Arizona Regional Haze Technical Support Document

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I. Definitions and Acronyms

(1) The words or initials *Act* or *CAA* mean or refer to the Clean Air Act, unless the context indicates otherwise.

(2) The initials *ADEQ* mean or refer to the Arizona Department of Environmental Quality.

(3) The initials *AEPCO* mean or refer to Arizona Electric Power Cooperative.

(4) The initials *AFUDC* mean or refer to allowance for funds used during construction.

(5) The initials *APS* mean or refer Arizona Public Service Company.

(6) The words *Arizona* and *State* mean the State of Arizona.

(7) The initials *BART* mean or refer to Best Available Retrofit Technology.

(8) The term *Class I area* refers to a mandatory Class I Federal area.[1]

(9) The initials *CBI* mean or refer to Confidential Business Information.

(10) The initials *CEMS* mean or refer to continuous emission monitoring system.

(11) The initials *COFA* mean or refer to close-coupled overfire air.

(12) The initials *CY* mean or refer to Calendar Year

(13) The initials *EGU* mean or refer to Electric Generating Unit.

(14) The initials *ESPs* mean or refer to electrostatic precipitators.

(15) The words *EPA*, *we*, *us* or *our* mean or refer to the United States Environmental Protection Agency.

(16) The initials *FGD* mean or refer to flue gas desulfurization.

(17) The initials *FGR* mean or refer to flue gas recirculation.

(18) The initials *FIP* mean or refer to Federal Implementation Plan.

(19) The initials *FLMs* mean or refer to Federal Land Managers.

[1] Although states and tribes may designate as Class I additional areas which they consider to have visibility as an important value, the requirements of the visibility program set forth in section 169A of the CAA apply only to "mandatory Class I Federal areas."

(20) The initials *IMPROVE* mean or refer to Interagency Monitoring of Protected Visual Environments monitoring network.

(21) The initials *IPM* mean or refer to Integrated Planning Model.

(22) The initials *LNB* mean or refer to low-NO_x burners.

(23) The initials *LTS* mean or refer to Long-Term Strategy.

(24) The initials *MW* mean or refer to megawatts.

(25) The initials *NEI* mean or refer to National Emission Inventory.

(26) The initials NH_3 mean or refer to ammonia.

(27) The initials NO_x mean or refer to nitrogen oxides.

(28) The initials *NP* mean or refer to National Park.

(29) The initials *OC* mean or refer to organic carbon.

(30) The initials *OFA* mean or refer to over fire air.

(31) The initials *PM* mean or refer to particulate matter.

(32) The initials $PM_{2.5}$ mean or refer to fine particulate matter with an aerodynamic diameter of less than 2.5 micrometers.

(33) The initials PM_{10} mean or refer to particulate matter with an aerodynamic diameter of less than 10 micrometers (coarse particulate matter).

(34) The initials *PNG* mean or refer to pipeline natural gas.

(35) The initials *ppm* mean or refer to parts per million.

(36) The initials *PSD* mean or refer to Prevention of Significant Deterioration.

(37) The initials *RAVI* mean or refer to Reasonably Attributable Visibility Impairment.

(38) The initials *RMC* mean or refer to Regional Modeling Center.

(39) The initials *RP* mean or refer to Reasonable Progress.

(40) The initials *RPG* or *RPGs* mean or refer to Reasonable Progress Goal(s).

(41) The initials *RPOs* mean or refer to regional planning organizations.

(42) The initials *SCR* mean or refer to Selective Catalytic Reduction

(43) The initials *SIP* mean or refer to State Implementation Plan.

(44) The initials *SNCR* mean or refer to Selective Non-catalytic Reduction

(45) The initials SO_2 mean or refer to sulfur dioxide.

(46) The initials *SOFA* mean or refer to separated over fire air.

(47) The initials *SRP* mean or refer to Salt River Project Agricultural Improvement and Power District.

(48) The initials *tpy* mean tons per year.

(49) The initials *TSD* mean or refer to Technical Support Document.

(50) The initials *VOC* mean or refer to volatile organic compounds.

(51) The initials *WA* mean or refer to Wilderness Area.

(52) The initials *WEP* mean or refer to Weighted Emissions Potential.

(53) The initials *WFGD* mean or refer to wet flue gas desulfurization.

(54) The initials *WRAP* mean or refer to the Western Regional Air Partnership.

II. Introduction and Background

A. Relationship of this TSD to our Proposal

EPA is proposing to partially approve and partially disapprove portions of the Arizona Regional Haze State Implementation Plan (SIP) submitted by the Arizona Department of Environmental Quality (ADEQ) on February 28, 2011. Specifically, EPA's proposed action pertains to Best Available Retrofit Technology (BART) for three electric generating stations in Arizona: Apache Generating Station, Cholla Power Plant and Coronado Generating Station. EPA is also proposing a Federal Implementation Plan (FIP) to replace the portions of the SIP it is proposing to disapprove. EPA will propose to address other facilities and other elements of the Arizona SIP in a later action.

This technical support document (TSD) is not meant to be a complete rationale for our proposed decisions; further discussion is included in the Federal Register notice for this proposed action. The TSD provides additional information concerning some of the technical bases for our proposed actions; additional information and analysis is contained in the docket. Information in this document may suggest we have made a final determination. However, all aspects of our TSD should be considered part of our proposal and are subject to change based on comments and other information we may receive during our public comment period.

B. Background on Regional Haze and BART Requirements

Good visibility is important to the enjoyment of national parks and scenic areas. Regional haze is air pollution that is transported long distances, causing reduced visibility in national parks and wilderness areas. This haze is composed of small particles that absorb and scatter light, affecting the clarity and color of what we see. The pollutants that create this haze are sulfates, nitrates, organic carbon, elemental carbon and soil dust. Human-caused (anthropogenic) sources include industry, motor vehicles, agricultural and forestry burning, and windblown dust from roads and farming practices.

There are 156 national parks and wilderness areas that have been designated by Congress as “mandatory federal Class I areas” (referred to herein as Class I areas). The Clean Air Act contains a national goal of reducing man-made visibility impairment in all Class I areas. To meet this goal, the Environmental Protection Agency (EPA) adopted the Regional Haze Rules in July 1999. These rules complement and are in addition to “Phase I” visibility rules adopted by EPA in 1980.

Our proposal regarding the Arizona RH SIP contains a general discussion of regional haze and EPA’s Regional Haze Rule (RHR), including BART. The RHR provides the following six factors that a BART determination must take into account (40 CFR 51.308(e)(1)(ii)(A)):

- the available technology to control emissions and the technical feasibility of each technology;
- the cost of compliance for the technically feasible control technologies;
- the energy and non-air quality impacts of the control technologies;
- any existing air pollution control technologies at the source;
- the remaining useful life of the source; and
- the degree of visibility improvement which may reasonably be anticipated to result from the various control technologies.

All but the first of these factors are also expressly required to be taken into account under Section 169A(g)(2) of the Clean Air Act (CAA), 42 U.S.C. § 7491(g)(2). Although we list six factors, the first factor is not always explicitly stated and the remaining factors are frequently referred to as the “five-factor analysis” for the RHR BART determination.

C. Affected Class I Areas

Arizona has twelve mandatory Class I areas, as shown in Table 1. Figure 1 shows each of the three facilities addressed by this proposed action, as well as the Class I areas located within 300 kilometers (km) of each facility. EPA’s Regional Haze guidance specifies the 300 km distance as an acceptable proxy for identifying Class I areas possibly affected by emissions from a facility. In addition to the many Class I areas in Arizona affected by these facilities’ emissions, there are several Class I areas in other states that potentially affected by these three facilities. Apache Generating Station (Apache) is within 300 kilometers of Gila Wilderness Area in New Mexico. Cholla Power Plant (Cholla) is within 300 kilometers of Capitol Reef National Park in Utah, Mesa Verde National Park in Colorado, and the Gila Wilderness Area in New Mexico. Coronado Generating Station (Coronado) is within 300 kilometers of Mesa Verde National Park in Colorado and the San Pedro Parks Wilderness Area, the Bandelier Wilderness Area, Bosque del Apache Wilderness Area, and the Gila Wilderness Area in New Mexico.

Table 1 - Arizona Class I Areas

Class I Area	Acreage
Chiricahua National Monument	11,985
Chiricahua Wilderness	87,700
Galiuro Wilderness	76,317
Grand Canyon National Park	1,218,375
Mazatzal Wilderness	252,390
Mount Baldy Wilderness	7,000
Petrified Forest National Park	93,532
Pine Mountain Wilderness	20,061
Saguaro National Park	84,000
Sierra Ancha Wilderness	20,850
Superstition Wilderness	160,200
Sycamore Canyon Wilderness	55,937

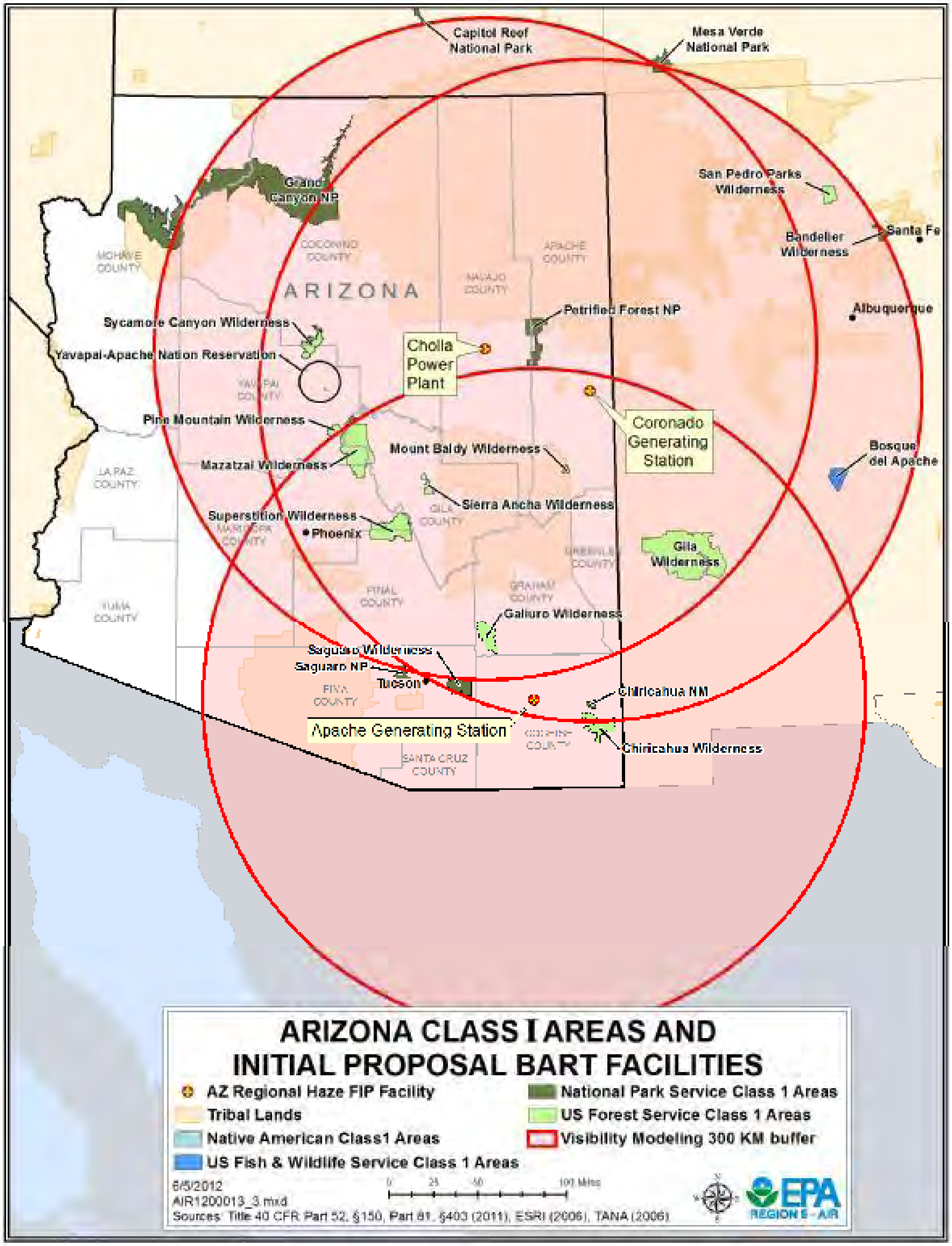

Figure 1 - Arizona Class I Areas and Initial Proposal BART Facilities

III. EPA's Evaluation of Arizona's BART Determinations

A. Arizona's Identification of BART Sources

1. ADEQ's Analysis

In the first step of the BART process, ADEQ identified all the BART-eligible sources within the jurisdiction of the State and local agencies, and applied the three eligibility criteria in the RHR (40 CFR 51.301) to these facilities. The criteria are: 1) one or more emission units at the facility are classified in one of the 26 industrial source categories listed in the BART Guidelines; 2) the emission unit(s) did not operate before August 7, 1962, but was in existence on August 7, 1977; and 3) the total potential to emit of any visibility impairing pollutant from the subject emission units is greater or equal to 250 tons per year. ADEQ determined that Apache, Cholla and Coronado have emissions units that meet these criteria.

In a second step, ADEQ identified those BART-eligible sources that may reasonably be anticipated to cause or contribute to visibility impairment at any Class I area. The BART Guidelines allow states to consider exempting some BART-eligible sources from BART review in the event that they may not reasonably be anticipated to cause or contribute to any visibility impairment in a Class I area. For states using modeling to determine the applicability of BART to single sources, the BART Guidelines note that the first step is to set a contribution threshold to assess whether the impact of a single source is sufficient to cause or contribute to visibility impairment at a Class I area. Further, the BART Guidelines state that, "[a] single source that is responsible for a 1.0 deciview change or more should be considered to 'cause' visibility impairment."[2] The BART Guidelines also state that "the appropriate threshold for determining whether a source contributes to visibility impairment' may reasonably differ across states," but, "[a]s a general matter, any threshold that you use for determining whether a source 'contributes' to visibility impairment should not be higher than 0.5 deciviews." For determining whether a source is subject to BART, ADEQ used a contribution threshold of 0.50 dv.

The WRAP's Regional Modeling Center (RMC) developed a modeling protocol, entitled "CALMET/CALPUFF Protocol for BART Exemption Screening Analysis for Class I Areas in the Western United States."[3] The protocol specified the use of CALPUFF version 6.112 and CALMET version 6.211, which were the accepted model versions at the time.[4] The WRAP RMC used this protocol to perform CALPUFF modeling for each of the western states. ADEQ then relied on the RMC's modeling to assess the potential of BART-eligible sources to cause or contribute to Class I visibility impairment. The visibility impacts of Apache, Cholla and Coronado are each well above the 0.5 dv "contribution" threshold as well as the 1.0 dv "causation" threshold.[5] As a result, ADEQ determined that emissions units at the Apache, Cholla, and Coronado facilities are subject to BART as listed in Table 2.

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[2] 70 FR 39104, 39161

[3] See Docket Item B-15.

[4] EPA subsequently required the uses of CALPUFF and CALMET version 5.8 for new modeling applications. However, EPA is accepting BART modeling performed according to a previously approved protocol, as was the case for the WRAP protocol.

[5] See Docket Item No. B-12. Visibility impacts as listed in "Summary of WRAP RMC BART Modeling for Arizona" Draft No. 5, May 7, 2005. Initial draft released on April 4, 2005.

Table 2 - Sources Subject to BART

Facility	BART Emission Units	Source Category	Pollutants Evaluated	WRAP Modeled Impact[a]
AEPCO Apache Generating Station	Units 1, 2, and 3	Fossil-fuel fired steam electric plants of more than 250 million British thermal units per hour heat input	NO_x, SO_2, PM_{10}	1.95 dv
APS Cholla Power Plant	Units 2, 3, and 4		NO_x, SO_2, PM_{10}	2.88 dv
SRP Coronado Generating Station	Units 1 and 2		NO_x, SO_2, PM_{10}	3.32 dv

[a] Average of the 98th percentile across 2001, 2002 and 2003 for the most affected Class I Area.

2. EPA's Evaluation

We are proposing to approve ADEQ's determination that Apache, Cholla, and Coronado are eligible for and subject to a BART control analysis. Each of the three facilities addressed in this notice (Apache, Cholla and Coronado) agreed with ADEQ's determination that they are subject to BART. While we do not agree with all aspects of the process by which ADEQ identified its eligible-for-BART and subject-to-BART sources, we do agree with ADEQ that the three facilities in this notice are eligible for and subject to BART. Since our action today focuses on only the three facilities, we will address ADEQ's other subject-to-BART determinations in a separate action at a later date.

B. Arizona's BART Control Analysis

The third step of the BART evaluation is to perform a five-factor BART analysis as the basis for making a BART control determination. In performing this analysis, 40 CFR 51.308(e)(1)(ii)(A) requires that states consider the following factors on a pollutant-by-pollutant basis: (1) The costs of compliance of each technically feasible control technology, (2) the energy and non-air quality environmental impacts of compliance of the control technologies, (3) any existing pollution control technology in use at the source, (4) the remaining useful life of the source, and (5) the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology. These factors are frequently referred to as the "five-factor analysis" for the RHR BART determination.

The BART Guidelines recommend that a BART analysis include the following five steps. The Guidelines provide detailed instructions on how to perform each of these steps.[6]

Step 1—Identify All Available Retrofit Control Technologies,
Step 2—Eliminate Technically Infeasible Options,
Step 3—Evaluate Control Effectiveness of Remaining Control Technologies,
Step 4—Evaluate Impacts and Document the Results,[7] and
Step 5—Evaluate Visibility Impacts.

[6] 40 CFR Part 51, Appendix Y, § IV.D.
[7] Step 4 includes evaluating the cost of compliance, energy impacts, non-air quality environmental impacts, and remaining useful life.

1. ADEQ's Analysis

ADEQ's BART analyses mostly followed this approach, with the addition of a step to identify existing control technologies and a step concluding "selection of BART."[8] Thus, ADEQ's analyses included the following seven steps:

Step 1: Identify the Existing Control Technologies in Use at the Source
Step 2: Identify All Available Retrofit Control Options
Step 3: Eliminate All Technically Infeasible Control Options
Step 4: Evaluate Control Effectiveness of Remaining Technologies
Step 5: Evaluate the Energy and Non-Air Quality Environmental Impacts and Document Results[9]
Step 6: Evaluate Visibility Impacts
Step 7: Select BART

2. EPA's Evaluation

We find that this overall approach to the five-factor analysis is generally reasonable and consistent with the RHR and the BART Guidelines. With respect to the three sources covered by this action, we find that ADEQ's implementation of the first four steps of its approach is generally reasonable and consistent with the RHR and the BART Guidelines. However, we do not agree with ADEQ's analysis in steps 5 through 7.[10] In particular, under step 5, we find that the costs of control were not calculated in accordance with the BART Guidelines; under step 6, we find that the visibility impacts were not appropriately evaluated and considered; and under step 7, we find that ADEQ did not provide a sufficient explanation and rationale for its determinations. While we find these problems in all of ADEQ's BART analyses for the three sources, they do not appear to have had a substantive impact on ADEQ's selection of controls for SO_2 and PM_{10}. With respect to ADEQ's NO_x BART determinations, however, we find that these problems resulted in control determinations that are inconsistent with the RHR and the BART Guidelines. We summarize below how ADEQ applied the five factors and identify a number of issues common to the three relevant sources.

a) Cost of Compliance

ADEQ included information relating to costs of compliance in its RH SIP, including information on total annualized costs, cost per ton of pollutant removed, and incremental cost per ton of pollutant removed for the various control options considered. Cost calculations were prepared by consulting firms on behalf of the facilities as part of their BART analyses that relied on a combination of vendor quotes, facility data, and internal cost calculation methodology. These BART analyses were subsequently submitted to ADEQ. Upon review, ADEQ requested certain clarifying information from the facilities regarding these cost calculations, including greater detail on the underlying assumptions and additional supporting documentation. ADEQ received responses of varying detail to these requests, and included this information as part of its RH SIP. As described in further detail in the discussion of each facility, there are certain aspects

[8] Arizona Regional Haze SIP, pp. 138-143.
[9] We note that, while ADEQ refers to its Step 5 as an evaluation of energy and non-air quality environmental impacts, this step also includes consideration of the costs of compliance and the remaining useful life of the source, consistent with the BART Guidelines, 40 CFR Part 51, Appendix Y, § IV.D.4.
[10] We do not believe that ADEQ appropriately used "the most stringent emission control level that the technology is capable of achieving" for SCR per the BART Guidelines at 40 CFR Part 51, Appendix Y, § IV.D.3. This issue is addressed on a source-by-source basis under the cost and visibility factors of our evaluation in section VI.C.

of these cost calculations that we find inconsistent with the BART Guidelines and EPA's Control Cost Manual. We also disagree with the manner in which ADEQ interpreted the cost-related information included in its RH SIP.

b) Energy and Non-air Quality Environmental Impacts

In its BART analyses, ADEQ identified only minor energy and non-air quality impacts for SO_2 or PM_{10} control strategies. Regarding NO_x emissions, ADEQ's BART analyses point out that the various control options will incur increased energy usage by any electric generating unit (EGU) where they are installed. In particular, Selective Catalytic Reduction (SCR) retrofit will cause an additional pressure drop in the flue gas system due to the catalyst, increasing power requirements. Additionally, ADEQ's SIP submission asserts that ammonia levels in fly ash due to Selective Non-catalytic Reduction (SNCR) and SCR installations could affect the decision of facility managers to sell or dispose of fly ash.[11] Finally, the Arizona SIP notes that SNCR and SCR may involve potential safety hazards associated with the transportation and handling of anhydrous ammonia.[12] However, ADEQ did not cite any of these potential energy and non-air impacts as the basis for eliminating any otherwise feasible control strategies for NO_x. EPA concurs that these impacts do not warrant elimination of any of the control options.

c) Existing Pollution Control Technology

The presence of existing pollution control technology is reflected in the BART analysis in two ways: first, in the consideration of available control technologies (step 1 of ADEQ's analysis), and second, in the development of baseline emission rates for use in cost calculations and visibility modeling (steps 5 and 6 of ADEQ's analysis). As described in greater detail in the discussion for each facility, AEPCO, APS, and SRP used baseline time periods that varied from 2001 to 2007. The respective baseline emissions and existing pollution control technology used in the BART analyses reflect the levels of control in place at the time. EPA considers ADEQ's approach to be reasonable and generally consistent with the RHR and the BART Guidelines.

d) Remaining Useful Life of the Source

The remaining useful life of the source is usually considered as a quantitative factor in estimating the cost of compliance. With the exception of Apache Generating Station Unit 1, ADEQ used the default 20-year amortization period in the EPA Cost Control Manual as the remaining useful life of the facilities in its RH SIP. Without commitments for an early shut down of an EGU, it is not appropriate to consider a shorter amortization period in a BART analysis.

e) Degree of Visibility Improvement

ADEQ assessed the degree of improvement in visibility from candidate BART technologies using models and procedures generally in accord with EPA guidance. ADEQ relied on visibility analysis performed by the facilities, which used the WRAP RMC's modeling protocol. However, ADEQ's use of the modeling results in making BART decisions is problematic in several respects. First, ADEQ appears to have considered the visibility benefit of controls at only a single Class I area for each facility, even though there are nine to seventeen Class I areas nearby, depending on the facility. Since the facilities' modeling results indicated that controls would contribute to visibility improvement in multiple Class I areas, consideration

[11] Arizona Regional Haze SIP, Appendix D, p. 63.
[12] See, e.g. *id.* p. 53.

of the benefits in additional areas is warranted. Although the RHR and the BART Guidelines do not prescribe a particular approach to calculating or considering visibility benefits across multiple Class I areas, overlooking significant visibility benefits at additional areas considerably understates the overall benefit of controls to improve visibility. A more complete assessment of the degree of visibility improvement for candidate BART controls would include consideration of the number of areas affected and the degree of visibility improvement expected in all areas. One could conduct this type of analysis by summing the benefits over the areas, or by some other quantitative or qualitative procedure.[13] The procedure followed by ADEQ is not a sufficient basis for making BART determinations for sources with substantial benefits across many Class I areas.

Second, ADEQ appears to have considered benefits from controls on only one emitting unit at a time. However, because the plumes from individual units overlap more or less completely by the time they reach a Class I area, the visibility benefits from controls on multiple units would be approximately additive. This issue of additive unit benefits could be addressed in some way without modeling all the units together, but ADEQ does not appear to have done this, and therefore underestimated the degree of visibility improvement from controls.

Finally, the ammonia background concentration assumed for Cholla and Coronado may be too low, ranging from 1 ppb to as low as 0.2 ppb. Nitrogen oxides and SO_2 emissions affect visibility after chemically transforming into particulate ammonium nitrate and ammonium sulfate, respectively. This process is limited by the amount of ammonia present, so modeling with a low assumed ammonia background may underestimate visibility impacts and thus the visibility benefit of controls. Ambient ammonia measurements for use as input to modeling are scarce, and measurements that include it in the form of ammonium even scarcer. In the absence of compelling ammonia background estimates, EPA guidance recommends the use of a 1 ppb ammonia background for areas in the west.[14]

C. Arizona's BART Determinations

Our evaluation of ADEQ's BART determinations is organized by source, unit and pollutant with a focus on the cost and visibility factors of the BART analysis. A summary of the State's BART determinations for the three sources is in Table 3. ADEQ's BART determinations for NO_x consist of combustion controls, either in the form of low-NO_x burners (LNB) with flue gas recirculation (FGR), or LNB with overfire air (OFA) or separated overfire air (SOFA). For PM_{10}, ADEQ's BART determinations consist of fuel switching to pipeline natural gas (PNG) for Apache Unit 1, and add-on particulate controls such as electrostatic precipitators (ESPs) or fabric filters for the remaining units. For SO_2, ADEQ's BART determinations consist of fuel-switching to PNG for Apache Unit 1, and wet flue gas desulfurization (FGD) systems that are either already in place or planned for the remaining units.

