremental cost effectiveness (\$/ton), and/or any other cost-effectiveness measures (such as \$/deciview);
- (5) Energy impacts;
- (6) Non-air quality environmental impacts; and
- (7) Modeled visibility impacts.

2. Selecting a “best” alternative

1. You have discretion to determine the order in which you should evaluate control options for BART. Whatever the order in which you choose to evaluate options, you should always (1) display the options evaluated; (2) identify the average and incremental costs of each option; (3) consider the energy and non-air quality environmental impacts of each option; (4) consider the remaining useful life; and (5) consider the modeled visibility impacts. You should provide a justification for adopting the technology that you select as the “best” level of control, including an explanation of the CAA factors that led you to choose that option over other control levels.

KDHE note: KDHE would like you to use a top-down approach to evaluate control strategies. If you determine that the most stringent alternative in the ranking does not impose unreasonable costs of compliance, taking into account both average and incremental costs, the analysis begins with the presumption that this level is selected. Under this, you would then proceed to consider whether energy and non-air quality environmental impacts would justify selection of an alternative control option. If there are no outstanding issues regarding energy and non-air quality environmental impacts, the analysis is ended and the most stringent alternative is identified as the “best system of continuous reduction.”

If you determine that the most stringent alternative is unacceptable due to such impacts, this approach would require you to document the rationale for this finding. Then, the next most effective alternative in the listing becomes the new control candidate and is similarly evaluated. This process continues until you identify a technology which does not pose unacceptable costs of compliance, energy, and/or non-air quality environmental impacts. KDHE staff will be available to work with you during your BART analysis preparation to address your questions and concerns, such as the specific concern that a particular technology favored by you would be eliminated under a top-down approach. In making the BART determination itself, all factors will be considered, including the degree of visibility improvement.

2. In the case where you are conducting a BART determination for two regulated pollutants on the same source, if the result is two different BART technologies that do not work well together, you could then

substitute a different technology or combination of technologies.

3. In selecting a “best” alternative, should I consider the affordability of controls?

1. Even if the control technology is cost effective, there may be cases where the installation of controls would affect the viability of continued plant operations.

2. There may be unusual circumstances that justify taking into consideration the conditions of the plant and the economic effects of requiring the use of a given control technology. These effects would include effects on product prices, the market share, and profitability of the source. Where there are such unusual circumstances that are judged to affect plant operations, you may take into consideration the conditions of the plant and the economic effects of requiring the use of a control technology. Where these effects are judged to have a severe impact on plant operations you may consider them in the selection process, but you may wish to provide an economic analysis that demonstrates, in sufficient detail for public review, the specific economic effects, parameters, and reasoning. (We recognize that this review process must preserve the confidentiality of sensitive business information). Any analysis may also consider whether other competing plants in the same industry have been required to install BART controls if this information is available.

4. Sulfur dioxide limits for utility boilers

You must require 750 MW power plants to meet specific control levels for SO₂ of either 95% control or 0.15 lbs/MMBtu, for each EGU greater than 200 MW that is currently uncontrolled unless you determine that an alternative control level is justified based on a careful consideration of the statutory factors. Thus, for example, if the source demonstrates circumstances affecting its ability to cost-effectively reduce its emissions, you should take that into account in determining whether the presumptive levels of control are appropriate for that facility. For a currently uncontrolled EGU greater than 200 MW in size, but located at a power plant smaller than 750 MW in size, such controls are generally cost-effective and could be used in your BART determination considering the five factors specified in CAA section 169A(g)(2). While these levels may represent current control capabilities, we expect that scrubber technology will continue to improve and control costs continue to decline. You should be sure to consider the level of control that is currently best achievable at the time that you are conducting your BART analysis.

For coal-fired EGUs with existing post-combustion SO₂ controls achieving less than 50% removal efficiencies, we recommend that you evaluate constructing a new FGD system to meet the same emission limits as above (95% removal or 0.15 lb/mmBtu), in addition to the evaluation of scrubber upgrades discussed below. For oil-fired units, regardless of size, you should evaluate limiting the sulfur content of the fuel oil burned to 1% or less by weight.

For those BART-eligible EGUs with pre-existing post-combustion SO₂ controls achieving removal efficiencies of at least 50%, your BART determination should consider cost effective scrubber upgrades designed to improve the system's overall SO₂ removal efficiency. There are numerous scrubber enhancements available to upgrade the average removal efficiencies of all types of existing scrubber systems. We recommend that as you evaluate the definition of “upgrade,” you evaluate options that not only improve the design removal efficiency of the scrubber vessel itself, but also consider upgrades that can improve the overall SO₂ removal efficiency of the scrubber system. Increasing a scrubber system's reliability, and conversely decreasing its downtime, by way of optimizing operation procedures, improving maintenance practices, adjusting scrubber chemistry, and increasing auxiliary equipment redundancy, are all ways to improve average SO₂ removal efficiencies.