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[13] Note that the issue here is not whether an individual in a given time and place would perceive the deciview benefits occurring at different Class I areas and under possibly different meteorological conditions. Rather, the issue is accounting in some way for the full set of expected visibility benefits. A national program for addressing regional haze must inherently address the multiple areas that occur in a region.

[14] Interagency Workgroup On Air Quality Modeling (IWAQM) Phase 2 Summary Report And Recommendations For Modeling Long Range Transport Impacts (EPA-454/R-98-019), EPA OAQPS, December 1998, **http://www.epa.gov/scram001/7thconf/calpuff/phase2.pdf**

Table 3 - Summary of Arizona's BART Determinations

Unit	Size (MW)	Fuel	NO_x		PM_{10}		SO_2	
			Control Technology	Emission Limit*	Control Technology	Emission Limit*	Control Technology	Emission Limit*
Apache 1	75	Natural Gas	LNB w/ FGR, PNG use	0.056	PNG use	0.0075	PNG use	0.00064
Apache 2	195	Coal	LNB w/ OFA	0.31	ESP (upgraded)	0.03	Wet FGD (existing)	0.15
Apache 3	195	Coal	LNB w/ OFA	0.31	ESP (upgraded)	0.03	Wet FGD (existing)	0.15
Cholla 2	305	Coal	LNB w/ SOFA	0.22	Fabric filter	0.015	Wet FGD (existing)	0.15
Cholla 3	305	Coal	LNB w/ SOFA	0.22	Fabric filter (existing)	0.015	Wet FGD (existing)	0.15
Cholla 4	425	Coal	LNB w/ SOFA	0.22	Fabric filter (existing)	0.015	Wet FGD (existing)	0.15
Coronado 1	411	Coal	LNB w/ OFA	0.32	Hot-side ESP	0.03	Wet FGD (per Consent Decree)	0.08
Coronado 2	411	Coal	LNB w/ OFA	0.32	Hot-side ESP	0.03	Wet FGD (per Consent Decree)	0.08

*Emission limits are in lb/MMBtu

1. AEPCO Apache Generating Station Unit 1

Apache consists of seven EGUs with a total plant-wide generating capacity of 560 megawatts. Unit 1 is a wall-fired boiler with a net unit output of 85 MW that burns pipeline-quality natural gas as its primary fuel, but also has the capability to use No. 2 through No. 6 fuel oils. At present, no emissions control equipment is installed on Unit 1. ADEQ's BART analyses for Apache Unit 1 relied largely on data and analyses provided by AEPCO and its contractor. These data and analyses are summarized below, along with ADEQ's determinations for each pollutant and EPA's evaluations of these analyses and determinations.

a) BART for NO_x

(1) ADEQ's Analysis

Unit 1 currently operates with no NO_x controls. In its BART analysis submitted to ADEQ, AEPCO developed baseline emissions for multiple fuel-use scenarios including natural gas, and No. 2 and No. 6 fuel oil usage. Baseline natural gas emissions were based on the highest 75 percent load 24-hour NO_x emission levels reported in EPA's Acid Rain Database for 2006. Since the only fuel burned in 2006 was natural gas, baseline emissions for No. 2 or No. 6 fuel oil usage could not be developed based on data from 2006. As a conservative simplifying assumption, baseline No. 2 fuel oil NO_x emissions were assumed to be equal to natural gas usage. Baseline emissions for No. 6 fuel oil usage were estimated using AP-42 emission factors.[15] A summary of baseline emissions for various fuels is provided in Table 4.

Table 4 - Apache Unit 1: Arizona's Baseline Emission Factors[a]

Pollutant	Natural Gas (lb/MMBtu)	No. 2 Fuel Oil	No. 6 Fuel Oil
NO_x	0.147	0.147	0.301
PM_{10}	0.0075	0.014	0.0737
SO_2	0.00064	0.051	0.906

[a] See Docket Item B-02 (Table 3-1 of AEPCO Apache 1 BART Analysis)

AEPCO examined multiple control technologies and options for Apache Unit 1, including combustion controls, post combustion add-on controls, and fuel-switching. A summary of cost of compliance and degree of visibility improvement for these options is in

Table 5. These cost and visibility improvement values are based on baseline and control case emissions corresponding to No. 6 fuel oil usage, which of the three fuels considered is the fuel type that generates the greatest NO_x emissions.

Table 5 - Apache Unit 1: Arizona's Cost and Visibility Analysis for NOx

Control Option[b]	Emission Rate (lb/MMBtu)	Emissions Removed (tons/yr)	Annualized Cost ($/year)	Cost-effectiveness[d] ($/ton)		Visibility Improvement[c] (dv)	
				Average	Incremental (from previous)	Total (from base case)	Incremental (from previous)
Baseline	0.301	--	--	--	--	--	--
LNB + FGR	0.15	297	551,982	1,859	--	0.194	--
ROFA	0.16	278	939,093	3,378	-20,374	0.256	0.062
SNCR with LNB + FGR	0.11	376	1,079,389	2,871	1,432	0.24	-0.016
ROFA w/ Rotamix	0.11	376	1,505,825	4,005	NA[a]	0.24	NA[a]
SCR with LNB + FGR	0.07	455	5,704,798	12,538	53,152	0.409	0.169

[a] The previous option, SNCR with LNB + FGR has the same emission rate, making an incremental comparison invalid.

[b] Per ADEQ's and AEPCO's analyses, control options are ranked here by cost, not by emission rate

[c] Visibility improvement at Chiricahua Wilderness Area, the Class I area exhibiting the highest impact

[d] Cost-effectiveness values obtained from Table 10.3, Appendix D (TSD) of Arizona RH SIP. See Docket Item B-01.

In its cost calculations for Apache Unit 1, AEPCO used a capital recovery factor based on a 7.10 percent interest rate, and a plant remaining useful life of eight years.[16] The plant's remaining useful life was based upon Apache Unit 1 operating until 2021, and an assumed

[15] See Docket Item B-2. Page 2-1 of AEPCO Apache 1 BART Analysis

[16] See Docket Item B-02. Appendix A (Economic Analysis) of AEPCO Apache 1 BART Analysis.

BART implementation date of 2013.[17] AEPCO eliminated many control options, including SCR, based on high cost-effectiveness ($/ton), and primarily examined the LNB w/ FGR and ROFA control options. AEPCO noted that LNB with FGR resulted in larger incremental visibility improvement than ROFA, and proposed LNB with FGR, burning either natural gas or fuel oil, as BART for NO_x at Apache Unit 1.

In order to evaluate AEPCO's BART analysis, ADEQ requested supporting information explaining assumptions used in the economic analysis, baseline emissions, and control technology options. Based on this additional information, as well as on AEPCO's original analysis, ADEQ accepted the company's proposed BART recommendation of LNB with FGR for Unit 1, but added a fuel restriction to allow only the use of natural gas. This determination corresponds to a BART emission limit for NO_x at Apache Unit 1 of 0.056 lb/MMBtu.[18]

(2) EPA's Evaluation

We disagree with multiple aspects of the analysis for Apache Unit 1. We consider the use of eight years for the plant's remaining useful life in the control cost calculations as unjustified in the absence of documentation that the unit will shut down in 2021. We also note that control cost calculations include costs that are disallowed by EPA's Control Cost Manual, such as owner's costs and AFUDC. Both of these elements have the effect of inflating cost calculations and thus the cost-effectiveness of the various control options considered. In addition, we do not consider using identical baseline emissions for No. 2 fuel oil and natural gas appropriate, although this likely did not affect either AEPCO's or ADEQ's BART determination, which was informed primarily by emission estimates based on No. 6 fuel oil, the highest emitting fuel.

By including a natural gas-only fuel restriction, ADEQ's BART determination of LNB with FGR results in a NO_x emissions limit of 0.056 lb/MMBtu, which is more stringent than any of the control options that AEPCO and ADEQ considered in conjunction with No. 6 or No. 2 fuel oil. Neither AEPCO's nor ADEQ's analysis, however, included visibility modeling for control options on a natural gas-only basis. The absence of such information does not allow us to fully evaluate if options more stringent than LNB with FGR are appropriate on a natural gas-only basis. Nevertheless, we are proposing to approve ADEQ's NO_x BART determination of LNB with FGR (natural gas usage only) with an emission limit of 0.056 lb/MMBtu for Apache Unit 1.

b) BART for PM_{10}

(1) ADEQ's Analysis

Apache Unit 1 currently operates with no PM_{10} controls. In its BART analysis submitted to ADEQ, AEPCO developed baseline emissions for multiple fuel use scenarios including natural gas, and No. 2 and No. 6 fuel oil usage. Baseline PM_{10} emissions for all fuels were calculated based on AP-42 emission factors.[19] A summary of these emissions is in Table 4.

AEPCO examined multiple control options for PM_{10} at Apache Unit 1, including add-on controls and fuel switching. A summary of cost of compliance and degree of visibility improvement for

[17] See Docket Item B-02. Page 2-1 of AEPCO Apache 1 BART Analysis

[18] See Docket Item B-01. Emission rate as specified in Table 10.2, Appendix D (Technical Support Document) of Arizona Regional Haze SIP

[19] See Docket Item B-02, Page 2-1 of AEPCO Apache 1 BART Analysis.

these options is summarized in Table 6. These cost and visibility improvement values are based on baseline and control case emissions corresponding to No. 6 fuel oil usage, which of the three fuels considered generates the greatest PM_{10} emissions. In its BART analysis, AEPCO cited high costs of compliance and minimal visibility improvements for the PM_{10} control options, and proposed no PM_{10} controls as BART for PM_{10}, using either natural gas or No. 2 fuel oil. Based on the data and analysis provided by AEPCO, ADEQ determined that BART for PM_{10} at Apache Unit 1 is no additional controls, but also determined that a fuel restriction to allow only the use of natural gas was appropriate. This corresponds to a PM_{10} BART emission limit for Apache Unit 1 of 0.0075 lb/MMBtu.[20]

Table 6 - Apache Unit 1: Arizona's Cost and Visibility Analysis for PM10

Control Option	Emission Rate (lb/MMBtu)	Emissions Removed (tons/yr)	Annualized Cost ($/year)	Cost-effectiveness[a] ($/ton)		Visibility Improvement[b] (dv)	
				Average	Incremental (from previous)	Total (from base case)	Incremental (from previous)
Baseline	0.0737	--	--	--	--	--	--
Fabric Filter	0.015	116	3,615,938	31,172	--	0.010	--
Fuel switch to PNG	0.0075	--	0	--	--	--	--

[a] Cost-effectiveness values as reported in Table 10.6, Appendix D (TSD) of Arizona RH SIP. See Docket Item B-01.
[b] As summarized in Table 5-12, AEPCO Apache 1 BART Analysis. See Docket Item B-02. Visibility improvement at Chiricahua Wilderness Area, the Class I area exhibiting the highest impact

(2) EPA's Evaluation

ADEQ's PM_{10} analysis includes many of the same issues we noted in its NO_x analysis, including the use of an eight-year plant remaining useful life, and inclusion of costs that are disallowed by EPA's Control Cost Manual. Although we do not agree with elements of ADEQ's PM_{10} BART analysis for Apache Unit 1, we find that its conclusion is reasonable, given the small visibility improvement projected to result from PM_{10} reductions at this Unit. Thus, we are proposing to approve ADEQ's PM_{10} BART determination for Apache Unit 1.

c) BART for SO_2

(1) ADEQ's Analysis

Apache Unit 1 currently operates with no SO_2 controls. In its BART analysis submitted to ADEQ, AEPCO developed baseline emissions for multiple fuel use scenarios including natural gas, and No. 2 and No. 6 fuel oil. Baseline natural gas emissions were based upon the highest 75 percent load 24-hour SO_2 emission levels reported in EPA's Acid Rain Database for 2006. Since the only fuel burned in 2006 was natural gas, baseline emissions for No. 2 or No. 6 fuel oil usage could not be developed based on data from 2006. Baseline emissions for No. 2 and

[20] See Docket Item B-01. Emission rate as specified in Table 10.5, Appendix D (Technical Support Document) of Arizona Regional Haze SIP

No. 6 fuel oil usage were estimated using AP-42 emission factors.[21] A summary of these emissions is summarized in Table 4.

AEPCO also examined multiple control options for SO_2 on Apache 1, including add-on controls and fuel-switching. A summary of cost of compliance and degree of visibility improvement for these options is summarized in Table 7. These cost and visibility improvement values are from baseline and control case emissions corresponding to No. 6 fuel oil usage, which is the fuel type that generates the greatest SO_2 emissions. In its BART analysis, AEPCO cited high costs of compliance and minimal visibility improvements for the SO_2 control options, and proposed no additional SO_2 controls, using either natural gas or No. 2 fuel oil, as BART for SO_2. ADEQ determined that BART for SO_2 is no additional controls, but added a fuel restriction to allow only the use of natural gas. This corresponds to an SO_2 BART emission limit for Apache Unit 1 of 0.00064 lb/MMBtu.[22]

Table 7 - Apache Unit 1: Arizona's Cost and Visibility Analysis for SO2

Control Option	Emission Rate (lb/MMBtu)	Emissions Removed (tons/yr)	Annualized Cost ($/year)	Cost-effectiveness[a] ($/ton)		Visibility Improvement[b] (dv)	
				Average	Incremental (from previous)	Total (from base case)	Incremental (from previous)
Baseline	0.906	--	--	--	--	--	--
Fuel switch to low-sulfur fuel oil	0.051	--	--	--	--	--	--
Spray dryer absorber (dry FGD)[1]	0.10	1,587	3,881,706	2,446	--	0.765	--
Fuel switch to PNG	0.00064	--	0	--	--	--	--

[a] Cost-effectiveness values as reported in Table 10.8, Appendix D (TSD) of Arizona RH SIP. See Docket Item B-01.

[b] As summarized in Table 5-12, AEPCO Apache 1 BART Analysis. See Docket Item B-02. Visibility improvement at Chiricahua Wilderness Area, the Class I area exhibiting the highest impact.

(2) EPA's Evaluation

The SO_2 analysis includes many of the same issues we noted in the NO_x analysis, including the use of an eight-year plant remaining useful life, and inclusion of costs that are disallowed by EPA's Control Cost Manual. ADEQ's BART determination, requiring the use of only natural gas, results in an SO_2 emission limit of 0.00064 lb/MMBtu. This emission rate is more stringent than any of the control options that ADEQ considered in conjunction with No. 6 fuel oil. We are proposing to approve ADEQ's BART determination for SO_2 as an emission limit of 0.00064 lb/MMBtu at Apache Unit 1.

[21] See Docket Item B-02. Page 2-2 of AEPCO Apache 1 BART Analysis

[22] See Docket Item B-01. Emission rate as specified in Table 10.7, Appendix D (Technical Support Document) of Arizona Regional Haze SIP

2. Apache Units 2 and 3

Apache Units 2 and 3 are both dry-bottom, Riley Stoker turbo-fired boilers, each with a gross unit output of 204 MW. Both units are BART-eligible and are coal-fired boilers operating on sub-bituminous coal. Although there are physical differences between the two units, ADEQ found that the overall differences are minimal and therefore considered both units together in its BART analysis. As with Apache Unit 1, ADEQ's analysis relied largely on information provided by AEPCO and its contractor. This information is summarized below, along with ADEQ's determinations for each pollutant and EPA's evaluation.

While the following sections describe both ADEQ's and EPA's evaluations based on the information in the record, we note that we received additional information from AEPCO on June 29, 2012, related to the affordability of NO_x controls at Apache. AEPCO states that affordability is affected by its small size, the low income profiles of AEPCO's service area, and AEPCO's ability to access financing. While this information came in too late to be evaluated as part of this proposed rulemaking, EPA has put the information in the docket and will evaluate it during the public comment period.[23]

a) BART for NO_x

(1) ADEQ's Analysis

AEPCO developed baseline NO_x emissions by examining the average NO_x emissions from 2002 to 2007, a time period in which both units were equipped with OFA as NO_x emission controls.[24] AEPCO examined several NO_x control technologies, including combustion controls and add-on post-combustion controls. A summary of Arizona's costs of compliance and visibility impacts associated with these options is presented in Table 8. ADEQ relied on this information from the facility to develop its RH SIP.[25] Estimates of control technology emission rates were developed based on a combination of vendor quotes, contractor information, and internal AEPCO information regarding environmental upgrades.[26] Annual emission reductions were calculated based on the emission rate estimates combined with annual capacity factors as specified by AEPCO.[27] Control costs were developed based on a combination of vendor quotes and contractor information. These cost calculations provided line item summaries of capital costs and annual operating costs, but did not include further supporting information such as detailed equipment lists, vendor quotes, or the design basis for line item costs.

[23] See Docket Item C-16, Letter from Michelle Freeark (AEPCO) to Deborah Jordan (EPA), AEPCO's Comments on BART for Apache Generating Station, June 29, 2012.

[24] See Docket Item B-03 and B-04, AEPCO Apache BART Analyses, page 2-2.

[25] See Docket Item B-03 and B-04, AEPCO Apache BART Analyses. This information is also summarized in Docket Item B-01, Arizona Regional Haze SIP, Appendix D, Tables 10.10 through 10.13

[26] As listed in Table 3-2, Docket Items B-03 and B-04, AEPCO Apache BART Analyses.

[27] As listed in Table 2-1, Docket Items B-03 and B-04. Annual capacity factors used for each unit are 92% (Apache 2), and 87% (Apache 3)

Table 8 - Apache Units 2 and 3: Arizona's Cost and Visibility Summary

Control Option	Emission Rate (lb/MMBtu)	Emissions Removed (tons/yr)	Annualized Cost ($/year)	Cost-effectiveness ($/ton)		Visibility Improvement[a] (deciviews)		Cost per Total Deciview Improvement ($/dv)
				Average	Incremental (from previous)	Total (from baseline)	Incremental (from previous)	
Apache Unit 2								
OFA (baseline)	0.47	--	--	--	--	--	--	--
LNB + OFA	0.31	1,305	$533,000	$408	--	0.267	--	$1,996,000
ROFA	0.26	1,710	$1,664,000	$973	$305	0.359	0.092	$4,636,000
SNCR + LNB + OFA	0.23	1,953	$1,738,000	$890	$1,860	0.416	0.057	$4,532,000
ROFA w/ Rotamix	0.18	2,358	$2,225,000	$944	$866	0.491	0.075	$4,177,000
SCR + LNB + OFA	0.07	3,250	$6,102,000	$1,878	$4,346	0.676	0.185	$9,028,000
Apache Unit 3								
OFA (baseline)	0.43	--	--	--	--	--	--	
LNB + OFA	0.31	926	$532,808	$575	--	0.206	--	$2,586,000
ROFA	0.26	1,312	$1,643,241	$1,252	$322	0.298	0.092	$5,484,000
SNCR + LNB + OFA	0.23	1,543	$1,717,633	$1,113	$1,920	0.356	0.058	$5,004,000
ROFA w/ Rotamix	0.18	1,929	$2,181,833	$1,131	$873	0.436	0.080	$4,825,000
SCR + LNB + OFA	0.07	2,778	$6,062,301	$2,182	$4,571	0.633	0.197	$9,577,000

[a] At the Class I area exhibiting the greatest baseline visibility impact, Chiricahua Wilderness Area

Regarding visibility impacts, ADEQ relied on visibility modeling submitted by AEPCO to evaluate the visibility improvement attributable to each of the NO_x control technologies that it considered. This visibility modeling was performed using three years of meteorological data (2001 to 2003), and was generally performed in accordance with the WRAP modeling protocol. The average of the three 98th percentiles from the modeled years 2001 to 2003 was used as the visibility metric for each emission scenario and Class I area. For assessing the degree of visibility improvement, ADEQ considered only the visibility benefits at the area with the highest base case (pre-control) impact: Chiricahua National Monument and Chiricahua Wilderness Area (two nearby Class I areas served by one air monitor). For each control, ADEQ listed visibility improvement in deciviews, and cost in millions of dollars per deciview improvement.[28] Results are comparable for both units, with Unit 2 showing somewhat higher visibility benefits and somewhat lower cost per improvement than Unit 3. Unit 2 visibility improvements range from 0.27 dv for LNB to 0.68 dv for SCR, while the costs per deciview range from $2 million for LNB to over $9 million for SCR. ADEQ concluded that LNBs with the existing OFA systems represent BART for Units 2 and 3, though no explicit reasoning is provided for the selection.

In making this determination, ADEQ did not provide adequate information regarding its rationale or weighing of the five factors. ADEQ stated only that "(A)fter reviewing the company's BART analysis, and based upon the information above, ADEQ has determined that, for Units 2 and 3 BART for NO_x is new LNBs and the existing OFA system with a NO_x emissions limit of 0.31 lb/MMBtu…"[29]

(2) EPA's Evaluation

We disagree with several aspects of the NO_x BART analysis for Apache Units 2 and 3. The control cost calculations included line item costs not allowed by the EPA Control Cost Manual, such as owner's costs, surcharge, and AFUDC. Inclusion of these line items has the effect of inflating the total cost of compliance and the cost per ton of pollutant reduced.

Regarding visibility improvement, as shown in Table 8, ADEQ chose LNB as BART, which provides the lowest visibility benefit of any of the controls modeled. By contrast, SCR would provide an improvement of more than 0.5 dv at a single Class I Area, and a substantial incremental benefit relative to the next more stringent control, ROFA-Rotamix. Multiple Class I areas have comparable benefits. The visibility benefits are larger than those listed, if both Units 2 and 3 are considered together. (See Tables 20 and 21 below for EPA's visibility results.) The SCR cost per deciview of improvement is lower than those for Cholla and Coronado, as indicated below in their respective sections.

ADEQ provides little explicit reasoning about the visibility basis for the BART selection. For example, there is no weighing of visibility benefits and visibility cost-effectiveness for the various candidate controls and the various Class I areas. The modeling results show that controls more stringent than LNB appear to be needed to give substantial visibility benefits. Visibility impacts at eight nearby Class I areas were not considered, and the visibility benefits of simultaneous controls on both units were not considered. For these reasons, EPA believes that

[28] Arizona SIP submittal, "Appendix D: Arizona BART – Supplemental Information", p.65.
[29] Docket Item B-01, Arizona Regional Haze SIP, Appendix D, Page 65.

ADEQ gave insufficient consideration to the visibility benefits of the various NO_x control options available at Apache Units 2 and 3.

In summary, we find that ADEQ has not provided an adequate justification for adopting LNB with OFA as the "best" level of control.[30] Although ADEQ has developed information regarding each of the five factors, there are problems in both its cost and visibility analyses as described above. Moreover, ADEQ's BART analysis does not explain how it weighed these factors. For example, ADEQ did not indicate whether or not it considered any cost thresholds to be reasonable or expensive in analyzing the costs of compliance for the various control options. We note that ADEQ has made similar NO_x BART determinations of LNB with OFA at other facilities, such as Cholla Power Plant. Although ADEQ's BART determinations for these other facilities implied that cost of compliance was an important consideration, it does not provide a rationale for this selection of NO_x BART.[31] Thus, we are proposing to disapprove ADEQ's BART determination for NO_x at Apache Units 2 and 3, since it does not comply with 40 CFR 51.308(e)(1)(ii)(A).

b) BART for PM_{10}

(1) ADEQ's Analysis

The existing PM_{10} controls on Apache Units 2 and 3 are hot-side Electrostatic Precipitators (ESPs).[32] AEPCO and ADEQ considered three potential retrofit control options for PM_{10}:

- Performance upgrades to existing hot-side ESP,
- Replacement of current ESP with a fabric filter, and
- Installation of a polishing fabric filter after ESP.

ADEQ found that all of these options are technically feasible and estimated their associated emission rates as shown in Table 9.

Table 9 - Apache Units 2 and 3: Arizona's Controls and Emission Rates for PM10

Control Technology	Expected PM_{10} Emission Rate
ESP Upgrades	0.03 lb/MMBtu
Full Size Fabric Filter	0.015 lb/MMBtu
Polishing Fabric Filter	0.015 lb/MMBtu

ADEQ found that a fabric filter, whether in addition to or as replacement for the ESP, would require additional energy, but did not identify any non-air environmental impacts from any of the

[30] See BART Guidelines, § IV.E.2.
[31] We do note, however, that AEPCO does provide some additional analysis on this position in the Apache BART analyses it submitted to ADEQ. Aside from stating that it reviewed AEPCO's analysis, ADEQ did not specifically reference or include any aspects of AEPCO's analysis in the RH SIP. As a result, we are not assuming that ADEQ necessarily agrees with AEPCO's rationale, and have therefore not provided an evaluation of it.
[32] See Appendix D, pages 65-69 for ADEQ's BART Analysis for PM_{10} at Apache Units 2 and 3. See AEPCO Apache Unit 2 BART Analysis.

three options. The cost of compliance and degree of visibility improvement for each of these options, as analyzed by ADEQ, are summarized in Table 10 and Table 11.

Table 10 - Apache Unit 2: Arizona's Control Cost of Visibility Reduction for PM10

Control	Deciview Reduction	Total Annualized Cost (Million $)	Cost per Deciview Reduced (Million $/dv)	Average Cost ($/ton)
ESP Upgrades	Unknown	Unknown	Unknown	Unknown
Polishing Fabric Filter	0.085	$2.217	$26.09	$9,121
Full Size Fabric Filter	0.085	$2.888	$33.98	$11,880

Table 11 - Apache Unit 3: Arizona's Control Cost of Visibility Reduction for PM10

Control	Deciview Reduction	Total Annualized Cost (Million $)	Cost per Deciview Reduced (Million $/dv)	Average Cost ($/ton)
ESP Upgrades	Unknown	Unknown	Unknown	Unknown
Polishing Fabric Filter	0.094	$2.192	$23.32	$9,471
Full Size Fabric Filter	0.094	$2.869	$30.52	$12,390

Based on its analysis of the five BART factors, as summarized above, ADEQ found BART for PM_{10} is upgrades to the existing ESP and a PM_{10} emissions limit of 0.03 lb/MMBtu for Units 2 and 3. In particular, ADEQ referred to installation of a flue gas conditioning system, improvements to the scrubber bypass damper system, and implementation of programming optimization measures for ESP automatic voltage controls as potential upgrades. ADEQ also noted that "PM_{10} emissions will be measured by conducting EPA Method 201/202 tests."

(2) EPA's Evaluation

As noted above, AEPCO's and ADEQ's control cost calculations include costs that are disallowed by EPA's Control Cost Manual, such as owner's costs and AFUDC.[33] In addition, AEPCO's and ADEQ's analyses do not demonstrate that all potential upgrades to the existing ESP were fully evaluated. Nonetheless, based on the small visibility improvement associated with PM_{10} reductions from these units (e.g., less than 0.1 dv improvement from the most stringent technology), we conclude that additional analyses of control options would not result in a different BART determination. As a result, we propose to approve ADEQ's PM_{10} BART determination at Apache Units 2 and 3.

[33] See AEPCO BART Analysis Technical Memorandum dated July 8, 2009, page 12.

However, we are seeking comment on whether test methods other than EPA Method 201 and 202[34] (chosen by ADEQ) should be allowed or required for establishing compliance with the PM_{10} limits that we are approving. In particular, as explained below, use of SCR[35] at these units is expected to result in increased condensable particulate matter in the form of sulfuric acid mist (H_2SO_4). In effect, the emission limit would be more stringent than intended by ADEQ and would likely not be achievable in practice. In order to avoid this result, while still assuring proper operation of the particulate control devices, we are requesting on comment on whether to allow compliance with the PM_{10} limit to be demonstrated using test methods that do not capture condensable particulate matter, namely EPA Methods 1 through 4 and Method 5 or Method 5e.[36] Method 201 is very rarely used for testing. The typical method used for filterable PM_{10} is Method 201A, "constant sampling rate procedure," which is similar to Method 201, but is much more practical to perform on a stack.

c) BART for SO_2

(1) ADEQ's Analysis

Apache Units 2 and 3 currently have wet limestone scrubbers installed for SO_2 removal.[37] Under the BART Guidelines, a state is not required to evaluate the replacement of the current SO_2 controls if their removal efficiency is over 50 percent, but should consider cost-effective scrubber upgrades designed to improve the system's overall SO_2 removal efficiency. Relying upon the BART analysis submitted by AEPCO,[38] ADEQ found that the following potential upgrades to the scrubbers are technically feasible:

- Elimination of bypass reheat,
- Installation of liquid distribution rings,
- Installation of perforated trays,
- Use of organic acid additives,
- Improved or upgraded scrubber auxiliary system equipment, and
- Redesigned spray header or nozzle.

ADEQ found that any upgrades likely would not increase power consumption, but would increase scrubber waste disposal and makeup water requirements, and would reduce the stack gas temperature. These three factors are the normal outcome of treating more of the exhaust gas and removing more of the SO_2 (increased scrubber waste disposal) and should not be given much weight in selecting a BART emission limit. ADEQ also noted that AEPCO had already made the following upgrades to the scrubbers: elimination of flue gas bypass; splitting the limestone feed

[34] See 40 CFR Part 51 Appendix M.
[35] EPA is proposing SCR as BART for all of the coal-fired units. See Section VII.
[36] See 40 CFR Part 60 Appendix A.
[37] See Arizona Regional Haze SIP, Appendix D, pages 69-71 for ADEQ's BART Analysis for SO2 at Apache Units 2 and 3.
[38] See AEPCO Apache Unit 2 BART Analysis

to the absorber feed tank and tower sump; upgrade of the mist eliminator system; installation of suction screens at pump intakes; automation of pump drain valves, and replacement of scrubber packing with perforated stainless steel trays. In addition, AEPCO tried using dibasic acid additive, but found that it did not result in significantly higher SO_2 removal. ADEQ did not evaluate the cost or visibility impacts of any additional upgrades to the scrubbers, but determined that BART for SO_2 emissions was no new controls and an emission limit of 0.15 lb/MMBtu on a 30-day rolling average basis.

(2) EPA's Evaluation

We are proposing to approve ADEQ's SO_2 BART determination for Apache Units 2 and 3. Although ADEQ has not demonstrated that it fully considered all cost effective scrubber upgrades, as recommended by the BART Guidelines, ADEQ conducted a five-factor BART analysis and its final SO_2 BART determination for Apache Units 2 and 3 is consistent with the presumptive BART limit of 0.15 lb/MMBtu for utility boilers.[39] We have no evidence that additional analysis would have resulted in a lower emission limit. Therefore, we are proposing to approve the SO_2 emission limit of 0.15 lb/MMBtu (30-day rolling average) for Apache Units 2 and 3.

However, we note that Apache can receive coal from a number of different mines that can have differing sulfur content and potential for SO_2 emissions.[40] Therefore, we are seeking comment on whether additional cost-effective scrubber upgrades are available that would warrant a lower emission limit. We are also requesting comment on whether requiring 90 percent control efficiency in addition to the lb/MMBtu limit would better assure proper operation of the upgraded scrubbers when burning some types of low-sulfur western coal. If we receive information establishing that a lower limit is achievable or that a control efficiency requirement is needed, then we may disapprove the SO_2 emissions limit set by ADEQ and promulgate a revised limit for one or both of these units.

3. Cholla Units 2, 3 and 4

Cholla Power Plant consists of four primarily coal-fired electricity generating units with a total plant-wide generating capacity of 1,150 megawatts. Unit 1 is a 125 MW tangentially-fired, dry-bottom boiler that is not BART-eligible. Units 2, 3 and 4 have capacities of 300 MW, 300 MW and 425 MW, respectively, and are tangentially-fired, dry-bottom boilers that are each BART-eligible. Based on information provided by APS, the Cholla units operate on a blend of bituminous and sub-bituminous rank coals from the Lee Ranch and El Segundo mines.[41]

a) BART for NO_x

(1) ADEQ's Analysis

APS submitted a BART analysis to ADEQ in January 2008. At the time of submittal, Cholla Units 2, 3 and 4 were equipped with close-coupled overfire air (COFA) as NO_x controls. APS developed baseline NO_x emissions by examining the highest 24-hour average emissions

[39] See BART Guidelines § IV.E.4.
[40] See, e.g. Apache Unit 2 BART Analysis, Table 3-1.
[41] A copy of the coal contract, including obligation amounts and coal quality, can be found in Docket Item B-09, “Additional APS Cholla BART response”, Appendix B.

from 2001 to 2003.[42] APS examined several NO_x control technologies, including combustion controls and add-on post combustion controls. A summary of the costs of compliance and visibility impacts associated with these options is presented in Table 12.

This information is contained in the Cholla BART analyses for each unit, and was relied upon by ADEQ in developing its RH SIP.[43] Estimates of control technology emission rates were developed based on a combination of vendor quotes, contractor information, and internal APS information regarding environmental upgrades.[44] Annual emission reductions were calculated based upon the emission rate estimates combined with annual capacity factors as reported in CAMD data from 2001 to 2006.[45] Control costs were also developed based on a combination of vendor quotes and contractor information. These cost calculations provided line item summaries of capital costs and annual operating costs, but did not provide further supporting information such as detailed equipment lists, vendor quotes, or the design basis for line item costs.

As part of its BART analysis, APS performed visibility modeling in order to evaluate the visibility improvement attributable to each of the NO_x control technologies that it considered. This visibility modeling was performed using three years of meteorological data (2001 to 2003), and was generally performed in accordance with the WRAP protocol, with a few exceptions. For example, rather than using a constant monthly ammonia background concentration of 1.0 ppb as specified in the WRAP protocol, APS used a variable monthly background ammonia concentration that varied from 0.2 ppb to 1.0 ppb.

For assessing the degree of visibility improvement, ADEQ considered only the visibility benefits at the area with the highest base case (pre-control) impact, the Petrified Forest National Park. For each control, ADEQ listed visibility improvement in deciviews, and visibility cost-effectiveness, (Arizona SIP submittal, “Appendix D: Arizona BART – Supplemental Information”, p.77) as in the comparable section for Apache. For Unit 2, improvements range from 0.19 dv for LNB with SOFA to 0.29 dv for SCR. Costs per deciview range from $3.4 million for LNB to and $33.5 million for SCR. Benefits for Unit 3 are about 20 percent lower (0.13 to 0.23 deciview), and for Unit 4 are about 20 percent higher (0.21 to 0.41 deciview), with percent differences increasing with more stringent control. For Unit 3, costs per deciview range from $5 million for LNB with SOFA to $41.6 million for SCR (about 30 percent higher than for Unit 2). For Unit 4, costs range from $4 million for LNB with SOFA to $32.4 million for SCR (about 20 percent higher except that SCR has a slightly lower cost per deciview).

ADEQ concluded (*ibid*, p.79) that LNBs with new SOFA systems represent BART for all three units, noting that for all scenarios the visibility benefits were less than 0.5 dv. ADEQ also stated that SCR, the most expensive option, provides only about 0.1 dv benefit more than LNB with SOFA, the least expensive option. This statement appears to apply only to Units 2 and 3; the comparable benefit for Unit 4 is 0.2 dv.

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[42] See Docket Item B-06 through -08, APS Cholla BART Analyses, page 2-2.

[43] See Docket Item B-06 through -08, APS Cholla BART Analyses. This information is also summarized in Docket Item B-01, Arizona Regional Haze SIP, Appendix D, Tables 11.3 through 11.5.

[44] As described in Table 3-2, Docket Items B-06 through -08, APS Cholla BART Analyses.

[45] As listed in Table 2-1, Docket Items B-06 through -08. Annual capacity factors used for each unit are 91 percent (Cholla 2), 86percent (Cholla 3), and 93 percent (Cholla 4).

Table 12 - Cholla Units 2, 3, and 4: Arizona's Cost and Visibility Summary for NOx

Control Option	Emission Rate (lb/MMBtu)	Emissions Removed (tons/yr)	Annualized Cost ($/year)	Cost-effectiveness ($/ton)		Visibility Improvement[a] (deciviews)		Cost per total deciview improvement ($/dv)
				Average	Incremental (from previous)	Total (from baseline)	Incremental (from previous)	
Cholla 2								
COFA (baseline)	0.50	--	--	--	--	--	--	--
LNB + SOFA	0.22	3,314	$635,000	$192	--	0.187	--	$3,400,000
SNCR + LNB + SOFA	0.17	3,900	$2,175,000	$558	$2,628	0.218	0.031	$9,980,000
ROFA	0.16	4,017	$2,297,000	$572	$1,043	0.232	0.014	$9,900,000
ROFA w/ Rotamix	0.12	4,485	$3,384,000	$755	$2,323	0.261	0.029	$12,970,000
SCR + LNB + SOFA	0.07	5,071	$9,625,000	$1,898	$10,650	0.287	0.026	$33,540,000
Cholla 3								
COFA (baseline)	0.41	--	--	--	--	--	--	--
LNB + SOFA	0.22	2,096	$635,000	$303	--	0.13	--	$5,040,000
SNCR + LNB + SOFA	0.17	2,648	$2,157,000	$815	$2,757	0.16	0.038	$13,150,000
ROFA	0.16	2,758	$2,243,000	$813	$782	0.17	0.005	$13,270,000
ROFA w/ Rotamix	0.12	3,200	$3,308,000	$1,034	$2,410	0.20	0.029	$16,710,000
SCR + LNB + SOFA	0.07	3,751	$9,569,000	$2,551	$11,363	0.23	0.032	$41,610,000
Cholla 4								
COFA (baseline)	0.42	--	--	--	--	--	--	
LNB + SOFA	0.22	3,390	$820,000	$242	--	0.21	--	$3,960,000
SNCR + LNB + SOFA	0.17	4,259	$2,852,000	$670	$2,338	0.27	0.058	$10,760,000
ROFA	0.16	4,433	$3,179,000	$717	$1,879	0.28	0.016	$11,310,000
ROFA w/ Rotamix	0.12	5,129	$4,537,000	$885	$1,951	0.34	0.055	$13,500,000
SCR + LNB + SOFA	0.07	5,998	$13,230,000	$2,206	$10,003	0.41	0.072	$32,430,000

[a] At the Class I area exhibiting the greatest baseline visibility impact, Petrified Forest National Park

In evaluating APS' BART analysis, ADEQ requested supporting information explaining certain assumptions used in the economic analysis, baseline emissions, and control technology options. Based on this additional information as well as APS' original BART analysis, ADEQ determined that LNB with SOFA is BART for NO_x at Cholla Units 2, 3 and 4. In making this determination, ADEQ relied almost exclusively on the degree of visibility improvement. ADEQ cited small visibility improvement on a per-unit basis, stating that "the change in deciviews between the least expensive and most expensive NO_x control technologies [...] is only 0.104 deciviews."[46] ADEQ's determination suggests that total capital costs may have been a consideration, although it is not clear to what extent this may have informed ADEQ's decision making, with the RH SIP simply stating, "[t]he corresponding capital costs are $5.4 million for LNB/SOFA and $82.8 million for SCR with LNB/SOFA."[47]

(2) EPA's Evaluation

We disagree with several aspects of the analyses performed for Cholla Units 2 3 and 4. Regarding the control cost calculations, we note that certain line item costs not allowed by the EPA Control Cost Manual were included, such as owner's costs, surcharge, and AFUDC. Inclusion of these line items has the effect of inflating the total cost of compliance and the cost per ton of pollutant reduced. As a result, we are proposing to find that ADEQ did not follow the requirements of section 51.308(e)(1)(ii)(A) by not properly considering the costs of compliance for each control option.

Regarding ADEQ's analysis of visibility impacts, the modeling procedures relied on by ADEQ for assessing the visibility impacts from Cholla were generally in accord with EPA guidance, but the use of the modeling results in evaluating the BART visibility factor was problematic. As was the case for Apache, ADEQ appears to have considered benefits from controls on only one emitting unit at a time. EPA believes that ADEQ's use of this procedure substantially underestimates the degree of visibility improvement from controls. ADEQ also overlooked comparable benefits at seven Class I areas besides Petrified Forest, thereby understating the full visibility benefits of the candidate controls. Using the default 1 ppb ammonia background concentration would also have increased estimated impacts and control benefits. For these reasons, EPA proposes to find that the ADEQ selection of LNB for Cholla under the degree of visibility improvement BART factor is not adequately supported, and that more stringent control may be warranted.

b) BART for PM_{10}

(1) ADEQ's Analysis

As of May 2009, Cholla Units 3 and 4 were both equipped with fabric filters for PM_{10} control, while Cholla Unit 2 was equipped with a mechanical dust collector and a venturi scrubber.[48] In its BART analysis, ADEQ noted that the facility had committed to install a fabric filter at Unit 2 by 2015. Because fabric filters are the most stringent control available for reducing PM_{10} emissions, ADEQ did not conduct a full BART analysis, but concluded that fabric filters and an emission limit of 0.015 lb/MMBtu are BART for control of PM_{10} at Units 2, 3 and

[46] Docket Item B-01, Arizona Regional Haze SIP, Appendix D, Page 79.
[47] Id.
[48] See Arizona Regional Haze SIP, Appendix D, pages 79-81 for ADEQ's BART Analysis for PM_{10} at Cholla Units 2, 3 and 4.

4. ADEQ also noted that "PM_{10} emissions will be measured by conducting EPA Method 201/202 tests."

(2) EPA's Evaluation

Given that ADEQ has chosen the most stringent control technology available and set an emissions limit consistent with other units employing this technology, we are proposing to approve this BART determination of an emission limit of 0.015 lb/MMBtu for PM_{10} at Cholla Units 2, 3 and 4.

c) BART for SO_2

Cholla Units 2, 3 and 4 are all equipped with wet lime scrubbers for SO_2 control. [49] Specifically, Unit 2 is equipped with four venturi flooded disc scrubbers/absorber with lime reagent, capable of achieving 0.14 lb/MMBtu to 0.25 lb/MMBtu of SO_2. Units 3 and 4 were retrofitted in 2009 and 2008, respectively, with scrubbers capable of achieving 0.15 lb/MMBtu of SO_2.

(1) ADEQ's Analysis

Based on a limited five-factor analysis, ADEQ determined BART for SO_2 at Cholla Unit 2 is upgrades to the existing scrubber that would achieve a limit of 0.15 lb/MMBtu. Because the BART analysis submitted by APS was conducted prior to installation of the scrubbers on Units 3 and 4, it included an analysis of other potential control technologies, namely, dry flue gas desulfurization and dry sodium sorbent injection. However, APS had already installed the wet lime scrubbers by the time ADEQ conducted its own BART analysis. Therefore, ADEQ did not consider SO_2 controls other than wet lime scrubbers for Units 3 and 4, but determined BART as use of these scrubbers with an associated emission limit of 0.15 lb/MMBtu of SO_2.

(2) EPA's Evaluation

We are proposing to approve ADEQ's BART determination for SO_2 at Cholla Units 2, 3 and 4. Although ADEQ did not fully consider all cost-effective scrubber upgrades as recommended by the BART Guidelines, we have no basis for concluding that additional analysis would have resulted in a lower emission limit. Therefore, we are proposing to approve the SO_2 emission limit of 0.15 lb/MMBtu (30-day rolling average) for Cholla Units 2, 3 and 4. However, we are seeking comment on whether additional cost-effective scrubber upgrades are available that would warrant a lower emission limit. If we receive comments establishing that a lower limit is achievable, then we may disapprove the SO_2 emissions limit set by ADEQ and promulgate a revised limit for one or more of these units.

4. Coronado Units 1 and 2

Coronado Generating Station consists of two EGUs with a total plant-wide generating capacity of over 800 MW. Units 1 and 2 are both dry-bottom, turbo-fired boilers, each with a gross unit output of 411 MW. Both units are BART-eligible and are coal-fired boilers operating on primarily Powder River Basin sub-bituminous coal.

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[49] See Arizona Regional Haze SIP, Appendix D, pp. 81-83, for ADEQ's BART Analysis for SO_2 at Cholla Units 2, 3 and 4.

SRP entered into a consent decree with EPA in 2008.[50] This consent decree resolved alleged violations of the CAA which occurred at Units 1 and 2 of the Coronado Generating Station, arising from the construction of modifications without obtaining appropriate permits under the Prevention of Significant Deterioration (PSD) provisions of the CAA, and without installing and applying best available control technology. The consent decree resolved the claims alleged by EPA in exchange for SRP's payment of a civil penalty and SRP's commitment to perform injunctive relief including: 1) installation of pollution control technology to control emissions of NO_x, SO_2, and PM --including flue gas desulfurization devices to control SO_2 on Units 1 and 2 at the Coronado Station and installation of SCR to control NO_x on one of the units (Unit 2); 2) meet specified emission rates or removal efficiencies for NO_x, SO_2, and PM; 3) comply with a plant-wide emissions cap for NO_x; and 4) perform $ 4 million worth of mitigation projects. The consent decree is not a permit, and compliance with the consent decree does not guarantee compliance with all applicable federal, state, or local laws or regulations. The emission rates and removal efficiencies set forth in the consent decree do not relieve SRP from any obligation to comply with other state and federal requirements under the CAA, including SRP's obligation to satisfy any State modeling requirements set forth in the Arizona SIP.

a) BART for NO_x

(1) ADEQ's Analysis

ADEQ's BART analysis relied in large part on an analysis submitted by SRP in February 2008. In its analysis, SRP developed baseline NO_x emissions by examining continuous emission monitoring system (CEMS) data from 2001 to 2003.[51] SRP examined several NO_x control technologies, including combustion controls and add-on post combustion controls. A summary of the costs of compliance and visibility impacts associated with these options is presented in Table 13. This information was contained in the SRP Coronado BART analysis, and was relied on by ADEQ in developing its RH SIP. Estimates of control technology emission rates were developed based on information provided by equipment vendors.[52] SRP's analysis did not provide an estimate of annual emissions.

[50] See Docket Item G-01, Consent Decree between United States and Salt River Project Agricultural Improvement and Power District.
[51] See Docket Item B-10, SRP Coronado BART Analysis, page 3-1.
[52] See Docket Item B-10, SRP Coronado BART Analysis, p 4-5.

Table 13 - Coronado Units 1 and 2: Arizona's Cost and Visibility Summary for NOx

Control Option	Emission Rate (lb/MMBtu)		Total Emissions Removed[a] (tons/yr)	Total Annualized Cost ($/year)	Cost-effectiveness[b] ($/ton)		Visibility Improvement[c] (deciviews)		Cost per total deciview improvement[d] ($/dv)	Improvement in Visibility Index[e] (deciviews)	
	Unit 1	Unit 2			Average	Incremental (from previous)	Total (from baseline)	Incremental (from previous)		Total (from base case)	Incremental (from previous)
OFA (baseline)	0.433	0.466	--	--	--	--	--	--	--	--	--
Full LNB+OFA	0.32	0.32	5,838	$1,227,000	$210	--	0.12	--	$10,225,000	0.11	--
Full SNCR+LNB +OFA	0.22	0.22	10,195	$4,654,000	$456	$787	0.16	0.04	$29,087,500	0.19	0.080
Partial SCR+LNB+ OFA[f]	0.32	0.08	11,003	$8,557,000	$778	$4,830	0.24	0.12	$35,654,167	0.22	0.030
Full SCR+LNB+ SOFA	0.08	0.08	16,730	$17,090,000	$1,022	$1,490	0.39	0.27	$43,820,513	0.34	0.120

[a] SRP did not provide estimates of annual emissions in its BART analysis. These values are summarized from the Arizona RH SIP.
[b] Cost-effectiveness was not presented in the Arizona RH SIP. These values are calculated from the emission removal and annualized costs that were included in the RH SIP.
[c] Visibility improvement at the Class I area exhibiting the greatest baseline visibility impact, Petrified Forest National Park, from the SRP Coronado BART Analysis.
[d] Cost per total deciview improvement was not presented in the Arizona RH SIP. These values are calculated from the annualized costs that were included in the RH SIP, and the visibility improvement at Petrified Forest National Park, from the SRP Coronado BART Analysis.
[e] Visibility index used in the Arizona RH SIP is the average of the impacts over the nine closest Class I areas.
[f] This control option examined LNB+OFA on Unit 1 and SCR on Unit 2.

Control costs for the various options considered were developed by Sargent and Lundy, the engineering firm retained by SRP for emission control projects at Coronado. In its BART analysis and subsequent additional response to ADEQ, SRP provided summaries of total control costs, such as total annual operating and maintenance costs and total annualized capital cost, but did not provide cost information at a level of detail that included line item costs. [53]

As part of its BART analysis, SRP performed visibility modeling in order to evaluate the visibility improvement attributable to each of the NO_x control technologies that it considered. This visibility modeling was performed using three years of meteorological data (2001 to 2003), and relied partially on the WRAP protocol with certain revisions based on EPA and Federal Land Manager guidance that became available in the intervening period. For example, the WRAP protocol used CALPUFF model version 6, whereas SRP used the current EPA-approved CALPUFF version 5.8.

For assessing the degree of visibility improvement, ADEQ considered a visibility index, defined as the average of the visibility benefits at the closest nine Class I areas. The average included the five areas with the highest baseline impacts. This metric is unlike that used for Apache and Cholla, for which the benefits at the single area with maximum baseline impact were used. Since it is an average, it is somewhat similar to the sum of benefits over the nine areas, a cumulative metric used in other analyses, except it is divided by nine to compute the average. (Typically the sum would be computed over all 17 Class I areas impacted by the Coronado facility.) For each control, ADEQ listed the average visibility improvement in deciviews, and cost in millions of dollars per average deciview improvement.[54] Improvements in the visibility index ranged from 0.11 dv for LNB with OFA to 0.34 dv for SCR. Costs per deciview for the index ranged from $11.1 million for LNB with OFA to $50.3 million for SCR. (These values are not shown in Table 13 above nor in the plan submittal. For LNB, $1,227,000 / 0.11 dv = $11.1 million/dv; for SCR, $17,090,000 / 0.34 dv = $50.3 million/dv.)

While an average of the visibility benefits over the nearest areas is an informative number, it is not directly comparable to the more typical metrics of the maximum benefit seen at any area, and sum over the areas. Moreover, neither the ADEQ RH SIP nor the facility's report (BART Analysis for the Coronado Generating Station Units 1 & 2, Document No. 05830-012-200, ENSR Corporation, February 2008) include control benefits for individual Class I areas. Thus, the maximum area benefit cannot be read from either document. However, the benefits can be computed from the individual area impacts that are provided in SRP's report, including for Petrified Forest National Park, which had the highest baseline impact. Figures that are comparable to those for Apache and Cholla are included in Table 13. Coronado's maximum area visibility benefits range from 0.12 dv for LNB to 0.39 dv for SCR. The costs per deciview range from $10.2 million for LNB with OFA to $43.8 for SCR.

In evaluating SRP's BART analysis, ADEQ requested additional supporting information from SRP regarding control cost calculations, and for further explanation regarding SRP's recommendation for BART for NO_x. In developing its Regional Haze SIP, ADEQ determined that LNB with OFA constitutes BART for NO_x at Coronado Units 1 and 2. In making this

[53] See Docket Item B-11, Additional SRP Coronado response
[54] Arizona RH SIP, Appendix D, p.112.

determination, ADEQ did not provide adequate information regarding its rationale or weighing of the five factors, stating only "[a]fter reviewing the BART analysis provided by the company, and based upon the information above, ADEQ has determined that BART for NO_x at Coronado Units 1 and 2 is advanced combustion controls (Low NO_x burners with OFA) with an associated NO_x emission rate of 0.32 lb/MMBtu [..]" [55]

(2) EPA's Evaluation

We disagree with several aspects of the BART analysis for Coronado Units 1 and 2. Regarding the control cost calculations, we note that SRP did not provide ADEQ with control cost calculations at a level of detail that allowed for a comprehensive review. Without such a level of review, we do not believe that ADEQ was able to evaluate whether SRP's control costs were reasonable. As a result, we are proposing to find that ADEQ did not follow the requirements of section 51.308(e)(1)(ii)(A) because ADEQ did not properly consider the costs of compliance for each control option.