We recommend that as you evaluate the performance of existing wet scrubber systems, you consider some of the following upgrades, in no particular order, as potential scrubber upgrades that have been proven in the industry as cost-effective means to increase overall SO₂ removal of wet systems:

- (a) Elimination of bypass reheat,

- (b) Installation of liquid distribution rings,
- (c) Installation of perforated trays,
- (d) Use of organic acid additives,
- (e) Improve or upgrade scrubber auxiliary system equipment, and/or
- (f) Redesign spray header or nozzle configuration.

We recommend that as you evaluate upgrade options for dry scrubber systems, you should consider the following cost effective upgrades, in no particular order:

- (a) Use of performance additives,
- (b) Use of more reactive sorbent,
- (c) Increase the pulverization level of sorbent, and/or
- (d) Engineering redesign of atomizer or slurry injection system.

You should evaluate scrubber upgrade options based on the 5-step BART analysis process.

5. Nitrogen oxide limits for utility boilers

You should establish specific numerical limits for NO_x control for each BART determination. For power plants with a generating capacity in excess of 750 MW currently using selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) for part of the year, you should presume that use of those same controls year-round is BART. For other sources currently using SCR or SNCR to reduce NO_x emissions during part of the year, you should carefully consider requiring the use of these controls year-round as the additional costs of operating the equipment throughout the year would be relatively modest.

For coal-fired EGUs greater than 200 MW located at greater than 750 MW power plants and operating without post-combustion controls (*i.e.*, SCR or SNCR), we have provided presumptive NO_x limits, differentiated by boiler design and type of coal burned. You may determine that an alternative control level is appropriate based on a careful consideration of the statutory factors. For coal-fired EGUs greater than 200 MW located at power plants 750 MW or less in size and operating without post-combustion controls, you should likewise presume that these same levels are cost-effective. You should require such utility boilers to meet the following NO_x emission limits, unless you determine that an alternative control level is justified based on consideration of the statutory factors. The following NO_x emission rates were determined based on a number of assumptions, including that the EGU boiler has enough volume to allow for installation and effective operation of separated overfire air ports. For boilers where these assumptions are incorrect, these emission limits may not be cost-effective.

Table 1. Presumptive NO_x Emission Limits for BART-Eligible Coal-Fired Units. ¹⁹

Unit type	Coal type	NO _x presumptive limit (lb/MMbtu) ²⁰
Dry-bottom wall-fired.....	Bituminous.....	0.39
	Subbituminous.....	0.23
	Lignite.....	0.29
Tangential-fired.....	Bituminous.....	0.28

	Subbituminous.....	0.15
	Lignite.....	0.17
Cell Burners.....	Bituminous.....	0.40
	Subbituminous.....	0.45
Dry-turbo-fired.....	Bituminous.....	0.32
	Subbituminous.....	0.23
Wet-bottom tangential-fired...	Bituminous.....	0.62

¹⁹ No cell burners, dry-turbo-fired units, nor wet-bottom tangential-fired units burning lignite were identified as BART eligible, thus no presumptive limit was determined. Similarly, no wet-bottom tangential-fired units burning subbituminous were identified as BART eligible.

²⁰ These limits reflect the design and technological assumptions discussed in the technical support document for NO_x limits for these guidelines. See Technical Support Document for BART NO_x Limits for Electric Generating Units and Technical Support Document for BART NO_x Limits for Electric Generating Units Excel Spreadsheet, Memorandum to Docket OAR 2002-0076, April 15, 2005.

Most EGUs can meet these presumptive NO_x limits through the use of current combustion control technology, *i.e.*, the careful control of combustion air and low- NO_x burners. For units that cannot meet these limits using such technologies, you should consider whether advanced combustion control technologies such as rotating opposed fire air should be used to meet these limits.

Because of the relatively high NO_x emission rates of cyclone units, SCR is more cost-effective than the use of current combustion control technology for these units. The use of SCRs at cyclone units burning bituminous coal, subbituminous coal, and lignite should enable the units to cost-effectively meet NO_x rates of 0.10 lb/MMBtu. As a result, we are establishing a presumptive NO_x limit of 0.10 lb/MMBtu based on the use of SCR for coal-fired cyclone units greater than 200 MW located at 750 MW power plants. As with the other presumptive limits established in this guideline, you may determine that an alternative level of control is appropriate based on your consideration of the relevant statutory factors. For other cyclone units, you should review the use of SCR and consider whether these post-combustion controls should be required as BART.