The modeling procedures relied on by ADEQ for assessing the visibility impacts from Coronado were generally in accord with EPA guidance. Coronado Units 1 and 2 were modeled together, and the modeling was done with the current regulatory version 5.8 of the CALPUFF modeling system.[56] However, the use of the modeling results in evaluating the BART visibility factor was problematic. The modeling results show that, of the controls considered, only SCR would provide substantial visibility benefits; the other controls options would provide roughly half the 0.5 dv contribution benchmark. ADEQ did not consider the typical visibility metrics of benefit at the area with maximum impact, nor benefits summed over the areas. Using the default 1 ppb ammonia background concentration would also have increased estimated impacts and control benefits. For these reasons, EPA proposes to find that the ADEQ selection of LNB with OFA for Coronado under the degree of visibility improvement BART factor is not adequately supported, and that more stringent control may be warranted. ADEQ provided little reasoning about the visibility basis for the Coronado BART selection. For example, there is no weighing of the visibility benefits and visibility cost-effectiveness for the various candidate controls and the various Class I areas.

In addition to the problems noted above, we find that overall ADEQ has not documented its evaluation of the results of its five-factor analysis, as required by 51.308(e)(1)(ii)(A) and the BART Guidelines. Although ADEQ has developed information regarding each of the five factors, its selection of BART does not cite or interpret information from its analyses. ADEQ does not, for example, indicate whether or not it considered any cost thresholds to be reasonable or expensive in analyzing the costs of compliance for the various control options. We note that ADEQ has made similar NO_x BART determinations of LNB with OFA at other facilities, such as Cholla Power Plant. Although ADEQ's BART determinations for these other facilities implied that cost of compliance was an important consideration, it does not provide a rationale for the determination of NO_x BART at Coronado.[57] Therefore, we propose to determine that ADEQ did

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[55] Docket Item B-01, Arizona Regional Haze SIP, Appendix D, Page 112.
[56] Arizona Regional Haze SIP, Appendix D, p. 112.
[57] We do note, however, that SRP does provide some additional analysis on this position in the BART analysis it submitted to ADEQ and in the responses it provided to ADEQ's additional questions. Aside from stating that it reviewed SRP's analysis, ADEQ did not specifically reference or include any aspects of SRP's analysis in the RH

not follow the requirements of section 51.308(e)(1)(ii)(A). We propose to disapprove ADEQ's selection of LNB with OFA as BART for NO_x at Coronado Units 1 and 2.

b) BART for PM_{10}

Emissions of PM_{10} from Coronado Units 1 and 2 are currently controlled by hot-side ESPs.[58] Under the terms of the Consent Decree described above, SRP is required to optimize its ESPs to achieve a PM_{10} emission rate of 0.030 lb/MMBtu.[59]

(1) ADEQ's Analysis

ADEQ conducted a streamlined PM_{10} BART analysis for Coronado Units 1 and 2. In particular, ADEQ found that "BART for similar emissions units with similar emissions controls was determined to be 0.03 lb/MMBtu." ADEQ concluded that because Coronado Units 1 and 2 are already meeting a limit of 0.03 lb/MMBtu, "further analysis was determined to be unnecessary."

EPA's Evaluation: ADEQ's analysis does not demonstrate that all potential upgrades to the existing ESPs were fully evaluated. However, we have no evidence that additional reductions in PM_{10} emissions would be achievable or cost-effective, or that such reductions would yield substantial visibility benefits. Therefore, we propose to approve ADEQ's PM_{10} BART determination at Coronado. However, we are seeking comment on whether additional cost-effective upgrades to the existing ESPs are available that would warrant a lower emission limit. If we receive comments establishing that a lower limit is achievable, then we may disapprove the PM_{10} emissions limit set by ADEQ and promulgate a revised limit for one or both of these units.

Finally, we are seeking comment on whether test methods other than EPA Method 201 and 202[60] (chosen by ADEQ) should be allowed or required for establishing compliance with the PM_{10} limits that we are approving. In particular, as explained below, use of SCR at these units is expected to result in increased condensable particulate matter in the form of H_2SO_4. In effect, the emission limit would be more stringent than intended by ADEQ and would likely not be achievable in practice. In order to avoid this result, while still assuring proper operation of the particulate control devices, we are requesting on comment on whether to allow compliance with the PM_{10} limit to be demonstrated using test methods that do not capture condensable particulate matter, namely EPA Methods 1 through 4 and Method 5 or Method 5e.[61] Method 201 is very rarely used for testing. The typical method used for filterable PM_{10} is Method 201A, "constant sampling rate procedure," which is similar to Method 201, but is much more practical to perform on a stack.

SIP. As a result, we are not assuming that ADEQ necessarily agrees with SRP's rationale, and have therefore not provided an analysis of it.

[58] See Arizona Regional Haze SIP, Appendix D, p. 112 for ADEQ's BART Analysis for PM_{10} at Coronado Units 1 and 2; and BART Analysis for Coronado Generating Station Units 1 and 2 (February 2008) for SRP's analysis.

[59] Docket Item G-01, Consent Decree between United States and Salt River Project Agricultural Improvement and Power District, § V.

[60] See 40 CFR Part 51 Appendix M.

[61] See 40 CFR Part 60 Appendix A.

c) BART for SO_2

Emissions of SO_2 at Coronado Units 1 and 2 are currently controlled with the use of low-sulfur coal and partial wet flue gas.[62] However, the consent decree between EPA and SRP described above requires installation of wet flue gas desulfurization (WFGD) systems at either Unit 1 or Unit 2 by January 2012, and at the remaining unit by January 1, 2013. Both units must achieve and maintain a 30-day rolling average SO_2 removal efficiency of at least 95.0 percent or a 30-day rolling average SO_2 emissions rate of no greater than 0.080 lb/MMBtu.

(1) ADEQ's Analysis

Because WFGD is the most effective control technology available for controlling SO_2 emissions, ADEQ did not evaluate other control options. Table 14 summarizes Arizona's assessment of the compliance costs and visibility improvements expected to result from installation of WFGD at both units. Based on this information, ADEQ determined SO_2 BART for both units is the installation of WFGDs and an emission rate of 0.08 lbs/MMBtu on 30-day rolling average basis.

Table 14 - Coronado Units 1 and 2: Arizona's BART Summary for SO2

	Option 1, Baseline	Option 2, WFGD
Reduction in Emission (tpy)	-	25,753
Annualized Cost	-	$44,353,330
Visibility Index (dv)	2.66	1.28
Improvement in Visibility Index (dv)	-	1.38
Incremental Cost-effectiveness ($ per dv)	-	$32,140,094

(2) EPA's Evaluation

We are proposing to approve ADEQ's SO_2 BART determination for Coronado Units 1 and 2. Although we do not necessarily agree with the underlying cost and visibility analyses performed by SRP, we have no evidence that additional analysis would have resulted in a lower emission limit. Therefore, we propose to approve ADEQ's SO_2 emission limit of 0.08 lb/MMBtu (30-day rolling average) for Coronado Units 1 and 2. However, we are seeking comment on whether a lower emission limit may be achievable when the units are burning a lower-sulfur coal. If we receive comments establishing that a lower limit is achievable, then we may disapprove the SO_2 emissions limit set by ADEQ and promulgate a revised limit for one or both of these units.

D. Enforceability of BART Limits

Regional Haze SIPs must include requirements to ensure that BART emission limits are enforceable. In particular, the RHR requires inclusion of (1) a schedule for compliance with BART for each source subject to BART; (2) a requirement for each BART source to maintain

[62] See Arizona Regional Haze SIP, Appendix D, pp. 113-15 for ADEQ's BART Analysis for PM_{10} at Coronado Units 1 and 2; and Docket No. B.10, BART Analysis for Coronado Generating Station Units 1 and 2 (Feb. 2008) for SRP's analysis.

the relevant control equipment; and (3) procedures to ensure control equipment is properly operated and maintained.[63] General SIP requirements also mandate that the SIP include all regulatory requirements related to monitoring, recordkeeping and reporting for the BART emissions limitations.[64] ADEQ did not include any of these elements in its Regional Haze SIP.[65] Therefore, we are proposing to disapprove this aspect of the Regional Haze SIP for these three sources and to promulgate a FIP to ensure the emission limits are enforceable.

IV. Technical Information for EPA's Proposed FIP Actions

A. EPA's BART Analysis for NO_x

EPA conducted a new five-factor BART analysis for NOx at each of the three facilities in order to evaluate Arizona's RH SIP, and to document the technical basis for proposing BART determinations in our FIP. Because EPA generally concurs with ADEQ's BART analyses in Steps 1 and 2 (Identify All Available Retrofit Control Technologies and Eliminate Technically Infeasible Options), we focused our technical analysis on Steps 3, 4 and 5 (Evaluate Control Effectiveness of Remaining Control Technologies, Evaluate Impacts and Document Results, and Evaluate Visibility Impacts). We relied on contractor assistance from the University of North Carolina Institute for the Environment to evaluate control effectiveness, perform cost calculations, and conduct new visibility modeling for each of the units at the three facilities, except Apache Generating Station Unit 1 for which this level of analysis was unnecessary. Our approach to each of these factors is explained below, followed by our BART determinations for the three sources in the next section.

1. Cost of Compliance

Cost Estimates and Calculations: In estimating the costs of compliance, we have relied on facility data from a number of sources including ADEQ, the Energy Information Administration (EIA), and EPA's Control Cost Manual. As discussed previously, ADEQ, in developing its RH SIP, requested certain clarifying information from the facilities regarding their control cost calculations, including greater detail regarding the underlying assumptions. ADEQ received responses of varying detail to these requests. Although in some cases the facilities provided summaries of certain broad line item costs, in no case does the supporting information that is available provide detail at a level that allows for critical review. In the case of SRP Coronado Generating Station, ADEQ received only a broad summary of control costs without itemized breakdowns of specific costs.

As a result, we have used EPA's Integrated Planning Model (IPM) to calculate the capital costs and annual operating costs associated with the various NO_x control options. EPA's Clean Air Markets Division (CAMD) uses IPM to evaluate the cost and emissions impacts of proposed policies to limit emissions of SO_2, NO_x, carbon dioxide (CO_2), and mercury (Hg) from the electric power sector. Developed by ICF Consulting, Inc. and used to support public and

[63] 40 CFR 51.308(e)(1).
[64] See, e.g. CAA section 110(a)(2) (F) and 40 CFR 51.212(c).
[65] As described above, ADEQ did specify a test method for PM_{10} for each of the relevant sources (Method 201/202). However, we are proposing to also allow the use of test methods that do not capture condensable particulate matter, namely EPA Methods 1 through 4 and Method 5 or Method 5e.

private sector clients, IPM is a multi-regional, dynamic, deterministic linear programming model of the U.S. electric power sector. EPA has used IPM in rulemakings such as the Mercury and Air Toxics Standard and the Cross-State Air Pollution Rule. For the purposes of this BART determination, we specifically used only the NO_x emission control technology cost methodologies contained in EPA's IPM Base Case v4.10 (August 2010).[66] For Base Case v4.10, EPA's Clean Air Markets Division contracted with engineering firm Sargent and Lundy to perform a complete bottom-up engineering reassessment of the cost and performance assumptions for SO_2 and nitrogen oxides NO_x emission controls. Summaries of our control cost estimates for the various control technology options considered for each unit are included below.

We used publicly available information to estimate that AEPCO is a small utility. EPA requested information from AEPCO on the economics of operating Apache Generating Station and what impact the installation of SCR may have on the economics of operating Apache Generating Station. Specifically, EPA is seeking information on the ability of AEPCO to recover the cost of pollution control technology through rate increases and the impact those rate increases may have on AEPCO's customers. If we receive comments sufficiently documenting that installation of SCR may have a severe impact on the economics of operating Apache Generating Station, we may incorporate such considerations in our selection of BART. Our impact analysis and request for comment is discussed in more detail below, under EPA's BART Determinations for Apache Units 2 and 3.

Control Effectiveness: The evaluation of control effectiveness is an important part of a five-factor analysis because it influences both cost-effectiveness and visibility benefits. The BART Guidelines note that for each technically feasible control option:

> "It is important . . . 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."[67]

In general, our estimates of LNB and SNCR control effectiveness differ slightly from the control effectiveness levels considered by ADEQ. In the case of LNB, for example, this is the result of the fact that actual emissions data for LNB performance were available for certain units at the time of our analysis. ADEQ's analysis was performed at an earlier date when these emissions data were not available. More detailed information regarding these differences is in our discussion of individual facilities in the following sections of this TSD.

In particular, we find that ADEQ did not adequately support its estimate of SCR control effectiveness. SCR, as an add-on control technology, can be installed by itself as a standalone option or in conjunction with burner upgrades. In cases where units can be upgraded with combustion control technology such as low-NOx burners, SCR is commonly installed as an add-on post-combustion control. When evaluating control options with a range of emission

[66] http://www.epa.gov/airmarkt/progsregs/epa-ipm/BaseCasev410.html#documentation
[67] 40 CFR Part 51, Appendix Y § IV.D.3.

performance levels, the BART Guidelines indicate that "in analyzing the technology you take into account the most stringent emission control level that the technology is capable of achieving."[68] Existing vendor literature and technical studies indicate that SCR systems are capable of achieving a 0.05 lb/MMBtu emission rate (approximately 80-90% control efficiency) and that this emission rate can be achieved on a retrofit basis, particularly when combined with combustion control technology such as LNB. [69]

For control options involving the installation SCR in conjunction with LNB, ADEQ considered the achievable emission rate to be between 0.07 lb/MMbtu (for Apache and Cholla) and 0.08 lb/MMbtu (for Coronado). These emission rates are within a range of SCR performance that has been considered by other western states in preparing RH SIPs, and may possibly be an appropriate estimation of the site-specific level of SCR performance for coal-fired units at Apache, Cholla, and Coronado. We note that the BART Guidelines indicate that, "In assessing the capability of the control alternative, latitude exists to consider special circumstances pertinent to the specific source under review […]. However, you should explain the basis for choosing the alternate level (or range) of control in the BART analysis."[70] Although the alternate levels of emission control considered by ADEQ for SCR in conjunction with LNB were stated in each respective facility's BART analysis, these emission rates were not further supported by any calculations, engineering analysis, or documentation. We do not believe that AEPCO, APS, and SRP have provided adequate supporting analysis to justify these emission rates. As mentioned in the Federal Register notice for this action, we are seeking comment on whether it is appropriate to consider an emission rate less stringent than 0.05 lb/MMBtu when evaluating the installation SCR in conjunction with LNB at Apache, Cholla, and Coronado.

In the absence of source-specific considerations warranting a less stringent control level, we presume that an emissions limit of 0.05 lb/MMBtu is achievable by these units through the use of SCR in addition to advanced combustion controls. We have recently received information from AEPCO and SRP regarding potential NO_x controls at their facilities. This information arrived too late to be fully evaluated for this proposed rulemaking, and EPA will need additional documentation from the utilities to support the information that they have provided to date. We have put the utility information in the docket for public review, and we will evaluate the information, and any additional information that the utilities may want to provide prior to making our final BART determinations.[71] If we receive additional comments that sufficiently document source-specific considerations justifying the use of an emission rate less stringent than 0.05 lb/MMBtu, we may incorporate such considerations in our selection of BART.

2. Energy and Non-air Environmental Impacts

Energy Impacts: With respect to the potential energy impacts of the BART control options, we note that SCR incurs a draft loss that will increase parasitic loads, and that other emissions controls may also have modest energy impacts. The costs for direct energy impacts,

[68] 70 FR 39166
[69] See Docket Items G-04, "Emissions Control: Cost-Effective Layered Technology for Ultra-Low NOx Control" (2007), Docket Item G-05 "What's New in SCRs" (2006), and Docket Item G-06 "Nitrogen Oxides Emission Control Options for Coal-Fired Electric Utility Boilers" (2005)
[70] 40 CFR Part 51, Appendix Y § IV.D.3.
[71] Docket Items C-15 "Letter from Kelly Barr (SRP) to Deborah Jordan (EPA)" and C-16 "Letter from Michelle Freeark (AEPCO) to Deborah Jordan (EPA)."

i.e., power consumption from the control equipment and additional draft system fans from each control technology, are included in the cost analyses and are not considered further in this section. Indirect energy impacts, such as the energy to produce raw materials, are not considered, consistent with the BART guidelines.

Ammonia Adsorption: Ammonia adsorption (resulting from ammonia injection from SCR or selective non-catalytic reduction—SNCR) to fly ash is generally not desirable due to odor but does not impact the integrity of the use of fly ash in concrete. However, other NO_x control technologies, including LNB, also have undesirable impacts on fly ash. LNBs increase the amount of unburned carbon in the fly ash, also known as Loss of Ignition (LOI), which does affect the integrity of the concrete. Commercial scale technologies exist to remove ammonia and LOI from fly ash. Moreover, the impact of SCR on fly ash is smaller than the impact of LNB on fly ash, and in both cases, the adverse effects can be mitigated.[72] We conclude that the ability of the relevant facilities to sell fly ash is unlikely to be affected by the installation of SCR and SNCR technologies.

Safety: SCR and SNCR may involve potential safety hazards associated with the transportation and handling of anhydrous ammonia. Since each of the relevant facilities is served by a nearby railroad line, EPA concludes that the use of ammonia does not pose any additional safety concern as long as established safety procedures are followed.

Thus, EPA proposes to find that potential energy and non-air quality impacts do not warrant elimination of any of the otherwise feasible control options for NO_x at any of the sources.

3. Pollution Control Equipment in Use at the Source

The presence of existing pollution control technology at each source is reflected in our BART analysis in two ways: first, in the consideration of available control technologies, and second, in the development of baseline emission rates for use in cost calculations and visibility modeling. As noted above, we largely agree with ADEQ's consideration of available control technologies. However, because several of the affected units have had new controls installed in the last several years, we have adjusted the baseline emissions periods to reflect current control technology at the sources, as described further below in our proposed BART determinations.

4. Remaining Useful Life of the Source

We are considering each source's "remaining useful life" as one element of the overall cost analysis as allowed by the BART Guidelines. Since we are not aware of any federally- or State-enforceable shut-down date for any of the affected sources, we have used the default 20-year amortization period in the EPA Cost Control Manual as the remaining useful life of the facilities considered in this proposed action.

5. Degree of Improvement in Visibility

EPA estimated the degree of visibility improvement expected from a BART control based on the difference between baseline visibility impacts prior to controls and visibility

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[72] See docket item G-13, "Impact of Ammonia in Fly Ash on its Beneficial Use," Memorandum from Nancy Jones and Stephen Edgerton, EC/R Incorporated, to Anita Lee, U.S. EPA/Region 9, August 31, 2010.

impacts with controls in operation. EPA used the CALPUFF model version 5.8[73] to determine the baseline and post-control visibility impacts for all three facilities. EPA followed the modeling approach recommended in the BART Guidelines. We developed a modeling protocol, used maximum daily emissions as a baseline, applied estimated percent reductions for alternative control technologies, and used the CALPUFF model to estimate visibility impacts at Class I areas within 300 kilometers.

a) Modeling Protocol

A modeling protocol was developed by our contractor[74] at the University of North Carolina (UNC) that is based largely on the WRAP protocol,[75] although there are a few differences between our protocol and that of the WRAP. Both protocols used meteorological inputs for 2001, 2002, and 2003 based on the Mesoscale Model version 5 (MM5) prognostic meteorological fields..... EPA meteorological inputs differed from the WRAP's in that the WRAP incorporated upper air data, as recommended by the Federal Land Managers, and also values for some parameters that enabled smoother and more realistic wind fields. These CALMET inputs were developed by the ENSR Corporation for modeling of emissions at the Navajo Generating Station.[76] Another key difference was EPA's use of the current regulatory version of the CALPUFF modeling system, version 5.8. Facility stack parameters, such as stack height and exit temperature, were generally the same as those provided by WRAP member states to the WRAP, except that in some cases updated parameters were provided by the facilities at EPA's request.

We performed separate CALPUFF modeling runs using baseline emissions, and using the emissions remaining after each candidate control technology was applied to the baseline. For baseline PM emissions, EPA used the WRAP's estimates. However, following procedures developed by the National Park Service,[77] EPA divided those emissions into separate chemical species, and into separate coarse and fine particle fractions, to reflect better their varying visibility impacts.

[73] EPA relied on version 5.8 of CALPUFF because it is the EPA-approved version promulgated in the Guideline on Air Quality Models (40 CFR 51, Appendix W, section 6.2.1.e; 68 FR 18440, April 15, 2003. It was also the approved version when EPA promulgated the BART Guidelines (70 FR 39122-39123, July 6, 2005). EPA updated the specific version to be used for regulatory purposes on June 29, 2007, including minor revisions as of that date; the approved CALPUFF modeling system includes CALPUFF version 5.8, level 070623, and CALMET version 5.8 level 070623. At this time, any other version of the CALPUFF modeling system would be considered an "alternative model", subject to the provisions of Guideline on Air Quality Models section 3.2.2(b), requiring a full theoretical and performance evaluation.

[74] Docket item E-01: ***Technical Analysis for Arizona Regional Haze FIPs: Modeling Protocol for Subject-to-BART and BART Control Options Analyses***, EP-D-07-102 WA5-12 Task 5, Institute for the Envir,onment, University of North Carolina at Chapel Hill (initial draft received March 14, 2012, final draft received July 16, 2012).

[75] ***CALMET/CALPUFF Protocol for BART Exemption Screening Analysis for Class I Areas in the Western United States***, Western Regional Air Partnership (WRAP); Gail Tonnesen, Zion Wang; Ralph Morris, Abby Hoats and Yiqin Jia, August 15, 2006. Available on UCR Regional Modeling Center web site, BART CALPUFF Modeling, http://pah.cert.ucr.edu/aqm/308/bart.shtml .

[76] Docket item G-16: ***Revised BART Analysis for the Navajo Generating Station Units 1-3***, ENSR Corporation, Document No. 05830-012-300, January 2009, Salt River Project – Navajo Generating Station, Tempe, AZ.

[77] "Particulate Matter Speciation", National Park Service, 2006. http://www.nature.nps.gov/air/Permits/ect/index.cfm

Although costs and emission reductions for each candidate BART control technology must necessarily be calculated separately for each emitting unit of a facility, emissions from all the units will be emitted into the air simultaneously. EPA modeled all units (stacks) and pollutants simultaneously. That is, even though only NO_x BART alternatives were evaluated, SO_2 and PM_{10} emissions were also included in the modeling. Modeling all emissions from all the units accounts for the chemical interaction between multiple plumes, and between the plumes and the background concentrations. This also accounts for the facts that deciview benefits from individual units are not linearly additive, and that each EPA BART proposal is for the facility as a whole. Additional details on the modeling may be found in the UNC report prepared for EPA.[78]

EPA used the current regulatory version of the CALPUFF modeling system, which comprises the following source code versions:

- CALMET Version 5.8, Level: 070623
- CALPUFF Version 5.8, Level: 070623
- POSTUTIL Version 1.56. Level: 070627
- CALPOST Version 6.221, Level 080724

The projection and coordinate system used was the same as used by the WRAP for Arizona modeling:

- Projection: Lambert Conformal Conic (LCC)
- Projection origin (lat, long): 40°, -97°
- Standard parallels: 33°, 45°
- False easting and northing: 0 m, 0 m
- Projection ellipsoid: "NWS-84", 6370 km radius sphere

The CALMET modeling domain was identical to the WRAP Arizona domain: 288 x 225 grid cells (X & Y), each 4 km, total size 1152 x 900 km; southwest corner at LCC coordinates -1944 km, -900 km. The CALPUFF domain was the same as the CALMET domain.

The CALPUFF and CALPOST inputs were prepared using the WRAP's input files as a starting point, from the WRAP Regional Modeling Center's "BART CalPuff Modeling" web site (http://pah.cert.ucr.edu/aqm/308/bart.shtml). Changes were made to the CALPUFF inputs to accommodate the facilities' locations, stack parameters, and emission rates for the base case and control scenarios. POSTUTIL inputs are not available on the WRAP web site, but input preparation was straightforward for HNO_3/NO_3 partitioning (MNITRATE = 1) and a constant 1 ppb ammonia background concentration per the IWAQM Phase 2 guidance, cited above. Changes to the CALPOST inputs were made to accommodate the natural background concentrations and relative humidity adjustment factors specific to each Class I area and the various visibility calculation methods, discussed below.

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[78] Docket item E-02: *Technical Analysis for Arizona Regional Haze FIPs: Task 8: Five-Factor BART Analysis for AEPCO Apache, APS Cholla and SRP Coronado*, EP-D-07-102 WA5-12 Task 8, Institute for the Environment, University of North Carolina at Chapel Hill (initial draft received June 28, 2012, final draft received July 16, 2012).

Table 15 - Class I Areas within 300 km of Apache, Cholla, and Coronado

abbrevia-tion	Class I Area	State	Managing Agency	Within 300 km of
band	Bandelier NM	NM	NPS	Coronado
bosq	Bosque del Apache Wilderness	NM	FWS	Coronado
care	Capitol Reef NP	UT	NPS	Cholla
chir	Chiricahua NM	AZ	NPS	Apache, Coronado
chrw	Chiricahua Wilderness	AZ	USFS	Apache, Coronado
gali	Galiuro Wilderness	AZ	USFS	All three
gila	Gila Wilderness	NM	USFS	All three
grca	Grand Canyon NP	AZ	NPS	Cholla, Coronado
maza	Mazatzal Wilderness	AZ	USFS	All three
meve	Mesa Verde NP	CO	NPS	Cholla, Coronado
moba	Mount Baldy Wilderness	AZ	USFS	All three
pefo	Petrified Forest NP	AZ	NPS	Cholla, Coronado
pimo	Pine Mountain Wilderness	AZ	USFS	Cholla, Coronado
sagu	Saguaro NP	AZ	NPS	All three
sape	San Pedro Parks Wilderness	NM	USFS	Coronado
sian	Sierra Ancha Wilderness	AZ	USFS	All three
supe	Superstition Wilderness	AZ	USFS	All three
syca	Sycamore Canyon Wilderness	AZ	USFS	Cholla, Coronado

b) Baseline Emissions

Baseline NO_x and SO_2 emissions for the facilities were generally based on the maximum daily emissions from recent data in EPA's CAMD database, with data examined for 2008 to 2011. The CAMD data derive from Continuous Emissions Monitoring in place at the facilities, and give the actual emissions that occurred. However, in cases where EPA is proposing to approve the BART emissions limits submitted by ADEQ, EPA used emission rates based on those limits, in lb/MMBtu, in combination with the maximum daily heat rate in MMBtu/hour from the CAMD data[79]. The baseline emissions used by EPA reflect current fuels and control technologies in place at the facilities, as well as regulatory requirements the facilities will be required to meet independent of EPA's BART determination. This results in a more realistic estimate of current visibility impacts, and of the improvements that one would expect to result from implementation of EPA's proposed BART controls.

c) Emission Reductions for Alternative Controls

For the CALPUFF modeling to assess visibility after application of a control technology, the percent control expected from the technology was applied to the baseline maximum daily emissions just described, as recommended in the BART Guidelines. As discussed elsewhere, LNB and SNCR each were assumed to reduce NO_x by 30 percent, and SCR was assumed to reduce NO_x by 90 percent. However, for SCR, we used a lower bound of 0.05 lb/MMBtu NO_x, an emission rate that we have confidence is achievable, as discussed above under "Control Effectiveness". The percent reduction actually applied to the maximum daily emissions was whatever was required to reduce the CAMD annual average emission factor down to this 0.05

[79] These data and the choice of maximum emission dates are in UNC's spreadsheet "AZ_BART_sources_all-Task7-8_2012-06-10.xls", supplemented by EPA's "AZ Max Emission Dates.xlsx"

lb/MMBtu NO_x. For the various emitting units at the facilities, this ranged from 80 to 89 percent, instead of a full 90 percent reduction.

Finally, in modeling the visibility impact of SCR for Apache and Coronado, EPA accounted for the increased sulfuric acid emissions that occur when the SCR catalyst oxidizes SO_2 present in the flue gas, using an estimation procedure developed by the Electric Power Research Institute[80] (EPRI). (***Estimating Total Sulfuric Acid Emissions from Stationary Power Plants***, Version 2010a, 1020636, Technical Update, Electric Power Research Institute, April 2010) This side effect of SCR's NO_x reduction increases sulfate emissions and decreases the visibility benefits of SCR by around 5 percent. This effect was not included for Cholla, because the existing baghouses would reduce the resulting sulfate particulate by 99%, making it negligible in comparison with other particulate emissions from the Cholla units.

In the EPRI method, the SO_4 emissions added for modeling due to the conversion of SO_2 via oxidation by the SCR catalyst are calculated as follows.

SO_4 emissions = (Mass of coal) × (S fraction)
× (Conversion to SO_2 & then to SO_3/H_2SO_4)
× (Effect of controls)
× (H_2SO_4 per S) × (SO_4 per H_2SO_4)
where (table and page numbers are from the cited EPRI 2010 document):

Mass of coal, lb/hr =
(10^6 × heat rate for max day, MMBtu/hr)/ × (heating value of fuel, Btu/lb)

S fraction = % sulfur content of coal / 100 = [%S]/100

Conversion to SO_2 & then to SO_3/H_2SO_4:
S to SO_2
0.95 equation 4-2b, for bituminous coals (p.4-3)
SCR catalyst SO_2 to SO_3/H_2SO_4
0.67% EPA, FCPP proposal, based on Hitachi guarantee[81]

Effect of Controls: product of penetration factors for each control
hot-side ESP + Air Preheater (APH) + Wet Flue Gas Desulfurization (WFGD or scrubber)
control before SCR: hot-side ESP, p=0.63 = 1 - 37%
0.63 Table 4-4, all coals (p.4-20)
other after SCR: APH, p=0.50 = 1 - 50%
0.50 Table 4-3, for low-sulfur eastern bituminous coal (p.4-18)
control after SCR: WFGD, p=0.47 = 1 - 53%
0.47 Table 4-5, Wet: Spray Tower for eastern bituminous coal (p.4-22)

[80] Docket item G-14: *Estimating Total Sulfuric Acid Emissions from Stationary Power Plants*, Version 2010a, 1020636, Technical Update, Electric Power Research Institute, April 2010
[81] Docket item F-01: EPA Technical Support Document for "Source Specific Federal Implementation Plan for Implementing Best Available Retrofit Technology for Four Corners Power Plant: Navajo Nation", 75 FR 64221, October 19, 2010; based on Hitachi guarantee on conversion using CX series catalyst

<u>Express as SO_4</u>, using ratio of molecular weights of S and SO_4:
(H_2SO_4 per S) × (SO_4 per H_2SO_4), to express calculated S as SO_4
(98.079/32.065) × (96.06/98.079) = 96.06/32.065

The product of all these is
SO_4 lb/hr emissions = (10^6 × heat rate MMBtu/hr / coal heating value Btu/lb)
× (%S/100) × 0.95 × 0.0067
× (0.63 × 0.50 × 0.47)
× 96.06/32.065

This formula is noted under table A-1(b) of Appendix A to the UNC Task 8 report, and is used in UNC's emission calculation spreadsheet (`AZ_BART_sources_all-Task7-8_2012-06-10.xls`, illustrated in the UNC Task 8 report, Appendix A). [82]

d) Visibility Impacts

Text and spreadsheet files used in EPA's visibility modeling are listed in Appendix A of this TSD and located in docket folder G-15. All of EPA's visibility modeling results are included in Appendix B of the TSD.

CALPUFF Modeling: EPA followed the BART Guidelines in assessing visibility impacts. For each Class I area within 300 km of a facility, the CALPUFF model is used to simulate the baseline visibility impact of each facility and the impacts resulting after alternative controls are applied. However, certain aspects of assessing visibility with CALPUFF are not fully addressed in the Guidelines. These aspects include which "98th percentile" from the model to use, the visibility calculation method (old vs. revised IMPROVE equation), and natural background concentrations (annual average versus best 20 percent of days). Additional model outputs are available in the docket in the form of Excel spreadsheets; the actual CALPUFF model input and output files are also available on request. The full list of files available appears at the end of this TSD.

98th Percentile from Model: As recommended in the BART Guidelines, the 98th percentile daily impact in deciviews is used as the basic metric of visibility impact. (For a given Class I area, and for each modeled day, the model finds the maximum impact. From among the 365 maximum daily values, the 98th percentile is chosen, that is, the 8th highest.) Since multiple years of meteorology are modeled, there are at least three ways to use the model results: the maximum from among the 98th percentiles for the individual years 2001, 2002, and 2003 ("maximum"); the average of these three ("average"), or a single 98th percentile computed from all three years of data together ("merged" or "All Years", the 22nd high among 1095 daily values). The average and merged values are both unbiased estimates of the true 98th percentile; for this proposal EPA has used the merged value. The more conservative maximum value would

[82] Docket item E-02: *Technical Analysis for Arizona Regional Haze FIPs: Task 8: Five-Factor BART Analysis for AEPCO Apache, APS Cholla and SRP Coronado*, EP-D-07-102 WA5-12 Task 8, Institute for the Environment, University of North Carolina at Chapel Hill (initial draft received June 28, 2012, final draft received July 16, 2012).

be appropriate for a screening purpose, such as for determining whether a source is subject to BART.

Visibility Calculation Method: The visibility calculation method relied on by EPA differed from that used by ADEQ. Visibility impacts may be simulated with CALPUFF using either the old or the revised IMPROVE equation for translating pollutant concentrations into deciviews; these are respectively CALPUFF visibility methods 6 and 8 (implemented in the CALPOST post-processor). Many BART assessments were performed before method 8 was incorporated into CALPUFF, so method 6 was generally for past assessments. However, in this proposal EPA is primarily relying on method 8. Method 8 is currently preferred by the Federal Land Managers; since the revised IMPROVE equation performs better at estimating visibility.[83] For the facilities examined in this proposal, baseline impacts using method 6 would average about 10 percent higher than those using method 8 (with a range of 18 percent lower to28 percent higher depending on facility and Class I area; the effect for areas showing the largest benefit from control was similar to the average).

Natural Background Conditions: Another CALPUFF choice is whether to calculate visibility impacts relative to annual average natural conditions, or relative to the best 20 percent of natural background days; these may be referred to as "a" and "b". For both "a" and "b", background concentrations for each Class I area are available in a Federal Land Managers' document.[84] EPA Guidance allows for the use of either "a" or "b.""[85] Since the annual average has worse visibility and higher deciviews than the best days do, a given facility impact will be smaller relative to the average than it is relative to the best days. That is, a facility's impact will stand out less under poorer visibility conditions. Thus, modeled facility impacts and control benefits appear smaller when "a" is used than when "b" is used. In this proposal, EPA is relying on "b", best 20 percent, consistent with initial EPA recommendations for BART assessments. [86] For the facilities examined in this proposal, baseline impacts would average about 20 percent lower using background "a" than those using background "b" (with a range of 17 percent to 28 percent lower depending on facility and Class I area; the effect for areas showing the largest benefit from control was similar to the average).

Considering visibility method and choice of background together, the BART visibility assessments relied on by ADEQ used method "6a", the old IMPROVE equation, and impacts relative to annual average natural conditions. This is a valid approach, and is consistent with EPA guidance.[87] However, for this proposal, EPA considered all four combinations of IMPROVE equation version and natural background: 6a, 6b, 8a, and 8b. EPA primarily relied on method "8b", that is, the revised IMPROVE equation, and impacts relative to the best 20 percent

[83] Pitchford, Marc, 2006, "New IMPROVE algorithm for estimating light extinction approved for use", The IMPROVE Newsletter, Volume 14, Number 4, Air Resource Specialists, Inc.; web page: http://vista.cira.colostate.edu/improve/Publications/news_letters.htm

[84] ***Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report—Revised*** (2010), U.S. Forest Service, National Park Service, U.S. Fish and Wildlife Service, October 2010. Available on web page http://www.nature.nps.gov/air/Permits/flag/

[85] "Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations", memorandum from Joseph W. Paisie, EPA OAQPS, July 19, 2006, p.2

[86] BART Guidelines, 70 FR 39125, July 6, 2005. "Finally, these final BART guidelines use the natural visibility baseline for the 20 percent best visibility days for comparison to the 'cause or contribute' applicability thresholds."

[87] Additional Regional Haze Questions", September 27, 2006 Revision, EPA OAQPS

of natural background days. This is most consistent with our current understanding of how best to assess source specific visibility impacts. Combining the differences in visibility method and chosen background, for the facilities examined in this proposal, baseline impacts would average about 15 percent lower using method "6a" than those using method "8b" (with a range of 1 percent to 37 percent lower depending on facility and Class I area; the effect for areas showing the largest benefit from control was similar to the average).

B. EPA's BART Determinations

1. Apache Units 2 and 3

a) Costs of Compliance

Our general approach to calculating the costs of compliance is described in III.A.1, while issues unique to Apache Units 2 and 3 are described herein. As mentioned in the Federal Register notice for this proposal, control costs were developed by our contractor using the Integrated Planning Model (IPM) Base Case v4.10 (August 2010). The specific parameters and assumptions used in developing these costs are included in our contractor's report and its associated spreadsheet. A summary of capital and operating costs is included in Table 16.

Table 16 - Apache 2 and 3: EPA's Control Cost Estimates

	Apache 2			Apache 3		
	LNB+OFA	SNCR+ LNB+OFA	SCR+ LNB+OFA	LNB+OFA	SNCR+ LNB+OFA	SCR+ LNB+OFA
Unit Output (MW)	204	204	204	204	204	204
Capacity Factor	0.62	0.62	0.62	0.71	0.71	0.71
Capital Cost	10,543,189	14,623,189	44,779,657	10,543,189	14,623,189	43,812,028
Capital Recovery Factor	0.094	0.094	0.094	0.094	0.094	0.094
Annualized Rate ($/yr)	**995,202**	**1,380,326**	**4,226,883**	**995,202**	**1,380,326**	**4,135,546**
Fixed O&M ($/year)	70,288	173,235	432,688	70,288	173,235	432,688
$/MW-yr	345	505	1,776	345	505	1,776
Variable O&M ($/year)	77,558	1,100,321	1,210,656	88,816	1,413,298	1,532,869
$/MWh	0.07	0.92	1.02	0.07	1.04	1.14
Annual O&M ($/year)	**147,845**	**1,273,555**	**1,643,344**	**159,104**	**1,586,532**	**1,965,557**
Total Annual Cost ($/year)	**1,142,120**	**2,652,841**	**5,869,299**	**1,153,378**	**2,968,611**	**6,103,078**

The capital recovery factor (0.094) listed above is based upon an interest rate of 7% over a 20 year equipment lifetime. Please note that this value does not include property tax (0.90%) and insurance (0.30%), which were included by our contractor in their calculation of capital recovery factor. As a result, the annualized rate ($/yr) and total annual cost ($/yr) listed in the table above are lower than the cost values summarized in our contractor's cost calculation deliverable.[88] Estimates of the annual emission rates used in cost calculations are summarized in Table 17.

Table 17 - Apache 2 and 3: EPA's Annual Emission Estimates

Control Option	Percent Reduction	Emission Factor (lb/MMBtu)	Heat Rate (MMBtu/hr)	Annual Capacity Factor	Emission Rate (lb/hr)	Emission Rate (tpy)
Apache 2						
Baseline (OFA)	--	0.371	2,316	0.62	859	2,333
LNB+OFA	30%	0.26	2,316	0.62	601	1,633
SNCR+LNB+OFA[1]	51%	0.18	2,316	0.62	421	1,143
SCR+LNB+OFA	87%	0.05	2,316	0.62	116	314
Apache 3						
Baseline (OFA)	--	0.438	2,223	0.71	974	3,028
LNB+OFA	30%	0.31	2,223	0.71	682	2,120
SNCR+LNB+OFA[1]	51%	0.21	2,223	0.71	477	1,484
SCR+LNB+OFA	89%	0.05	2,223	0.71	111	346

[1] SNCR control effectiveness is based upon a 30% incremental reduction from LNB emission rates

In particular, we highlight below certain aspects of our analysis of this factor that differ from ADEQ's and AEPCO's analysis.

(1) Selection of Baseline Period

AEPCO's BART analysis used a 2002 to 2007 time period in order to establish its baseline NO_x emissions. In our analysis, we decided to make use of the most recent Acid Rain Program emission data reported to CAMD, which, at the time that we began our analysis in 2011, was the three-year period from 2008 to 2010. Based on CAMD documentation, no new control technology beyond the existing OFA system has been installed on either Apache Unit 2 or 3. We consider the use of this more recent baseline period to be a realistic depiction of anticipated future emissions.[89]

(2) SCR Control Efficiency

In determining the control efficiency of SCR, we have relied upon an SCR level of performance of 0.05 lb/MMBtu, which is more stringent than the level of performance used by ADEQ in its SIP. In the Apache BART analyses submitted to ADEQ, AEPCO indicated an SCR level of performance of 0.07 lb/MMBtu, but did not provide site-specific information describing how this emission rate was developed or discussing why a more stringent 0.05 lb/MMBtu level of performance could not be attained. Our control cost calculations for the SCR and LNB with OFA control options are based upon the control efficiency of SCR (combined with LNB) summarized in Table 18.

[88] See Appendix C of WA5-12 Task 8 Deliverable (Apache-Cholla-Coronado BART Analysis Report).docx
[89] BART Guidelines, 40 CFR Part 51, Appendix P, Section IV.D.4.d

Table 18 - Apache 2 and 3: EPA's SCR (Combined with LNB) Control Efficiency

Unit	Baseline Emission Rate[1] (lb/MMBtu)	SCR Emission Rate	SCR Control Efficiency (percentage)
Apache 2	0.371	0.05	87%
Apache 3	0.438	0.05	89%

[1] This baseline emission rate represents operation of OFA only.

(3) Capacity Factor

As noted previously, AEPCO calculated annual emission estimates for its control scenarios, in tons per year, using annual capacity factors developed internally over an unspecified time frame.[90] The annual capacity factors AEPCO used for each unit were 92 percent (Apache 2), and 87 percent (Apache 3). We have also calculated annual emission estimates for our control scenarios using capacity factors, but have used information developed from CAMD information, and over a more recent 2008 to 2011 time frame. The annual capacity factors we have used for each unit are 62 percent (Apache 2), and 71 percent (Apache 3). We recognize that these capacity factors are lower than those used by AEPCO, and that by using these lower capacity factors, our estimates of total annual emissions (and correspondingly, the annual emission reductions) for each control scenario are lower than AEPCO's estimates.[91] Since cost-effectiveness ($/ton) is calculated by dividing annual control costs ($/year) by annual emission reductions (tons/year), the use of emission reductions based on lower capacity factors will increase the cost per ton of pollutant reduced.

We have elected to use the capacity factors specified above, as based on a 2008 to 2011 time frame, in order to remain consistent with the time frame used to develop baseline annual emissions for Apache and the other power plants that are the subject of today's proposed action.

(4) Summary of Control Cost Estimates

A summary of our control cost estimates for the various control technology options considered for Apache Units 2 and 3 is in Table 19.

Table 19 - Apache Units 2 and 3: EPA's Control Cost Summary

Control Option	Emission Factor	Emission Rate	Emissions Removed	Annual Cost	Cost-effectiveness ($/ton)

[90] As listed in Table 2-1 in Docket Items B-03 and B-04, Apache BART Analyses

[91] We note that there are multiple reasons why our annual emission estimates (and estimates of emission removal) are lower than AEPCO's and ADEQ's estimates. We are not implying that the use of capacity factor is the sole, or even dominant, reason for this difference, simply that the use of lower capacity factors will result in lower annual emission estimates.

	(lb/MMBtu)	(lb/hr)	(tpy)	(tpy)	($/yr)	Ave	Incremental (from previous)
Apache 2							
OFA (baseline)	0.371	859	2,333	--	--	--	--
LNB+OFA	0.26	601	1,633	700	1,142,120	1,632	--
SNCR+LNB+OFA	0.18	421	1,143	1,190	2,652,841	2,230	3,084
SCR+LNB+OFA	0.05	116	314	2,019	5,869,299	2,908	3,881
Apache 3							
OFA (baseline)	0.438	974	3,028	--	--	--	--
LNB+OFA	0.31	682	2,120	908	1,153,378	1,270	--
SNCR+LNB+OFA	0.22	477	1,484	1,544	2,968,611	1,922	2,854
SCR+LNB+OFA	0.05	111	346	2,683	6,103,078	2,275	2,754

As seen in Table 19, our calculations indicate that the SCR-based control options have average cost-effectiveness values of $2,275/ton to $2,908/ton, which falls in a range that we consider cost-effective. In addition, our calculations indicate that the SCR-based control options have an incremental cost-effectiveness of $2,754/ton to $3,881/ton, which is also in a range that we would consider cost-effective. As a result, our analysis of this factor indicates that the costs of compliance (average or incremental) are not sufficiently large to warrant eliminating any of the control options from consideration.

b) Visibility Improvement

The overall visibility modeling approach was described above; aspects of the modeling specific to Apache are described here. EPA is proposing a NO_x BART determination only for Apache units 2 and 3, but Unit 1 was also included in the modeling runs for greater realism in assessing the full facility's visibility impacts.[92] For Unit 1's NO_x emissions, ADEQ's emission factor of 0.56 lb/MMBtu was combined with the maximum MMBtu/hr heat rate from EPA's CAMD database for 2008 to 2010. The baseline emissions used for these units were the maximum daily emissions in lb/hr from 2008 to 2010; the maxima occurred in early 2008. The base case reflects only OFA as the control in place.

EPA evaluated LNB, SNCR (including LNB), and SCR (including LNB) applied to both Units 2 and 3; as mentioned above the SCR simulation accounted for the increase in sulfuric acid emissions due to catalyst oxidation of SO_2. SCR was assumed to give a control effectiveness of 87 percent and 89 percent for Units 2 and 3, respectively (less than 90 percent due to the 0.05 lb/MMBtu NO_x lower limit assumed for SCR). The nine Class I areas within 300 km of Apache were modeled; they are in the states of Arizona and New Mexico. The 98th percentile of delta deciviews over all three years of data was computed for each area and emission scenario. Table 20 shows the impact for the base case, and the improvement from that baseline impact when

[92] Apache Unit 4, which consists of four simple-cycle gas turbines, was not included in the modeling because its NOx emissions are less than 1 percent of the emissions of units 2 and 3, and are therefore expected to have a ***de minimis*** effect on modeled visibility impacts.

controls are applied, all in deciviews, for each area.[93] Note that in all cases the deciview impacts are the "delta deciviews" from the CALPUFF model, that is, the impairment added (the "delta") when pollution from the facility is added to natural background conditions. The Class I area types are National Monument (NM), Wilderness Area (WA), and National Park (NP). Also shown are the cumulative deciviews, the simple sum of impacts or improvements over all the Class I areas, and the number of areas with a baseline impact or improvement of at least 0.5 dv. The "Max. area number of days >= 0.5 dv" row shows the number of days that visibility impairment was greater than or equal to 0.5 dv, for the area having the greatest modeled impairment; the next row is comparable but uses 1.0 dv as the day-counting threshold. (Note that the "Improvement" columns shows the difference between a) the number of days over 0.5 that is the highest among all the areas before controls, and b) the number of days highest among the areas after controls; the highest number of days may occur at different areas before and after controls. The improvements within a single given area are shown in the other table.)

Finally, the table includes two "dollars per deciview" [94] measures of cost-effectiveness, both of which take the annual cost of the control in millions of dollars per year, and divide by an improvement in deciviews. For the first metric, "$/max dv", cost is divided by the deciview improvement at the Class I area with the greatest improvement. The second metric, "$/cumulative dv", divides cost by the cumulative deciview improvement. In assessing the degree of visibility improvement from controls, EPA relied heavily on the maximum dv improvement and the number of areas showing improvement, with cumulative improvement providing a supplemental measure that combines information on the number of areas and on individual area improvement. The dollars per deciview metrics provided information supplemental to the dollars per ton that was considered in the cost factor.

Table 21[95] shows the number of days each area experiences modeled visibility impairment greater than or equal to 0.5 dv, and also the "cumulative" number of days. This is just the sum of the individual area values, and may not actually represent distinct calendar days.

In its comments on Arizona's proposed Regional Haze SIP, the National Park Service noted that:

> Compared to the typical control cost analysis in which estimates fall into the range of $2,000 - $10,000 per ton of pollutant removed, spending millions of dollars per deciview (dv) to improve visibility may appear extraordinarily expensive. However, our compilation of BART analyses across the U.S. reveals that the average cost per dv proposed by either a state or a BART source is $14 - $18 million.[96]

[93] The deciview impacts are copied from the spreadsheet "AZRHFIP_TSD_vis_summ_tables.xlsx", which in turn relies on the spreadsheet "aep_az_unit2-3_dollarperdv_analysis_finalwithplots2.xls" prepared by UNC.
[94] The costs used in $/dv rely on the spreadsheet "EGU BART Costs_Apache_Cholla_Coronado_FINAL2.xlsx" also prepared by UNC. Note that the costs in the latter are slightly different than those in the cost tables in this TSD, which as noted above do not include property tax and insurance.
[95] The number of days above 0.5 and 1.0 dv are from the spreadsheet "AZRHFIP_TSD_Apache_visx.xlsx"
[96] Arizona Regional Haze SIP, Appendix E, Public Process, NPS General BART Comments on ADEQ BART Analyses (November 29, 2010), p. 4.

While we do not necessarily consider $14 to $18 million/dv as being a reasonable range in all cases, we note that for all of the NO_x control options, including SCR, both the $/max dv and the $/cumulative dv are well below this range.

The area with the greatest dv improvement was the Chiricahua Wilderness Area; the improvement from LNB was 0.5 dv, from SNCR was 1 dv, and from SCR was 1.6 dv. Any of these improvements would contribute to improved visibility, with SCR being the superior option for visibility. The corresponding cumulative improvements are 2.1, 3.8, and 6.5. Both SNCR and SCR give improvements exceeding 0.5 dv at four areas, but for SCR the improvements at those areas also exceed a full 1 dv. As shown in Table 21, the number of days per year with impacts above 0.5 dv decreases by 10 for LNB, by 23 for SNCR, and by 42 for SCR (considering the area where the decrease is the greatest, Chiricahua National Monument). The improvements from SCR are substantially greater than for the other candidate controls. The modeled degree of visibility improvement supports SCR as BART for Apache.