For oil-fired and gas-fired EGUs larger than 200 MW, we believe that installation of current combustion control technology to control NO_x is generally highly cost-effective and should be considered in your determination of BART for these sources. Many such units can make significant reductions in NO_x emissions which are highly cost-effective through the application of current combustion control technology.²¹

²¹ See Technical Support Document for BART NO_x Limits for Electric Generating Units and Technical Support Document for BART NO_x Limits for Electric Generating Units Excel Spreadsheet, Memorandum to Docket OAR 2002-0076, April 15, 2005.

KDHE note: KDHE expects these presumptive levels of control will be cost effective in most cases. If your facility falls in the EGU category described above and you propose controls at or beyond these presumptive levels, you need not take into account the remaining statutory factors, as BART will be met. If you propose controls above these presumptive levels, justification incorporating the statutory factors will be required.

V. Enforceable Limits/Compliance Date

To complete the BART process, you must establish enforceable emission limits that reflect the BART requirements and require compliance within a given period of time. In particular, you must establish an enforceable emission limit for each subject emission unit at the source and for each pollutant subject to review that is emitted from the source. In addition, you must require compliance with the BART emission limitations no later than 5 years after EPA approves your regional haze SIP. If technological or economic limitations in the application of a measurement methodology to a particular emission unit make a conventional emissions limit infeasible, you may instead prescribe a design, equipment, work practice, operation standard, or combination of these types of standards. You should consider allowing sources to "average" emissions across any set of BART-eligible emission units within a facility, so long as the emission

reductions from each pollutant being controlled for BART would be equal to those reductions that would be obtained by simply controlling each of the BART-eligible units that constitute a BART-eligible source.

You should ensure that any BART requirements are written in a way that clearly specifies the individual emission unit(s) subject to BART regulation. Because the BART requirements themselves are “applicable” requirements of the CAA, they must be included as Title V permit conditions according to the procedures established in 40 CFR part 70 or 40 CFR part 71.

Section 302(k) of the CAA requires emissions limits such as BART to be met on a continuous basis. Although this provision does not necessarily require the use of continuous emissions monitors (CEMs), it is important that sources employ techniques that ensure compliance on a continuous basis. Monitoring requirements generally applicable to sources, including those that are subject to BART, are governed by other regulations. See, e.g., 40 CFR part 64 (compliance assurance monitoring); 40 CFR 70.6(a)(3) (periodic monitoring); 40 CFR 70.6(c)(1) (sufficiency monitoring). Note also that while we do not believe that CEMs would necessarily be required for all BART sources, the vast majority of electric generating units potentially subject to BART already employ CEM technology for other programs, such as the acid rain program. In addition, emissions limits must be enforceable as a practical matter (contain appropriate averaging times, compliance verification procedures, and recordkeeping requirements). In light of the above, the permit must:

- Be sufficient to show compliance or noncompliance (*i.e.*, through monitoring times of operation, fuel input, or other indices of operating conditions and practices); and
- Specify a reasonable averaging time consistent with established reference methods, contain reference methods for determining compliance, and provide for adequate reporting and recordkeeping so that air quality agency personnel can determine the compliance status of the source; and
- For EGUS, specify an averaging time of a 30-day rolling average, and contain a definition of “boiler operating day” that is consistent with the definition in the proposed revisions to the NSPS for utility boilers in 40 CFR Part 60, subpart Da.²² You should consider a boiler operating day to be any 24-hour period between 12:00 midnight and the following midnight during which any fuel is combusted at any time at the steam generating unit. This would allow 30-day rolling average emission rates to be calculated consistently across sources.

KDHE note: KDHE expects to enter into agreements with facilities that will specify emissions limits and compliance schedules to address BART. These agreements will become part of the Regional Haze SIP and will be federally enforceable. Emissions limits specified in the agreement will be incorporated into a facility's Title V operating permit during the first Title V renewal period after the agreement is entered into. While KDHE will determine the compliance date and emission limit, we encourage you to suggest a compliance schedule and to propose a BART limit consistent with the above guidance.

KDHE will allow you to average emissions across any set of BART-eligible emission units within a facility, so long as facility-wide emission reductions from each pollutant being controlled for BART would be equal or greater than those reductions expected by simply controlling each of the BART-eligible units at a BART-eligible source.