Table 20 - Apache Units 2 and 3: EPA's Visibility Improvement from NOx Controls

	base	ctrl1_r	ctrl2_r	ctrl3s
Class I Area	Baseline impact (dv)	Improvement from LNB (dv)	Improvement from SNCR (dv)	Improvement from SCR (dv)
Chiricahua NM	3.41	0.44	0.82	1.51
Chiricahua WA	3.46	0.53	1.00	1.59
Galiuro WA	2.22	0.39	0.65	1.10
Gila WA	0.63	0.14	0.22	0.37
Mazatzal WA	0.28	0.05	0.09	0.14
Mount Baldy WA	0.28	0.07	0.11	0.18
Saguaro NP	2.49	0.38	0.66	1.16
Sierra Ancha WA	0.29	0.06	0.10	0.14
Superstition WA	0.61	0.10	0.19	0.31
Cumulative dv	13.67	2.14	3.83	6.51
# areas >= 0.5	6	1	4	4
Max. area number of days >= 0.5 dv	128	10	23	42
Max. area number of days >= 1.0 dv	75	12	25	40
$/max dv, millions		$4.8	$6.0	$8.2
$/cumulative dv, millions		$1.2	$1.6	$2.0

Table 21 - Apache Units 2 and 3: EPA's Visibility Improvement Days from NOx Controls

	Base	ctrl1_r	ctrl2_r	ctrl3s
Class I Area	Baseline impact (days)	Improvement from LNB (days)	Improvement from SNCR (days)	Improvement from SCR (days)
Chiricahua NM	128	10	21	42
Chiricahua WA	116	8	23	39
Galiuro WA	46	7	10	20
Gila WA	12	5	8	11
Mazatzal WA	3	2	3	3
Mount Baldy WA	2	1	1	2
Saguaro NP	80	6	13	19
Sierra Ancha WA	2	1	1	2
Superstition WA	9	2	5	8
Cumulative #days >= 0.5	398	41	85	146

c) EPA's BART Determination

In considering the results of the five-factor analysis, we note that the remaining useful life of the source, as indicated previously by the plant economic life of Apache Units 2 and 3, is incorporated into control cost calculations as a 20-year amortization period. In addition, the presence of existing pollution control technology is reflected in the cost and visibility factors as a result of selection of the baseline period for cost calculations and visibility modeling. For Apache Units 2 and 3, a baseline period (2008 to 2010) was selected that reflects the currently existing pollution control technology (OFA). In examining energy and non-air quality impacts, we note certain potential impacts resulting from the use of ammonia injection associated with the

SNCR and SCR control options, but do not consider these impacts sufficient enough to warrant eliminating any of the available control technologies.

Our consideration of degree of visibility improvement focuses primarily on the improvement from base case impacts associated with each control option. While each of the available NO_x control options achieves some degree of visibility improvement, we consider the improvement associated with the most stringent option, SCR with LNB and OFA, to be substantial. Our consideration of cost of compliance focuses primarily on the cost-effectiveness of each control option, as measured in cost per ton and incremental cost per ton of each control option. Despite the fact that the most stringent option, SCR with LNB and OFA, is the most expensive of the available control options, we consider it cost-effective on an average basis as well as on an incremental basis when compared to the next most stringent option, SNCR with LNB and OFA.

As a result, we consider the most stringent available control option, SCR with LNB and OFA, to be both cost-effective and to result in substantial visibility improvement, and that the energy and non-air quality impacts are not sufficient to warrant eliminating it from consideration. Therefore, the results of our five-factor analysis indicate that NO_x BART for Apache Units 2 and 3 is SCR with LNB and OFA.

However, we note that the BART guidelines state that:

> 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. […]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."[97]

As explained in Section IX.C of the Federal Register notice for this proposed action, because AEPCO is a "small entity", as defined under the Regulatory Flexibility Act, we have conducted an initial assessment of the potential adverse impacts on AEPCO of requiring SCR with LNB and OFA. Using publicly available information, EPA estimates that the annualized cost of requiring SCR in Units 1 and 2 would likely be in the range of 3 percent of AEPCO's assets and between 6 and 7 percent of AEPCO's annual sales. The projected costs of SCR with LNB and OFA are approximately $12 million per year. This exceeds AEPCO's net margins of $9.5 million in 2010 and $1.9 million in 2011.[98] See Table 22 for more information.

[97] 70 FR 39171

[98] See Docket Item G-12Arizona Electric Power Cooperative, Inc. Annual Report Electric for Year Ending December 31, 2011 submitted to Arizona Corporation Commission Utilities Division, also available at http://www.azcc.gov/Divisions/Utilities/Annual%20Reports/2011/Electric/Arizona_Electric_Power_Cooperative_Inc.pdf.

Table 22 - Relationship between Emission Control Costs and AEPCO Financial Data

Cost of controls (SCR option)		
Apache 2:	$5,870,227	
Apache 3:	$6,101,103	
Total:	$11,971,330	
AEPCO Financials	**2010**	**2011**
Total Revenue:*	$207,377,079	$169,668,330
Net Margin:*	$9,503,556	$1,855,188
Total Assets:*	$350,634,866	
cost/revenue	5.8%	7.1%
cost/assets	3.4%	
net margin-cost	$(2,467,774)	$(10,116,142)

*From Docket Item H-1- Arizona Electric Power Cooperative, Inc. Annual Report Electric for Year Ending December 31, 2011 submitted to Arizona Corporation Commission Utilities Division

In addition to conducting this initial economic impact assessment, we requested information from AEPCO on the economics of operating Apache Generating Station and what impact the installation of SCR may have on the economics of operating Apache Generating Station. On June 29, 2012, we received a description of plant conditions and potential economic effects and are placing this information in the docket for this action.[99] We will consider this information and any additional information received during the comment period as part of our final action. If our analysis of this information indicates that installation of SCR will have a severe impact on the economics of operating Apache Generating Station, we will incorporate such considerations in our selection of BART.

Nonetheless, based on the available control technologies and the five factors discussed above, EPA is proposing to require Apache Generating Station to meet an emission limit for NO_x on Units 2 and 3 of 0.050 lb/MMBtu. Each of these emission limits is based on a rolling 30-boiler-operating-day average.

2. Cholla Units 2, 3 and 4

a) Costs of Compliance

Our general approach to calculating the costs of compliance is described in section III.A.1 above. Issues unique to Cholla Units 2, 3 and 4 are explained herein. As mentioned in the Federal Register notice for this proposal, control costs were developed by our contractor using

[99] Docket Item C-16, Letter from Michelle Freeark (AEPCO) to Deborah Jordan (EPA), AEPCO's Comments on BART for Apache Generating Station, June 29, 2012.

the Integrated Planning Model (IPM) Base Case v4.10 (August 2010). The specific parameters and assumptions used in developing these costs are included in our contractor's report and its associated spreadsheet. A summary of capital and operating costs is included in Table 23.

The capital recovery factor (0.094) listed above is based upon an interest rate of 7% over a 20 year equipment lifetime. Please note that this value does not include property tax (0.90%) and insurance (0.30%), which were included by our contractor in their calculation of capital recovery factor. As a result, the annualized rate ($/yr) and total annual cost ($/yr) listed in the table above are lower than the cost values summarized in our contractor's cost calculation deliverable.[100] Estimates of the annual emission rates used in cost calculations are summarized in Table 24.

[100] See Appendix C of WA5-12 Task 8 Deliverable (Apache-Cholla-Coronado BART Analysis Report).docx

Table 23 - Cholla 2, 3, and 4: EPA's Control Cost Estimates

	Cholla 2		Cholla 3		Cholla 4	
	SNCR	**SCR**	**SNCR**	**SCR**	**SNCR**	**SCR**
Unit Output (MW)	290	290	312	312	414	414
Capacity Factor	0.74	0.74	0.75	0.75	0.72	0.72
Capital Cost	5,778,000	53,939,914	6,246,000	60,563,867	8,280,000	73,858,811
Capital Recovery Factor	0.094	0.094	0.094	0.094	0.094	0.094
Annualized Rate ($/yr)	**545,402**	**5,091,546**	**589,578**	**5,716,801**	**781,573**	**6,971,749**
Fixed O&M ($/year)	120,277	363,780	124,352	362,052	144,686	362,400
$/kW-yr	0.41	1.25	0.40	1.16	0.35	0.88
$/MW-yr	415	1,254	399	1,160	349	875
Variable O&M ($/year)	1,816,639	2,019,701	1,816,580	2,034,278	2,258,790	2,560,647
$/MWh	0.97	1.07	0.89	0.99	0.87	0.98
Annual O&M ($/year)	**1,936,916**	**2,383,481**	**1,940,933**	**2,396,330**	**2,403,476**	**2,923,047**
Total Annual Cost ($/year)	**2,482,318**	**7,475,028**	**2,530,511**	**8,113,131**	**3,185,049**	**9,894,796**

Table 24 - Cholla 2, 3, and 4: EPA's Annual Emission Estimates

Control Option	**Percent**	**Emission Factor**	**Heat Rate**	**Annual Capacity**	**Emission Rate**	
	Reduction	**(lb/MMBtu)**	**(MMBtu/hr)**	**Factor**	**(lb/hr)**	**(tpy)**
Cholla 2						
Baseline (LNB+OFA)	--	0.295	3,022	0.74	892	2,890
SNCR+LNB+OFA	30%	0.21	3,022	0.74	624	2,023
SCR+LNB+OFA	83%	0.05	3,022	0.74	151	490
Cholla 3						
Baseline (LNB+OFA)	--	0.254	3,480	0.75	885	2,908
SNCR+LNB+OFA	30%	0.18	3,480	0.75	620	2,036
SCR+LNB+OFA	80%	0.05	3,480	0.75	174	572
Cholla 4						
Baseline (LNB+OFA)	--	0.260	4,399	0.72	1144	3,609
SNCR+LNB+OFA	30%	0.18	4,399	0.72	801	2,526
SCR+LNB+OFA	81%	0.05	4,399	0.72	220	694

There are several aspects of our analysis of this factor that differ from ADEQ's and APS' analysis and we discuss the most important of these below.

(1) Selection of Baseline Period

APS' BART analysis used a 2001-03 time period in order to establish its baseline NO_x emissions. As noted previously, the NO_x control technology present on Cholla Units 2 through 4 during that time period was close-coupled over fire air (COFA). APS has since installed low-NO_x burners with separated over fire air (SOFA) on Cholla Units 2 through 4. In order to properly consider the second BART factor (pollution control equipment in use at the source) and to ensure that actual conditions at the plant were reflected in our baseline NO_x emissions, we decided to make use of the most recent Acid Rain Program emission data reported to CAMD, which, at the time that we began our analysis in 2011, was the three-year period from 2008 to 2010. Based on CAMD documentation, the low-NO_x burners were installed on the Cholla units at different times during 2008 and 2009, making it necessary for us to clearly distinguish between the pre-LNB and post-LNB periods of emission data for each unit.

The use of a 2008 to 2010 baseline was, however, complicated by the fact that the Cholla plant operates under a new coal contract for Lee Ranch/El Segundo coal, which is a higher NO_x-emitting coal than what was previously used.[101] This coal contract indicates that steadily increasing minimum quantities of coal shall be delivered, starting with 325,000 tons in 2006 and up to 3,700,000 tons in 2010. This gradual transition to the newer, higher-NO_x emitting coal source made it difficult to determine the extent to which a particular year's emissions were representative of anticipated annual emissions. In the absence of more detailed fuel usage records on a per-unit basis, it was not possible for us to identify which units may have operated using the newer coal during the 2006 to 2010 transition period to the newer coal type. We note, however, that the coal contract specifically states that, for 2010 to 2024, no later than July 1 of each year, the buyer shall indicate the annual tonnage for the following calendar year, and that in no case shall the annual tonnage be less than 3,700,000 tons. As a result, 2011 represents the first complete calendar year at which we can be certain that the Cholla plant operated at the new coal contract's "full" minimum purchase quantity of 3,700,000 tons per year.

Since 2011 Acid Rain Program emission data became available during the intervening time between the start of our analysis and our proposed action today, we have selected 2011 as the time period for establishing baseline annual NO_x emissions. Although this represents only a single year of data, we believe the use of this more recent baseline period represents the most realistic depiction of anticipated annual emissions, as it is the only time period that ensures each of the Cholla units is operating using the new coal and LNB with SOFA.

(2) SCR Control Efficiency

In determining the control efficiency of SCR, we have relied upon an SCR level of performance of 0.05 lb/MMBtu, which is more stringent than the level of performance used by ADEQ in its SIP. In the Cholla BART analysis submitted to ADEQ, APS indicated an SCR level of performance of 0.07 lb/MMBtu, but did not provide site-specific information describing how

[101] A copy of the coal contract, including obligation amounts and coal quality, can be found in Docket Item B-09, "Additional APS Cholla BART response", Appendix B.

this emission rate was developed or discussing why a more stringent 0.05 lb/MMBtu level of performance could not be attained. Our control cost calculations for the SCR and LNB with OFA control options are based upon the SCR control efficiencies summarized in Table 25. These control efficiencies reflect the emission reductions associated with controlling from an annual average baseline emission rate that represents LNB with OFA (as described previously) down to an SCR emission rate of 0.05 lb/MMBtu.

Table 25 - Cholla Units 2, 3, and 4: EPA's SCR Control Efficiency

Unit	Baseline Emission Rate[1] (lb/MMBtu)	SCR Emission Rate	SCR Control Efficiency (percentage)
Cholla 2	0.295	0.05	83%
Cholla 3	0.254	0.05	80%
Cholla 4	0.260	0.05	81%

[1] As noted previously, this baseline emission rate reflects the installation of LNB+OFA

(3) Capacity Factor

As noted previously, APS calculated annual emission estimates for its control scenarios, in tons per year, using annual capacity factors based on Acid Rain Program data from CAMD over a 2001 to 2006 time frame.[102] The annual capacity factors APS used for each unit were 91 percent (Cholla 2), 86 percent (Cholla 3), and 93 percent (Cholla 4). We have also calculated annual emission estimates for our control scenarios using capacity factors developed from CAMD information, but have instead used a more recent 2008 to 2011 time frame. The annual capacity factors we have used for each unit are 74 percent (Cholla 2), 75 percent (Cholla 3), and 71 percent (Cholla 4). We recognize that these capacity factors are lower than those used by APS, and that by using these lower capacity factors, our estimates of total annual emissions (and correspondingly, the annual emission reductions) for each control scenario are lower than APS' estimates.[103] Since cost-effectiveness ($/ton) is calculated by dividing annual control costs ($/year) by annual emission reductions (tons/year), the use of emission reductions based on lower capacity factors will increase the cost per ton of pollutant reduced.

We have elected to use the capacity factors specified above, as based on a 2008 to 2011 time frame, in order to remain consistent with the time frame used to develop baseline annual

[102] As listed in Table 2-1 in Docket Items B-06 through B-08, Cholla BART Analyses

[103] We note that there are multiple reasons why our annual emission estimates (and estimates of emission removal) are lower than APS' and ADEQ's estimates. We are not implying that the use of capacity factor is the sole, or even dominant, reason for this difference, simply that the use of lower capacity factors will result in lower annual emission estimates.

emissions for Cholla and the other power plants that are the subject of today's proposed action.[104]

(4) Summary of Control Costs

A summary of our control cost estimates for the various control technology options considered is included in Table 26.

Table 26 - Cholla Units 2, 3, and 4: EPA's Control Cost Summary

Control Option	Emission Factor (lb/MMBtu)	Emission Rate		Emissions Removed (tpy)	Annual Cost ($/yr)	Cost-effectiveness ($/ton)	
		(lb/hr)	(tpy)			Ave	Incremental (from previous)
Cholla 2							
OFA	NA; LNB+OFA is the currently installed technology						
LNB+OFA (baseline)	0.295	892	2,890	--	--	--	--
SNCR+LNB+OFA	0.21	624	2,023	867	2,482,318	2,863	--
SCR+LNB+OFA	0.05	151	490	2,400	7,475,028	3,114	3,257
Cholla 3							
OFA	NA; LNB+OFA is the currently installed technology						
LNB+OFA (baseline)	0.254	885	2,908	--	--	--	--
SNCR+LNB+OFA	0.18	620	2,036	872	2,533,432	2,904	--
SCR+LNB+OFA	0.05	174	572	2,337	8,113,131	3,472	3,811
Cholla 4							
OFA	NA; LNB+OFA is the currently installed technology						
LNB+OFA (baseline)	0.260	1144	3,609	--	--	--	--
SNCR+LNB+OFA	0.18	801	2,526	1,083	3,185,822	2,943	--
SCR+LNB+OFA	0.05	220	694	2,915	9,894,796	3,395	3,661

[104] We recognize that there are more aggressive approaches we could adopt that could justify the use of higher capacity factors, which would thereby lower the cost per ton of pollutant reduced. For example, instead of using historical data to develop a capacity factor value for each unit, we could use a single capacity factor value for each unit, one that represented a reasonable depiction of anticipated annual baseload operations. Alternately, we could also use the capacity factor estimates from APS' Cholla BART analyses, as based on a 2001-06 time frame, or develop new capacity factors based on a longer 2001 to 2011 time frame.

As indicated in Table 26, our calculations indicate that the SCR-based control options have average cost-effectiveness values of $3,114/ton to $3,472/ton, which falls in a range that we would consider cost-effective. In addition, our calculations indicate that the SCR-based control options have an incremental cost-effectiveness of $3,257/ton to $3,811/ton, which is also in a range that we would consider cost-effective. As a result, our analysis of this factor indicates that the costs of compliance (average or incremental) are not sufficiently large to warrant eliminating any of the control options from consideration.

b) Visibility Improvement

The overall visibility modeling approach was described above; aspects of the modeling specific to Cholla are described here. EPA made a NO_x BART determination for Cholla Units 2, 3 and 4, but Unit 1 (which is not BART-eligible) was also included in the modeling runs for greater realism in assessing the full facility's visibility impacts. For Unit 1's NO_x emissions, the maximum daily emissions from EPA's CAMD database for 2008 to 2010 were used; the maximum occurred in early 2008. LNBs were installed on Units 2 and 4 early in 2008, and on Unit 3 in mid-2009; for a realistic base case, the baseline emissions used for these units were the maximum daily emissions in lb/hr from 2008-2010 occurring after the respective LNB installation dates. The maximum for unit 2 occurred in mid-2009, and the maxima for Units 2 and 3 occurred in late 2010. The base case reflects LNB as the control in place.

EPA evaluated SNCR (including LNB) and SCR (including LNB) applied to Units 2, 3 and 4. SCR was assumed to give a control effectiveness of 83 percent, 80 percent, and 81 percent for units 2, 3 and 4, respectively (less than 90 percent due to the 0.05 lb/MMBtu NO_x lower limit assumed for SCR). For Cholla, the increase in sulfuric acid due to SCR was not simulated, because the baghouse (fabric filter) installed for particulate matter control would reduce this increased sulfate by 99 percent, resulting in a negligible effect on the visibility estimate. The 13 Class I areas within 300 km of Cholla were modeled; they are in the states of Arizona, Colorado, New Mexico, and Utah. The 98th percentile delta deciview using all three years of data together was computed for each area and emission scenario.

Table 27[105] and Table 28 show baseline visibility impacts and the visibility improvement when controls are applied; the various table entries are described above in the discussion of the comparable tables for Apache Generating Station. The area with the greatest dv improvement was the Petrified Forest National Park; the improvement from SNCR was just under 0.5 dv and from SCR was 1.3 dv. Either of these improvements would contribute to improved visibility, with SCR being the superior option for visibility. The corresponding cumulative improvements are 2.7 and 7.2. Only SCR gives improvements exceeding 0.5 dv, and it does so at eight areas, two of which have improvements above a full 1 dv. The number of days per year with impacts above 0.5 dv decreases by 7 for SNCR, and by 21 for SCR (considering the area where the

[105] The deciview impacts are copied from the spreadsheet "AZRHFIP_TSD_vis_summ_tables.xlsx", which in turn relies on the spreadsheet "cho_az_unit2-3_dollarperdv_analysis_finalwithplots2.xls" prepared by UNC. The costs used in $/dv rely on the spreadsheet "EGU BART Costs_Apache_Cholla_Coronado_FINAL2.xlsx" also prepared by UNC. Note that the costs in the latter are slightly different than those in the cost tables in this TSD, which as noted above do not include property tax and insurance. The number of days above 0.5 and 1.0 dv are from the spreadsheet "AZRHFIP_TSD_Cholla_visx.xlsx".

decrease is the greatest, Mesa Verde). The modeled degree of visibility improvements supports SCR as BART for Cholla.

Table 27 - Cholla Units 2, 3, and 4: EPA's Visibility Improvement from NOx Controls

	base	**ctrl1_r**	**ctrl2_r2**
Class I Area	Baseline impact (dv)	Improvement from SNCR (dv)	Improvement from SCR (dv)
Capitol Reef NP	1.46	0.27	0.76
Galiuro WA	0.45	0.05	0.14
Gila WA	0.70	0.09	0.22
Grand Canyon NP	2.22	0.37	1.06
Mazatzal WA	1.19	0.16	0.43
Mesa Verde NP	1.34	0.26	0.70
Mount Baldy WA	1.21	0.27	0.52
Petrified Forest NP	4.53	0.47	1.34
Pine Mountain WA	0.85	0.12	0.31
Saguaro NP	0.30	0.02	0.05
Sierra Ancha WA	1.36	0.20	0.51
Superstition WA	1.27	0.17	0.51
Sycamore Canyon WA	1.42	0.27	0.68
Cumulative dv	18.30	2.71	7.21
# areas >= 0.5	11	0	8
Max. area number of days >= 0.5 dv	252	7	21
Max. area number of days >= 1.0 dv	213	8	29
$/max dv, millions		$17.8	$20.8
$/cumulative dv, millions		$3.1	$3.8

Table 28 - Cholla Units 2, 3, and 4: EPA's Visibility Improvement Days from NOx Controls

	base	ctrl1_r	ctrl2_r2
Class I Area	Baseline impact (days)	Improvement from SNCR (days)	Improvement from SCR (days)
Capitol Reef NP	19	1	8
Galiuro WA	5	1	3
Gila WA	17	4	10
Grand Canyon NP	28	3	9
Mazatzal WA	35	5	16
Mesa Verde NP	33	7	21
Mount Baldy WA	29	4	14
Petrified Forest NP	252	6	20
Pine Mountain WA	19	4	11
Saguaro NP	4	2	3
Sierra Ancha WA	41	5	16
Superstition WA	26	3	10
Sycamore Canyon WA	24	5	12
Cumulative #days >= 0.5	530	50	152

c) EPA's BART Determination

As noted above, the remaining useful life of the source is incorporated into control cost calculations as a 20-year amortization period. In addition, the presence of existing pollution control technology is reflected in the cost and visibility factors as a result of selection of the baseline period for cost calculations and visibility modeling. For Cholla Units 2, 3, and 4, a baseline period (2011) was selected that reflects the currently existing pollution control technology (LNB with OFA). In examining energy and non-air quality impacts, we note certain potential impacts resulting from the use of ammonia injection associated with the SNCR and SCR control options, but do not consider these impacts sufficient enough to warrant eliminating any of the available control technologies.

Our consideration of degree of visibility improvement focuses primarily on the improvement from base case impacts associated with each control option. While each of the available NO_x control options achieves some degree of visibility improvement, we consider the improvement associated with the most stringent option, SCR with LNB and OFA, to be substantial.

Our consideration of cost of compliance focuses primarily on the cost-effectiveness of each control option, as measured in cost per ton and incremental cost per ton of each control option. Despite the fact that the most stringent option, SCR with LNB and OFA, is the most expensive of the available control options, we consider it cost-effective on average basis as well as on an incremental basis when compared to the next most stringent option, SNCR with LNB and OFA.

As a result, we consider the most stringent available control option, SCR with LNB and OFA, to be both cost-effective and to result in substantial visibility improvement, and that the energy and non-air quality impacts are not sufficient to warrant eliminating it from consideration. Therefore, we propose to determine that NO_x BART for Cholla Units 2, 3, and 4 is SCR with LNB and OFA, with an associated emission limit for NO_x on each of Units 2, 3, and 4 of 0.050 pounds per million British thermal units (lb/MMBtu), based on a rolling 30-boiler-operating-day average.

3. Coronado Units 1 and 2

a) Costs of Compliance

Our general approach to calculating the costs of compliance is described in section III.A.1 above, while considerations unique to Coronado Units 1 and 2 are explained herein. As mentioned in the Federal Register notice for this proposal, control costs were developed by our contractor using the Integrated Planning Model (IPM) Base Case v4.10 (August 2010). The specific parameters and assumptions used in developing these costs are included in our contractor's report and its associated spreadsheet. A summary of capital and operating costs is included in Table 29.

Table 29 - Coronado 1 and 2: EPA's Control Cost Estimates

	Coronado 1		Coronado 2	
	SNCR	**SCR**	**SCR (0.08 lb/MMBtu)**	**SCR (0.05 lb/MMBtu)**
Unit Output (MW)	411	411	411	411
Capacity Factor	0.81	0.81	0.89	0.89
Capital Cost	8,218,000	56,980,624	53,330,450	53,416,253
Capital Recovery Factor	0.094	0.094	0.094	0.094
Annualized Rate ($/yr)	**775,721**	**5,378,568**	**5,034,017**	**5,042,116**
Fixed O&M ($/year)	144,105	362,488	362,488	362,488
$/kW-yr	0.35	0.88	0.88	0.88
$/MW-yr	351	882	882	882
Variable O&M ($/year)	2,905,730	3,574,257	3,325,130	3,588,511
$/MWh	1.00	1.23	1.04	1.12
Total Annual O&M ($/year)	**3,049,835**	**3,936,745**	**3,687,619**	**3,950,999**
Total Annual Cost ($/year)	**3,825,556**	**9,315,313**	**8,721,636**	**8,993,116**

The capital recovery factor (0.094) listed above is based upon an interest rate of 7% over a 20 year equipment lifetime. Please note that this value does not include property tax (0.90%) and insurance (0.30%), which were included by our contractor in their calculation of capital recovery factor. As a result, the annualized rate ($/yr) and total annual cost ($/yr) listed in the table above are lower than the cost values summarized in our contractor's cost calculation deliverable.[106] Estimates of the annual emission rates used in cost calculations are summarized in Table 30.

[106] See Appendix C of WA5-12 Task 8 Deliverable (Apache-Cholla-Coronado BART Analysis Report).docx

Table 30 - Coronado 1 and 2: EPA's Annual Emission Estimates

Control Option	Percent	Emission Factor	Heat Rate	Annual Capacity	Emission Rate	
	Reduction	(lb/MMBtu)	(MMBtu/hr)	Factor	(lb/hr)	(tpy)
Coronado 1						
Baseline (LNB+OFA)	--	0.303	4,316	0.81	1,308	4,639
SNCR+LNB+OFA	30%	0.21	4,316	0.81	915	3,248
SCR+LNB+OFA	83%	0.05	4,316	0.81	216	766
Coronado 2						
SCR (0.08 lb/MMBtu)	--	0.08	3,984	0.89	319	1,242
SCR (0.05 lb/MMBtu)	--	0.05	3,984	0.89	199	776

There are several aspects of our analysis of this factor that differ from ADEQ's and SRP's analysis and we describe the most important elements below.

(1) Selection of Baseline Period and Baseline Control Technology

SRP's BART analysis used a 2001-03 time period in order to establish its baseline NO_x emissions. Since that time period, SRP has since installed LNB with OFA on Coronado Units 1 and 2. In order to ensure that actual conditions at the plant are reflected in our baseline NO_x emissions, we decided to make use of the most recent Acid Rain Program emission data reported to CAMD, which, at the time that we began our analysis in 2011, was the three-year period from CY2008-10. Based on CAMD documentation, the low-NO_x burners were installed on Coronado Unit 1 on May 16, 2009, making it necessary for us to clearly distinguish between the pre-LNB and post-LNB periods of emission data for Coronado Unit 1. In our analysis, we have decided to make use of CAMD emission data corresponding to the post-LNB period extending from May 16, 2009 to December 31, 2010. We believe the use of this more recent baseline period represents the most realistic depiction of anticipated annual emissions, as it reflects operation of Coronado Unit 1 with LNB and OFA.

For Coronado Unit 2, we note that a consent decree between SRP and EPA requires the installation of SCR and compliance with an emission limit of 0.080 lb/MMBtu (30-day rolling average) by June 1, 2014.[107] Although we realize this SCR system has not yet been installed on Coronado Unit 2, this limit is federally enforceable and represents a realistic depiction of anticipated future emissions.[108] As a result, we consider 0.080 lb/MMBtu to be the baseline emission rate in our BART analysis and are examining only one control scenario in our analysis for Unit 2, SCR at a more stringent emission rate of 0.050 lb/MMBtu.[109]

[107] See Docket Item G-01, "Consent Decree Between U.S. and SRP (final as entered)." See also ADEQ Title V Permit Renewal Number 52639, SRP – Coronado Generating Station, section II.E.1.a.iii (December 06, 2011).
[108] See 40 CFR Part 51, Appendix Y, Section IV.D.4.d.
[109] A discussion of our rationale for considering SCR at an emission rate of 0.05 lb/MMBtu can be found in Section VII.A.2 (Control Effectiveness) of this notice.

(2) SCR Control Efficiency

In determining the control efficiency of SCR in our BART analysis, we have relied upon an SCR level of performance of 0.05 lb/MMBtu, which is more stringent than the level of performance used by ADEQ in its SIP, or by SRP in its Coronado BART analysis. In the Coronado BART analysis submitted to ADEQ, SRP indicated an SCR level of performance of 0.08 lb/MMBtu, and noted that "If inlet NO_x concentrations are less than 250 ppmvd, SCR can achieve NO_x control efficiencies ranging only from 70 to 80 percent."[110] Our control cost calculations for the SCR control option at Coronado Unit 1 are based upon the SCR control efficiency summarized in Table 31. This control efficiency reflects the emission reductions associated with controlling from an annual average baseline emission rate that represents LNB+OFA (as described previously) down to an SCR emission rate of 0.05 lb/MMBtu.

Table 31 - Coronado Unit 1: EPA's SCR Control Efficiency

Unit No.	Baseline Emission Rate (lb/MMBtu)	SCR Emission Rate	SCR Control Efficiency (percentage)
Coronado 1	0.303	0.05	83.5%

(3) Capacity Factor

SRP did not calculate annual emission estimates for its control scenarios, in tons per year, in its BART analysis submitted to ADEQ. In developing its RH SIP, ADEQ estimated annual emission reductions based upon 8,760 hours/year of operation (i.e., 100 percent capacity factor). We have calculated annual emission estimates for our control scenarios using capacity factors developed over a CY2008-11 time frame. The annual capacity factors we have used for each unit are 81 percent (Coronado 1), and 89 percent (Coronado 2). We recognize that these capacity factors are lower than those used by ADEQ, and that by using these lower capacity factors, our estimates of total annual emissions (and correspondingly, the annual emission reductions) for each control scenario are lower than ADEQ's estimates.[111] Since cost-effectiveness ($/ton) is calculated by dividing annual control costs ($/year) by annual emission reductions (tons/year), the use of emission reductions based on lower capacity factors will increase the cost per ton of pollutant reduced.

We have elected to use the capacity factors specified above, as based on a 2008 to 2011 time frame, in order to remain consistent with the time frame used to develop baseline annual emissions for Coronado and the other power plants that are the subject of today's proposed action.[112]

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[110] See Docket Item B-10, SRP Coronado BART Analysis, page 4-5

[111] We note that there are multiple reasons why our annual emission estimates (and estimates of emission removal) are lower than AEPCO's and ADEQ's estimates. We are not implying that the use of capacity factor is the sole, or even dominant, reason for this difference, simply that the use of lower capacity factors will result in lower annual emission estimates.

[112] We recognize that there are more aggressive approaches we could adopt that could justify the use of higher capacity factors, which would thereby lower the cost per ton of pollutant reduced. For example, instead of using

(4) Summary and Conclusions Regarding Costs of Control

A summary of our control cost estimates for the various control technology options considered for Coronado Units 1 and 2 is in Table 32.

Table 32 - Coronado Units 1 and 2: EPA's Control Cost Summary

Control Option	Emission Factor (lb/MMBtu)	Emission Rate		Emissions Removed (tpy)	Annual Cost ($/yr)	Cost-effectiveness ($/ton)	
		(lb/hr)	(tpy)			Average	Incremental (from previous)
Coronado 1							
OFA	NA; LNB+OFA is the currently installed technology						
LNB+OFA (baseline)	0.303	1,308	4,639	--	--	--	--
SNCR+LNB+OFA	0.21	915	3,248	1,392	3,825,556	2,749	--
SCR+LNB+OFA	0.05	216	766	3,874	9,315,313	2,405	2,212
Coronado 2							
SCR@0.08 lb/MMBtu (baseline)	0.08	319	1,242	--	8,721,636[1]	--	--
SCR@0.05 lb/MMBtu	0.05	199	776	466	8,993,116	--	583

[1] Annual cost for the baseline scenario is provided here only to allow calculation of the incremental cost associated with a control option of SCR@0.05 lb/MMBtu.

For Coronado 1, our calculations indicate that the SCR-based control option has an average cost-effectiveness value of $2,405/ton and an incremental cost-effectiveness of $2,212/ton, both of which we consider cost-effective. As described further below, our analysis for Coronado 2 relied upon SCR at an emission rate of 0.08 lb/MMBtu as a baseline scenario. As a result, the only control option we examined for Coronado 2 was an SCR-based option at a more stringent level of performance, 0.05 lb/MMBtu. Our initial analysis indicates that the incremental cost-effectiveness of such an option is $583/ton, making it a control option that we would consider cost-effective. However, we received information from SRP indicating that design and construction of the SCR system for this unit are well under way. In its letter, SRP states that "if SRP were required to abandon the current design, incur procurement losses, possibly remove foundations, and undertake new design and procurement, such steps would vastly increase the cost of the SCR retrofit." Since these types of additional costs were not factored into our original analysis, the average and incremental cost-effectiveness of requiring Coronado Unit 2 to meet an emissions limit of 0.050 lb/MMBtu may in fact be greater than indicated by our analysis.

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historical data to develop a capacity factor value for each unit, we could use a single capacity factor value for each unit, one that represented a reasonable depiction of anticipated annual baseload operations. Alternately, we could also use a 100% capacity factor, or develop new capacity factors based on a longer 2001 to 2011 time frame.

However, we intend to request further documentation in order to determine the extent of these costs and how they would affect our cost-effectiveness calculations. We will include all non-CBI material received in the docket for this action and will consider it as part of our final action. We are specifically interested in information from SRP concerning the number of layers of catalyst for the SCR at Unit 2, how they plan to manage replacement of the catalyst, and whether the catalyst could be installed and managed to allow Unit 2 to meet a lower emission limit than 0.08 lb/MMBtu.

Thus, our initial analysis of this factor indicates that the costs of compliance (average or incremental) are not sufficiently large to warrant eliminating any of the control options from consideration. However, we note that, based on preliminary information received from SRP, the average and incremental costs of achieving an emission rate of 0.050 lb/MMBtu at Unit 2 may be greater than our initial analysis suggests.

b) Visibility Improvement

The overall modeling approach was described above; aspects of the modeling specific to Coronado are described here. LNB was installed on Unit 1 in mid-2009, and on Unit 2 in mid-2011. For Unit 1's NO_x emissions, the maximum daily emissions in EPA's CAMD database for 2008 to 2010 was used; the maximum post-LNB installation emissions occurred in late 2010. For unit 2 emissions, the consent decree-mandated NO_x emission limit of 0.08 lb/MMBtu was combined with the maximum heat rate from 2008-2010 CAMD data, which occurred in late 2008. Since this limit has a 30-day averaging time, daily emissions may be larger than the emissions EPA modeled; the emission and visibility benefit would also be larger. Thus, visibility benefits from control applied to the base case may actually be larger than presented here. The base case reflects LNB as the control in place on Unit 1, and SCR at 0.08 lb/MMBtu NO_x on Unit 2.

EPA evaluated SNCR applied to Unit 1 ("`ctrl1_r`"), SCR at 0.05 lb/MMBtu on unit 1 but at 0.08 on unit 2 ("`ctrl2_r`") and SCR at 0.05 lb/MMBtu applied to both Units 1 and 2 ("`ctrl5_rs`"). SCR was assumed to give a control effectiveness of 83.5 percent for unit 1 (less than 90 percent due to the 0.05 lb/MMBtu NO_x lower limit assumed for SCR). SCR at 0.05 lb/MMBtu NO_x was assumed to give a control effectiveness of 37.5 percent over the base case 0.08 lb/MMBtu. As mentioned above, the SCR simulation ("`ctrl5_rs`") accounted for the increase in sulfuric acid emissions due to catalyst oxidation of SO_2 at Unit 2. However, originally, the other simulations did not account for this effect. If this additional Unit 2 sulfate were accounted for, it could make some background ammonia unavailable to form visibility-affecting particulate from Unit 1's NO_x emissions, thus reducing the visibility impact and also the visibility benefit of controls. We expected this to have very little effect on the estimated SNCR visibility benefit, since it was computed relative to an alternative base case that likewise did not include the catalyst oxidation effect, but the visibility benefits from SNCR could have been slightly less than originally thought. EPA subsequently accounted for this effect by simulating the increased sulfate from SCR for the SNCR scenario ("`ctrl1_rs`", SNCR on unit 1, SCR on unit 2), and the scenario with SCR on both units at different control levels ("`ctrl2_rs`", 0.05 lb/MMBtu for Unit 1, and 0.08 lb/MMBtu for Unit 2). This language in the NPRM reflects the situation before these subsequent simulations. However, the updated results fully accounting for SCR catalyst oxidation are reported in the NPRM visibility impact tables, and were considered in EPA's decision-making.

The emissions basis for these additional simulations is briefly described here, since they are not elsewhere documented; they are revised versions of "`ctrl1_r`" and "`ctrl2`" covered in the UNC report.

- Scenario "`ctrl1_rs`" for SNCR on Unit 1 is the same as UNC's "`ctrl1_r`", except it includes the added SCR catalyst sulfate for Unit 2. The amount of sulfate added was the same as for Unit 2 in "`base_rs`".
- Scenario "`ctrl2_rs`" for SCR at 0.05 lb/MMBtu on Unit 1 and SCR at 0.08 lb/MMBtu on Unit 2 is similar to UNC's "`ctrl2`". However, it starts from the revised base case using post-LNB installation emissions before applying the 83.5% reduction to Unit 1; it also includes the added SCR catalyst sulfate for both units. Thus, Unit 1 emissions are the same as in "`ctrl5_rs`", and Unit 2 emissions are the same as in "`base_rs`".
- An additional scenario "`ctrl6_rs`" portrays SCR at 90% control relative to post-LNB installation emissions. For Unit 1, the starting point was "`base_rs`" (CAMD maximum NOx emissions on 11/3/2010 of 16.6 tons/day or 33,208 lb/day; this is 174.3 g/s), reduced by 90% to 17.53 g/s for modeling. For Unit 2, the starting point was not available from other simulations, which were based directly on 0.08 or 0.05 lb/MMBtu NOx. So, the CAMD maximum NOx emissions on 6/2/2011 of 18.859 tons/day were used. This is 33,718 lb/day or 198.02 g/s; reducing by 90% gives 19.80 g/s for modeling. For both units, the added SCR catalyst sulfate was taken from "`ctrl5_rs`" (the scenario with 0.05 lb/MMBtu on both units).

Sixteen Class I areas within 300 km of Coronado were modeled; they are in the states of Arizona, Colorado, and New Mexico. A 17th area, the Bosque del Apache Wilderness Area in New Mexico, was inadvertently omitted from modeling performed by UNC for EPA. Since it is in the same general direction from Coronado as the Gila Wilderness Area, but farther away, visibility impacts and control benefits at Bosque del Apache are likely to be lower than for Gila, so the maximum dv benefit would not be affected by this omission. EPA verified this by simulating all the control scenarios for Bosque del Apache; the results for this area are included in the tables below, although they were not part of EPA's decision process in developing the NPRM. However, the cumulative impacts and benefits would be higher than reported here since Bosque del Apache is omitted from the sum. The 98th percentile delta deciviews over all three years of data were computed for each area and emission scenario.

Table 33 and Table 34[113] show baseline visibility impacts and the visibility improvement[114] when controls are applied; the various table entries are described above in the

[113] The deciview impacts are copied from the spreadsheet "AZRHFIP_TSD_vis_summ_tables.xlsx", which in turn relies on the spreadsheet "srp_az_unit2-3_dollarperdv_analysis_finalwithplots2.xls" prepared by UNC. The costs used in $/dv rely on the spreadsheet "EGU BART Costs_Apache_Cholla_Coronado_FINAL2.xlsx" also prepared by UNC. Note that the costs in the latter are slightly different than those in the cost tables in this TSD, which as noted above do not include property tax and insurance. The number of days above 0.5 and 1.0 dv are from the spreadsheet "AZRHFIP_TSD_Coronado_visx.xlsx".

discussion of the comparable table for Apache. EPA is proposing SCR at 0.05 lb/MMBtu on Unit 1 and SCR at 0.08 lb/MMBtu on Unit 2, shown as scenario “ctrl2_rs”. The area with the greatest dv improvement was the Gila Wilderness Area; there is an improvement of 0.2 dv from SNCR (ctrl1_rs), 0.7 dv from SCR on unit 1 (ctrl2_rs), and 0.9 dv from SCR at 0.05 lb/MMBtu on both units (ctrl5_rs). These improvements are smaller than for the other facilities because the benefit from SCR at 0.08 lb/MMBtu on unit 2 is subsumed in the baseline. The cumulative improvements corresponding to the three control scenarios are 1.0 dv, 2.8 dv, and 3.1 dv. The number of days per year with impacts above 0.5 dv decreases by 6 for SNCR on unit 1, by 16 for SCR on unit 1, and by 18 for SCR on both units at 0.05 lb/MMBtu NOx (considering the area where the decrease is the greatest, Gila Wilderness Area). The modeled degree of visibility improvements supports either SCR scenario as BART for Coronado.

Under baseline conditions the maximum number of days per year with impacts above 0.5 dv seen at any area is 28 (“Max. area” in Table 33; see additional explanation of this table row in the section on Apache visibility improvement). For SNCR (ctrl1_rs), this maximum decreases by 6, leaving 22 days over 0.5 dv. For EPA’s proposed BART, SCR of 0.05 lb/MMBtu on unit 1 and 0.08 lb/MMBtu on Unit 2 (ctrl2_rs), it decreases by 16, leaving 12 days over. The decrease is slightly more at 18 for SCR on both units at 0.05 lb/MMBtu NOx (ctrl5_rs), leaving 10 days over 0.5 dv.

Table 34 shows the number of days with impairment exceeding 0.5 dv, for each Class I area (instead of the maximum among any area that is shown in Table 33), as well as the cumulative number of days (sum over the areas). For the baseline condition, Petrified Forest has the largest number of such days, the baseline 28 appearing in Table 33. However Gila Wilderness Area is has the greatest improvement for all the control scenarios, so its row has the same entries as the maximum “Max. area number of days >= 0.5 dv” in Table 33.

Any of these improvements would contribute to improved visibility, though SNCR on unit 2 only marginally so. SCR is the superior option for visibility, with the more stringent SCR at 0.05 lb/MMBtu on unit 2 giving a slightly greater benefit than when that limit is applied only to unit 1. Only the SCR scenarios give improvements exceeding 0.5 dv. The modeled degree of visibility improvements supports either SCR scenario as BART for Coronado.

[114] The table below differs from the corresponding one in the NPRM due to the NPRM’s use of the 23rd high over the 2001-2003 period as the 98th percentile visibility impact for the ctrl1_rs and ctrl2_rs scenarios. The table below relies on the 22nd high throughout, in accord with standard practice. The changes to the estimates of visibility benefit were very small, and the results continue to support EPA’s proposed BART determination.

Table 33 - Coronado Units 1 and 2: EPA's Visibility Improvements from NOx Controls

	base_rs	ctrl1_rs	ctrl2_rs	ctrl5_rs	ctrl6_rs
Class I Area	Baseline impact (dv)	Improvement from SNCR on unit 1 (dv)	Improvement from SCR .05 on unit 1 (dv)	Improvement from SCR .05 on (dv)	Improvement from SCR - 90% on both (dv)
*Bosque del Apache **	*0.47*	*0.08*	*0.20*	*0.23*	*0.25*
Bandelier NM	0.37	0.07	0.18	0.20	0.22
Chiricahua NM	0.20	0.03	0.07	0.08	0.09
Chiricahua WA	0.21	0.03	0.07	0.09	0.09
Galiuro WA	0.20	0.02	0.08	0.09	0.09
Gila WA	1.23	0.22	0.59	0.66	0.73
Grand Canyon NP	0.24	0.03	0.09	0.11	0.12
Mazatzal WA	0.20	0.01	0.06	0.07	0.08
Mesa Verde NP	0.40	0.07	0.19	0.20	0.23
Mount Baldy WA	0.87	0.16	0.42	0.44	0.50
Petrified Forest NP	1.22	0.17	0.47	0.56	0.63
Pine Mountain WA	0.14	0.02	0.04	0.05	0.06
Saguaro NP	0.12	0.01	0.03	0.04	0.04
San Pedro Parks WA	0.54	0.11	0.28	0.30	0.34
Sierra Ancha WA	0.24	0.03	0.06	0.07	0.08
Superstition WA	0.21	0.02	0.06	0.06	0.07
Sycamore Canyon WA	0.16	0.01	0.05	0.06	0.07
Cumulative dv	6.54	1.02	2.74	3.07	3.43
# areas >= 0.5	4	0	1	2	2
Max. area number of days >= 0.5 dv	28	6	16	18	20
Max. area number of days >= 1.0 dv	10	2	8	8	10
$/max dv, millions		$17.7	$16.3	$15.0	$13.5
$/cumulative dv, millions		$3.9	$3.5	$3.2	$2.9

* Bosque del Apache is NOT included in cumulative totals above: its simulations were not part of EPA decision-making for the NPRM

Note: Costs of implementing SCR at 0.08 lb/MMBtu on unit 2 are not included.

Table 34 - Coronado Units 1 and 2: EPA's Visibility Improvement Days from NOx Controls

	base_rs	ctrl1_rs	ctrl2_rs	ctrl5_rs	ctrl6_rs
Class I Area	Baseline impact (dv)	Improvement from SNCR on unit 1 (dv)	Improvement from SCR .05 on unit 1 (dv)	Improvement from SCR .05 on both (dv)	Improvement from SCR - 90% on both (dv)
*Bosque del Apache **	*6*	*1*	*5*	*5*	*6*
Bandelier NM	3	2	3	3	3
Chiricahua NM	1	1	1	1	1
Chiricahua WA	2	1	2	2	2
Galiuro WA	2	1	1	2	2
Gila WA	27	6	16	18	20
Grand Canyon NP	3	1	2	2	3
Mazatzal WA	1	1	1	1	1
Mesa Verde NP	6	1	5	6	6
Mount Baldy WA	17	2	12	13	15
Petrified Forest NP	28	4	13	15	18
Pine Mountain WA	0	0	0	0	0
Saguaro NP	1	0	0	1	1
San Pedro Parks WA	8	4	8	8	8
Sierra Ancha WA	2	1	1	2	2
Superstition WA	0	0	0	0	0
Sycamore Canyon WA	0	0	0	0	0
Cumulative #days >= 0.5	100	24	67	74	80

* Bosque del Apache is NOT included in the cumulative totals above: its simulations were not part of EPA decision-making for the NPRM.

c) EPA's BART Determination

As noted above, we have considered the remaining useful life of the source by incorporating a 20-year amortization period into our control cost calculations. The presence of existing pollution control technology is reflected in the cost and visibility factors as a result of selection of the baseline period for cost calculations and visibility modeling. For Coronado Unit 1, a baseline period (May 2009 to December 2010) was selected that reflects the currently existing pollution control technology (LNB with OFA). For Coronado Unit 2, a baseline of 0.080 lb/MMBtu was selected to reflect the requirements of the consent decree decribed above. In addition, as noted above, we have received information from SRP indicating that the design and construction of SCR at Unit 2 have aleady progressed significantly. To the extent that we receive additional documentation establishing the status of this effort, we will take this information into consideration under the factors of "costs of compliance" and "existing controls."

In examining energy and non-air quality impacts, we note certain potential impacts resulting from the use of ammonia injection associated with the SNCR and SCR control options, but do not consider these impacts sufficient enough to warrant eliminating any of the available control technologies.

Our consideration of degree of visibility improvement focuses primarily on the improvement from base case impacts associated with each control option. While each of the available NO_x control options achieves some degree of visibility improvement, we consider the improvement associated with the most stringent option, SCR with LNB and OFA, to be substantial. Our consideration of cost of compliance focuses primarily on the cost-effectiveness of each control option, as measured in cost per ton and incremental cost per ton of each control option. Despite the fact that the most stringent option, SCR with LNB and OFA, is the most expensive of the available control options, we consider it cost-effective on average basis as well as on an incremental basis when compared to the next most stringent option, SNCR with LNB and OFA.

As a result, we consider the most stringent available control option, SCR with LNB and OFA, to be cost-effective and to result in substantial visibility improvement, and that the energy and non-air quality impacts are not sufficient to warrant eliminating it from consideration. Therefore, we propose to determine that NO_x BART for Coronado Units 1 and 2 is SCR with LNB and OFA. At Unit1 we propose an emission limit for NO_x of 0.050 lb/MMBtu, based on a rolling 30-boiler-operating-day average.

At Unit 2, we propose an emission limit of 0.080 lb/MMBtu, which is consistent with the emission limit in the consent decree. We acknowledge that the emission limit of 0.080 lb/MMBtu established in the consent decree was not the result of a BART five-factor analysis, nor does the consent decree indicate that SCR at 0.080 lb/MMBtu represents BART. Nonetheless, given the compliance schedule established in the consent decree and the preliminary information received from SRP regarding the status of design and construction of the SCR system, it appears that achieving a 0.050 lb/MMBtu emission rate may not be technically feasible. Even if it is feasible, achievement of this emission rate may not be cost-effective. Therefore, we are proposing an emission limit of 0.080 lb/MMBtu as BART for NO_x at Unit 2. However, if we do not receive sufficient documentation establishing that achievement of a more stringent limit is infeasible or not cost-effective, then we may determine that a more stringent limit for this unit is required in our final action.

For Coronado Unit 2, we are proposing a compliance date of June 1, 2014 for the NO_x limit, consistent with the consent decree described above.

Finally, at Coronado Unit 1, we are proposing to require compliance with the NO_x limit within five years of final promulgation of this FIP consistent with the compliance times for the NOx limits at the other units. However, we are seeking comment on whether a shorter compliance schedule may be practicable for this unit.

C. Enforceability Requirements

In order to meet the requirements of the RHR and the CAA and to ensure that the BART limits are practically enforeceable, we propose to include the following elements in the FIP:

1. Requirements for use of continuous emission monitoring systems (CEMS) (and associated quality assurance procedures) to determine compliance with NO_x and SO2 limits.

2. Use of 30-day rolling averaging period and definition of boiler operating day, consistent with the BART Guidelines for NO_x and SO_2.

3. Requirements for annual performance stack tests and implementation of Compliance Assurance Monitoring (CAM) plan to establish compliance with PM emission limits.

4. Recordkeeping and reporting requirements.

5. Requirement to maintain and operate the unit including associated air pollution control equipment in a manner consistent with good air pollution control practices for minimizing emissions.

The foregoing requirements would apply to all units.

In addition, we are proposing specific compliance deadlines for each of ADEQ's BART emissions limits that we are proposing to approve. In most instances, the control technologies required to meet these limits have already been installed. (See Table 3.) Therefore, we are proposing to require compliance with the applicable emissions limits for PM and SO_2 within 180 days of final promulgation of this FIP, except that at Cholla Unit 2, we propose to require compliance with the PM limit by January 1, 2015, consistent with ADEQ's BART determination.

Regarding NO_x, we propose to allow up to five years from final promulgation of this FIP for each unit subject to an emission limit consistent with SCR, with the exception of Coronado Unit 2. This proposal is based on the results of two analyses of SCR installation times, as summarized in EPA Region 6's Complete Response to Comments for NM Regional Haze/Visibility Transport FIP.[115] An analysis performed by EPA Region 6, based on a review of a number of sources, found that the design and installation of SCR took between 18 and 69 months. A separate analysis performed for the Utility Air Regulatory Group (UARG) found that it took 28 to 62 months to design and install the 14 SCRs in its sample.[116] In the case of the BART FIP for San Juan Generating Station, EPA Region 6 initially proposed to allow a three-year compliance time frame for design and installation of SCR, but ultimately allowed for a five-year compliance schedule.[117] We also note that SCR installations often trigger Prevention of Significant of Deterioration permitting requirements because they constitute physical changes to an existing emission unit that may result in increased emissions of sulfuric acid mist. Therefore, we are proposing a five-year compliance time frame, which would provide adequate time for SCR design and installation based on the high-end of the range of dates in the analyses cited above. For Apache Unit 1, we are approving the state's NOx BART emission limit, which is consistent with LNB with flue gas recirculation (FGR) (natural gas use only), and are also propsing a five-year compliance time frame. Although we realize that the design and installation required for LNB with FGR is not as complex as for SCR, we note that such an installation may be subject to the same timing and scheduling issues as SCR, including the potential to trigger

[115] Available on regulations.gov, docket no. EPA-R06-OAR-2010-0846, pp. 70-72. See also 76 FR at 52408-09
[116] J. Edward Cichanowicz , Implementation Schedule for Selective Catalytic Reduction (SCR) and Flue Gas Desulfurization (FGD) Process Equipment (Oct. 10, 2010).
[117] 76 FR at 52408-09

Prevention of Significant Deterioration permitting requirements as a result of physical changes that result in increased carbon monoxide (CO) emissions,

However, we are seeking comment on whether these compliance dates are reasonable and consistent with the requirement of the CAA and the RHR that BART be installed "as expeditiously as practicable." We are specifically seeking comment on whether the outage schedule for any of these units may warrant a shorter compliance schedule (up to five years). If we receive information during the comment period that establishes that a shorter compliance timeframe is appropriate for one or more of these units, we may finalize a different compliance date.

VIII. Summary of EPA's Proposed Action

Based on the available control technologies and the five factors discussed in more detail below, EPA is proposing to require these facilities to meet NO_x, PM_{10} and SO_2 emission limits as listed in Table 35. With the exception of Apache Unit 1, the NO_x emission limits in Table 35 are proposed as part of EPA's FIP, based on the five factor analyses summarized in Section III.A. The PM_{10} and SO_2 emission limits in Table 35 are taken from ADEQ's BART determinations for these facilities, proposed for EPA approval in this action. EPA is seeking comment on alternative PM_{10} and SO_2 emissions limits for Apache Generating Station Units 2 and 3; Cholla Power Plant Units 2, 3 and 4; and Coronado Units 1 and 2 as described in Section VI.B of the Federal Register notice for this proposed action. We are also seeking comment on whether a test method other than EPA Method 201/202 should be allowed or required for establishing compliance with the PM_{10} limits that we are proposing to approve. Finally, we are proposing compliance dates and specific requirements for monitoring, recordkeeping, reporting and equipment operation and maintenance for all of the units covered by this action. Our proposed compliance dates are summarized in Table 36. We are seeking comment on whether these compliance dates are reasonable and consistent with the requirement of the CAA and the RHR that BART be installed "as expeditiously as practicable." We are also taking comment on whether it would be technically feasible and cost-effective for Coronado Unit 2 to meet an emissions limit of 0.050 lb/MMBtu for NO_x.

Table 35 - Summary of BART Emission Limits

Unit	Emission limitation (lb/MMBtu) (rolling 30-boiler-operating-day average)		
	NO_x	PM_{10}	SO_2
Apache Generating Station Unit 1	0.056	0.0075	0.00064
Apache Generating Station Unit 2	0.050	0.03	0.15
Apache Generating Station Unit 3	0.050	0.03	0.15
Cholla Power Plant Unit 2	0.050	0.015	0.15
Cholla Power Plant Unit 3	0.050	0.015	0.15
Cholla Power Plant Unit 4	0.050	0.015	0.15
Coronado Generating Station Unit 1	0.050	0.03	0.08
Coronado Generating Station Unit 2	0.080	0.03	0.08

Table 36 - Summary of BART Compliance Dates

Unit	Compliance Date		
	NO_x	PM_{10}	SO_2
Apache Generating Station Unit 1	Five years	180 days	180 days
Apache Generating Station Unit 2	Five years	180 days	180 days
Apache Generating Station Unit 3	Five years	180 days	180 days
Cholla Power Plant Unit 2	Five years	January 1, 2015	180 days
Cholla Power Plant Unit 3	Five years	180 days	180 days
Cholla Power Plant Unit 4	Five years	180 days	180 days
Coronado Generating Station Unit 1	Five years	180 days	180 days
Coronado Generating Station Unit 2	June 1, 2014	180 days	180 days

V. Appendix A: Listing of Modeling-Related Files

The following files are all located in the docket in folder G-15.

LISTS

readme_modeling_files.txt
 contains this list: lists files used in preparing model inputs
 and processing and presenting model output

c1_area_list_3plants.txt
 list of Class I areas

AZ_RH_FIP_NPRM_scenarios.txt
 very brief description of modeling scenarios

lookups.xls
 lookup tables for scenario names and Class I areas;
 includes some additional brief characterization of scenarios

AZ_NPRM_model_file_names.txt
 CALPUFF etc. file naming convention

COSTS AND EMISSIONS

EGU BART Costs_Apache_Cholla_Coronado_FINAL2.xlsx
 Costs, TPY, and % emission reductions calculations
 - costs relied on by both UNC "...dollarperdv_analysis_finalwithplots.xls"
 and by EPA in "TSD_vis_tables.xlsx";
 - emissions relied for % reduction
 in UNC AZ_BART_sources_all-Task7-8_2012-06-10.xls

AZ_BART_sources_all-Task7-8_2012-06-10.xls
 "master" spreadsheet of modeling emissions;
 includes some CAMD data for picking max emission day;
 refers to speciation spreadsheets;
 has g/s emission rates for CALPUFF input lines

AZ Max Emission Dates.xlsx
 maximum daily emissions from CAMD data for modeling
 (prepared by EPA, not UNC)

2006FinalUncontrolledUtilityResOilBlrpmSpeciationProfile_AEPCO-Unit1-filtPM.xls
2006FinalDryBottomPC_FGD_ESPpmSpeciationProfile_AEPCO-Unit2-filtPM.xls
2006FinalDryBottomPC_FGD_ESPpmSpeciationProfile_AEPCO-Unit3-filtPM.xls
2006FinalDryBottomPC_FGD_FFpmSpeciationProfile_Cholla-Unit1-filtPM.xls

2006FinalDryBottomPC_ScrubberpmSpeciationProfile_Cholla-Unit2-filtPM.xls
2006FinalDryBottomPC_FGD_FFpmSpeciationProfile_Cholla-Unit3-filtPM.xls
2006FinalDryBottomPC_FGD_FFpmSpeciationProfile_Cholla-Unit4-filtPM.xls
PM speciation spreadsheets
referred to by AZ_BART_sources_all-Task7-8_2012-06-10.xls

MODEL OUTPUTS

NPR_vis_tables_120702.xls
summary dv and $/dv tables used in NPRM itself

AZRHFIP_TSD_vis_summ_tables.xlsx
UNC and EPA CALPUFF output to support NPRM
- Summary dv and $/dv tables, and # days >=0.5 dv, used in TSD
- Differs from NPRM tables in having some updated costs,
and consistently uses 22nd three-year high for
"98th percentile" visibility impacts
(some in results in NPRM used 23rd high)

AZRHFIP_TSD_Cholla_visx.xlsx
AZRHFIP_TSD_Coronado_visx.pdf
AZRHFIP_TSD_Coronado_visx.xlsx
UNC and EPA CALPUFF output (extracted visibility info)
- tables of dv and # days over 0.5 and 1.0 dv;
- bar graphs of 98th percentile impairment
(graphs only for 8b, MVISBK=8 and 20% best background)
- % differences between the various visibility
methods 6a, 6b, 8a, 8b)

aep_az_unit2-3_dollarperdv_analysis_finalwithplots2.xls
cho_az_unit2-4_dollarperdv_analysis_finalwithplots.xls
srp_az_unit1-2_dollarperdv_analysis_finalwithplots.xls
UNC CALPUFF output; much included in UNC report for WA5-12 Task 8
- tables of dv, tons/dv, $/dv (calc. for each area & year);
- bar graphs of 98th percentile impairment and
benefit (in "area impacts" tabs)
(NOTE: These do NOT include Coronado "modrev3" results for
scenarios: ctrl1_rs, ctrl2_rs, ctrl6_rs)

Coronado_modrev3_n822_visx.xlsx
Supplemental Coronado results, for scenarios:
base_q, ctrl1_rs, ctrl2_rs, ctrl6_rs
(Not really needed since contents already included
in the above AZRHFIP_NPRM_Coronado_visx.xlsx,
and base_q scenarion in Coronado_baseq_NPRM.zipx below.)

Coronado_bosq_n822_visx.xlsx
Visibility results for Coronado at Bosque del Apache only
Not considered for NPRM, but some is in TSD

CALPUFF MODEL INPUT AND OUTPUT FILES

These files are too large to include in the electronic docket, but they are available for examination in the hard copy of the docket located at the EPA Region 9 office. See the Federal Register notice for this proposed action, Section I.B., for more information on accessing the hardcopy docket.

AZ_NPRM_zip_file_notes.txt
Notes about the modeling zip file contents and organization;
includes model file naming convention

AZ_NPRM_zip_file_listing.txt
Full listing of files within the zip files

Zip files

Apache_calpost_NPRM.zipx
Apache_calpuff_NPRM.zipx
Apache_postcalpost_NPRM.zipx
Apache_postutil_NPRM.zipx
Apache_visx_NPRM.zipx
Cholla_calpost_NPRM.zipx
Cholla_calpuff_NPRM.zipx
Cholla_postcalpost_NPRM.zipx
Cholla_postutil_NPRM.zipx
Cholla_visx_NPRM.zipx
Coronado_calpost_NPRM.zipx
Coronado_calpuff_NPRM.zipx
Coronado_postcalpost_NPRM.zipx
Coronado_postutil_NPRM.zipx
Coronado_visx_NPRM.zipx

Note that results for Coronado "modrev3",
that is, ctrl1_rs, ctrl2_rs, and ctrl6_rs (but not base_q)
are already included in the above.
Coronado_modrev3_n822_visx.xlsx

Extra files (not relied on for NPRM)

AZ_extra_zip_file_notes.txt
    note on different naming convention for bosq files

Coronado_baseq_NPRM.zipx
Coronado_baseq_zip_file_listing.txt
    CALPUFF input and output files for Coronado
    for scenario base_q only (not incl. bosq)
    which has LNB (no SCR) on both units

Coronado_bosq_NPRM.zipx
Coronado_bosq_zip_file_listing.txt
    CALPUFF input and output files for Coronado
    impacts at Bosque del Apache only;
    included in TSD but not considered by
    EPA for NPRM. (includes bosq base_q)

VI. Appendix B: Visibility Impact and Benefit Tables

AEPCO Apache, Arizona RH FIP, July 2012

98th percentile delta deciviews (Average of 8th highs for 2001, 2002, 2003; 22nd high for 2001-2003)

Visibility Impacts, dv

Visibility method: vis8, 20best	Control Scenario base: Base (OFA)		ctrl1_r: LNB		ctrl2_r: SNCR		ctrl3_s: SCR; w/SO4	
Class I Area	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**
Chiricahua NM	3.33	**3.41**	2.88	**2.97**	2.56	**2.59**	1.81	**1.90**
Chiricahua Wild.	3.42	**3.46**	2.91	**2.93**	2.44	**2.47**	1.75	**1.87**
Galiuro Wild.	2.18	**2.22**	1.81	**1.83**	1.56	**1.57**	1.11	**1.12**
Gila Wild.	0.64	**0.63**	0.49	**0.49**	0.38	**0.41**	0.25	**0.26**
Mazatzal Wild.	0.27	**0.28**	0.22	**0.23**	0.20	**0.19**	0.15	**0.14**
Mount Baldy Wild.	0.27	**0.28**	0.21	**0.22**	0.16	**0.17**	0.10	**0.10**
Saguaro NP	2.50	**2.49**	2.15	**2.12**	1.83	**1.84**	1.34	**1.33**
Sierra Ancha Wild.	0.29	**0.29**	0.23	**0.23**	0.19	**0.19**	0.15	**0.15**
Superstition Wild.	0.60	**0.61**	0.48	**0.51**	0.41	**0.42**	0.30	**0.30**
Maximum	3.42	**3.46**	2.91	**2.97**	2.56	**2.59**	1.81	**1.90**
Cumulative (sum)	13.49	**13.67**	11.38	**11.53**	9.74	**9.84**	6.95	**7.16**

Visibility Benefits, dv

Visibility method: vis8, 20best	Control Scenario base: Base (OFA)		ctrl1_r: LNB		ctrl2_r: SNCR		ctrl3_s: SCR; w/SO4	
Class I Area	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**
Chiricahua NM			0.44	**0.44**	0.77	**0.82**	1.52	**1.51**
Chiricahua Wild.			0.51	**0.53**	0.98	**1.00**	1.67	**1.59**
Galiuro Wild.			0.37	**0.39**	0.62	**0.65**	1.06	**1.10**
Gila Wild.			0.15	**0.14**	0.26	**0.22**	0.39	**0.37**
Mazatzal Wild.			0.04	**0.05**	0.07	**0.09**	0.12	**0.14**
Mount Baldy Wild.			0.06	**0.07**	0.11	**0.11**	0.16	**0.18**
Saguaro NP			0.35	**0.38**	0.67	**0.66**	1.17	**1.16**
Sierra Ancha Wild.			0.06	**0.06**	0.10	**0.10**	0.14	**0.14**
Superstition Wild.			0.11	**0.10**	0.19	**0.19**	0.30	**0.31**
Maximum			0.51	**0.53**	0.98	**1.00**	1.67	**1.59**
Cumulative (sum)			2.11	**2.14**	3.75	**3.83**	6.53	**6.51**

Chiricahua Wilderness has the greatest 22nd high **impacts** for the base case; Chiricahua NM has the greatest for the contro

Chiricahua Wilderness has the greatest **benefit** in 22nd high for all the control scenarios.

AEPCO Apache, Arizona RH FIP, July 2012

Number of days with delta deciview impacts greater than or equal to 0.5 dv in 2001-2003; Average

Visibility Impacts, # Days ≥ 0.5 dv

Visibility method: vis8, 20best	base: Base (OFA)		ctrl1_r: LNB		ctrl2_r: SNCR		ctrl3_s: SCR; w/SO4	
Class I Area	Sum	**Avg**	Sum	**Avg**	Sum	**Avg**	Sum	**Avg**
Chiricahua NM	383	**128**	354	**118**	320	**107**	257	**86**
Chiricahua Wild.	349	**116**	325	**108**	281	**94**	231	**77**
Galiuro Wild.	138	**46**	118	**39**	108	**36**	79	**26**
Gila Wild.	35	**12**	21	**7**	10	**3**	3	**1**
Mazatzal Wild.	9	**3**	3	**1**	1	**0.3**	0	**0.0**
Mount Baldy Wild.	5	**2**	2	**0.7**	1	**0.3**	0	**0.0**
Saguaro NP	241	**80**	224	**75**	203	**68**	183	**61**
Sierra Ancha Wild.	7	**2**	3	**1**	3	**1**	1	**0.3**
Superstition Wild.	28	**9**	22	**7**	14	**5**	3	**1**
Maximum	383	**128**	354	**118**	320	**107**	257	**86**
Cumulative (sum)	1195	**398**	1072	**357**	941	**314**	757	**252**

Visibility Benefits, # Days ≥ 0.5 dv

Visibility method: vis8, 20best	base: Base (OFA)		ctrl1_r: LNB		ctrl2_r: SNCR		ctrl3_s: SCR; w/SO4	
Class I Area	Sum	**Avg**	Sum	**Avg**	Sum	**Avg**	Sum	**Avg**
Chiricahua NM			29	**10**	63	**21**	126	**42**
Chiricahua Wild.			24	**8**	68	**23**	118	**39**
Galiuro Wild.			20	**7**	30	**10**	59	**20**
Gila Wild.			14	**5**	25	**8**	32	**11**
Mazatzal Wild.			6	**2**	8	**3**	9	**3**
Mount Baldy Wild.			3	**1**	4	**1**	5	**2**
Saguaro NP			17	**6**	38	**13**	58	**19**
Sierra Ancha Wild.			4	**1**	4	**1**	6	**2**
Superstition Wild.			6	**2**	14	**5**	25	**8**
Maximum			29	**10**	68	**23**	126	**42**
Cumulative (sum)			123	**41**	254	**85**	438	**146**

Chiricahua NM has the greatest **number of days** over 0.5 dv for the base case and all control scenarios.

Chiricahua NM has the greatest **decrease in number of days** over 0.5 dv for all control scenarios, except SNCR, for which Chircahua Wilderness has the greatest.

AEPCO Apache, Arizona RH FIP, July 2012

98th percentile delta deciviews (8th high for each of 2001, 2002, 2003; their Average; and 22nd high for 2001-2003 period)

Visibility Impacts, dv

Visibility method: vis8, 20best	Control Scenario base: Base (OFA)					ctrl1_r: LNB					ctrl2_r: SNCR					ctrl3_s: SCR; w/SO4				
Class I Area	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**
Chiricahua NM	3.21	3.27	3.50	3.33	**3.41**	2.79	2.89	2.97	2.88	**2.97**	2.47	2.62	2.60	2.56	**2.59**	1.63	1.94	1.85	1.81	**1.90**
Chiricahua Wild.	3.40	3.39	3.46	3.42	**3.46**	2.93	2.91	2.88	2.91	**2.93**	2.44	2.47	2.42	2.44	**2.47**	1.87	1.72	1.67	1.75	**1.87**
Galiuro Wild.	1.81	2.11	2.62	2.18	**2.22**	1.52	1.64	2.27	1.81	**1.83**	1.29	1.42	1.97	1.56	**1.57**	0.94	1.06	1.34	1.11	**1.12**
Gila Wild.	0.67	0.75	0.50	0.64	**0.63**	0.49	0.58	0.40	0.49	**0.49**	0.36	0.45	0.33	0.38	**0.41**	0.22	0.30	0.23	0.25	**0.26**
Mazatzal Wild.	0.30	0.27	0.23	0.27	**0.28**	0.24	0.23	0.20	0.22	**0.23**	0.22	0.21	0.17	0.20	**0.19**	0.16	0.16	0.12	0.15	**0.14**
Mount Baldy Wild.	0.29	0.28	0.24	0.27	**0.28**	0.22	0.23	0.18	0.21	**0.22**	0.17	0.18	0.14	0.16	**0.17**	0.09	0.13	0.09	0.10	**0.10**
Saguaro NP	2.30	2.77	2.44	2.50	**2.49**	1.99	2.38	2.09	2.15	**2.12**	1.69	2.03	1.77	1.83	**1.84**	1.21	1.37	1.44	1.34	**1.33**
Sierra Ancha Wild.	0.29	0.30	0.28	0.29	**0.29**	0.21	0.24	0.22	0.23	**0.23**	0.19	0.21	0.18	0.19	**0.19**	0.13	0.16	0.14	0.15	**0.15**
Superstition Wild.	0.61	0.68	0.49	0.60	**0.61**	0.48	0.56	0.41	0.48	**0.51**	0.42	0.47	0.34	0.41	**0.42**	0.30	0.28	0.31	0.30	**0.30**
Maximum	3.40	3.39	3.50	3.42	**3.46**	2.93	2.91	2.97	2.91	**2.97**	2.47	2.62	2.60	2.56	**2.59**	1.87	1.94	1.85	1.81	**1.90**
Cumulative (sum)	12.87	13.83	13.76	13.49	**13.67**	10.86	11.67	11.60	11.38	**11.53**	9.24	10.05	9.92	9.74	**9.84**	6.55	7.12	7.19	6.95	**7.16**

Visibility Benefits, dv

Visibility method: vis8, 20best	Control Scenario base: Base (OFA)					ctrl1_r: LNB					ctrl2_r: SNCR					ctrl3_s: SCR; w/SO4				
Class I Area	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**
Chiricahua NM						0.43	0.38	0.53	0.44	**0.44**	0.74	0.65	0.91	0.77	**0.82**	1.58	1.33	1.66	1.52	**1.51**
Chiricahua Wild.						0.47	0.48	0.58	0.51	**0.53**	0.96	0.92	1.05	0.98	**1.00**	1.53	1.67	1.79	1.67	**1.59**
Galiuro Wild.						0.28	0.47	0.35	0.37	**0.39**	0.52	0.69	0.65	0.62	**0.65**	0.87	1.05	1.27	1.06	**1.10**
Gila Wild.						0.18	0.18	0.11	0.15	**0.14**	0.32	0.30	0.17	0.26	**0.22**	0.46	0.46	0.27	0.39	**0.37**
Mazatzal Wild.						0.06	0.04	0.03	0.04	**0.05**	0.08	0.06	0.06	0.07	**0.09**	0.14	0.11	0.11	0.12	**0.14**
Mount Baldy Wild.						0.07	0.05	0.06	0.06	**0.07**	0.12	0.11	0.10	0.11	**0.11**	0.19	0.15	0.15	0.16	**0.18**
Saguaro NP						0.31	0.39	0.36	0.35	**0.38**	0.61	0.74	0.67	0.67	**0.66**	1.09	1.40	1.00	1.17	**1.16**
Sierra Ancha Wild.						0.07	0.06	0.06	0.06	**0.06**	0.10	0.09	0.09	0.10	**0.10**	0.15	0.14	0.14	0.14	**0.14**
Superstition Wild.						0.13	0.12	0.09	0.11	**0.10**	0.19	0.22	0.15	0.19	**0.19**	0.31	0.41	0.18	0.30	**0.31**
Maximum						0.47	0.48	0.58	0.51	**0.53**	0.96	0.92	1.05	0.98	**1.00**	1.58	1.67	1.79	1.67	**1.59**
Cumulative (sum)						2.01	2.16	2.16	2.11	**2.14**	3.63	3.78	3.84	3.75	**3.83**	6.33	6.71	6.57	6.53	**6.51**

Chiricahua Wilderness has the greatest 22nd high **impacts** for the base case; Chiricahua NM has the greatest for the control scenarios.

Chiricahua Wilderness has the greatest **benefit** in 22nd high for all the control scenarios.

AEPCO Apache, Arizona RH FIP, July 2012

Number of days with delta deciview impacts greater than or equal to 0.5 dv; for each of 2001, 2002, 2003; their Sum, and their Average (rounded to integer unless < 1)

Visibility Impacts, # Days ≥ 0.5 dv

Visibility method:	**Control Scenario**																			
vis8, 20best	**base: Base (OFA)**					**ctrl1_r: LNB**					**ctrl2_r: SNCR**					**ctrl3_s: SCR; w/SO4**				
Class I Area	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg
Chiricahua NM	130	126	127	383	**128**	118	120	116	354	**118**	107	108	105	320	**107**	85	89	83	257	**86**
Chiricahua Wild.	128	114	107	349	**116**	113	108	104	325	**108**	95	98	88	281	**94**	81	81	69	231	**77**
Galiuro Wild.	47	46	45	138	**46**	38	39	41	118	**39**	35	35	38	108	**36**	25	26	28	79	**26**
Gila Wild.	12	16	7	35	**12**	7	10	4	21	**7**	4	6	0	10	**3**	0	3	0	3	**1**
Mazatzal Wild.	3	5	1	9	**3**	1	2	0	3	**1**	0	1	0	1	**0.3**	0	0	0	0	**0.0**
Mount Baldy Wild.	2	2	1	5	**2**	1	1	0	2	**0.7**	1	0	0	1	**0.3**	0	0	0	0	**0.0**
Saguaro NP	80	83	78	241	**80**	74	76	74	224	**75**	64	71	68	203	**68**	58	59	66	183	**61**
Sierra Ancha Wild.	2	3	2	7	**2**	2	1	0	3	**1**	2	1	0	3	**1**	0	1	0	1	**0.3**
Superstition Wild.	10	11	7	28	**9**	7	9	6	22	**7**	5	4	5	14	**5**	1	1	1	3	**1**
Maximum	130	126	127	383	**128**	118	120	116	354	**118**	107	108	105	320	**107**	85	89	83	257	**86**
Cumulative (sum)	414	406	375	1195	**398**	361	366	345	1072	**357**	313	324	304	941	**314**	250	260	247	757	**252**

Visibility Benefits, # Days ≥ 0.5 dv

Visibility method:	**Control Scenario**																			
vis8, 20best	**base: Base (OFA)**					**ctrl1_r: LNB**					**ctrl2_r: SNCR**					**ctrl3_s: SCR; w/SO4**				
Class I Area	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg
Chiricahua NM						12	6	11	29	**10**	23	18	22	63	**21**	45	37	44	126	**42**
Chiricahua Wild.						15	6	3	24	**8**	33	16	19	68	**23**	47	33	38	118	**39**
Galiuro Wild.						9	7	4	20	**7**	12	11	7	30	**10**	22	20	17	59	**20**
Gila Wild.						5	6	3	14	**5**	8	10	7	25	**8**	12	13	7	32	**11**
Mazatzal Wild.						2	3	1	6	**2**	3	4	1	8	**3**	3	5	1	9	**3**
Mount Baldy Wild.						1	1	1	3	**1**	1	2	1	4	**1**	2	2	1	5	**2**
Saguaro NP						6	7	4	17	**6**	16	12	10	38	**13**	22	24	12	58	**19**
Sierra Ancha Wild.						0	2	2	4	**1**	0	2	2	4	**1**	2	2	2	6	**2**
Superstition Wild.						3	2	1	6	**2**	5	7	2	14	**5**	9	10	6	25	**8**
Maximum						15	7	11	29	**10**	33	18	22	68	**23**	47	37	44	126	**42**
Cumulative (sum)						53	40	30	123	**41**	101	82	71	254	**85**	164	146	128	438	**146**

Chiricahua NM has the greatest **number of days** over 0.5 dv for the base case and all control scenarios.
Chiricahua NM has the greatest **decrease in number of days** over 0.5 dv for all control scenarios,

AEPCO Apache, Arizona RH FIP, July 2012

Number of days with delta deciview impacts greater than or equal to 1.0 dv; for each of 2001, 2002, 2003; their Sum, and their Average (rounded to integer unless < 1)

Visibility Impacts, # Days ≥ 1.0 dv

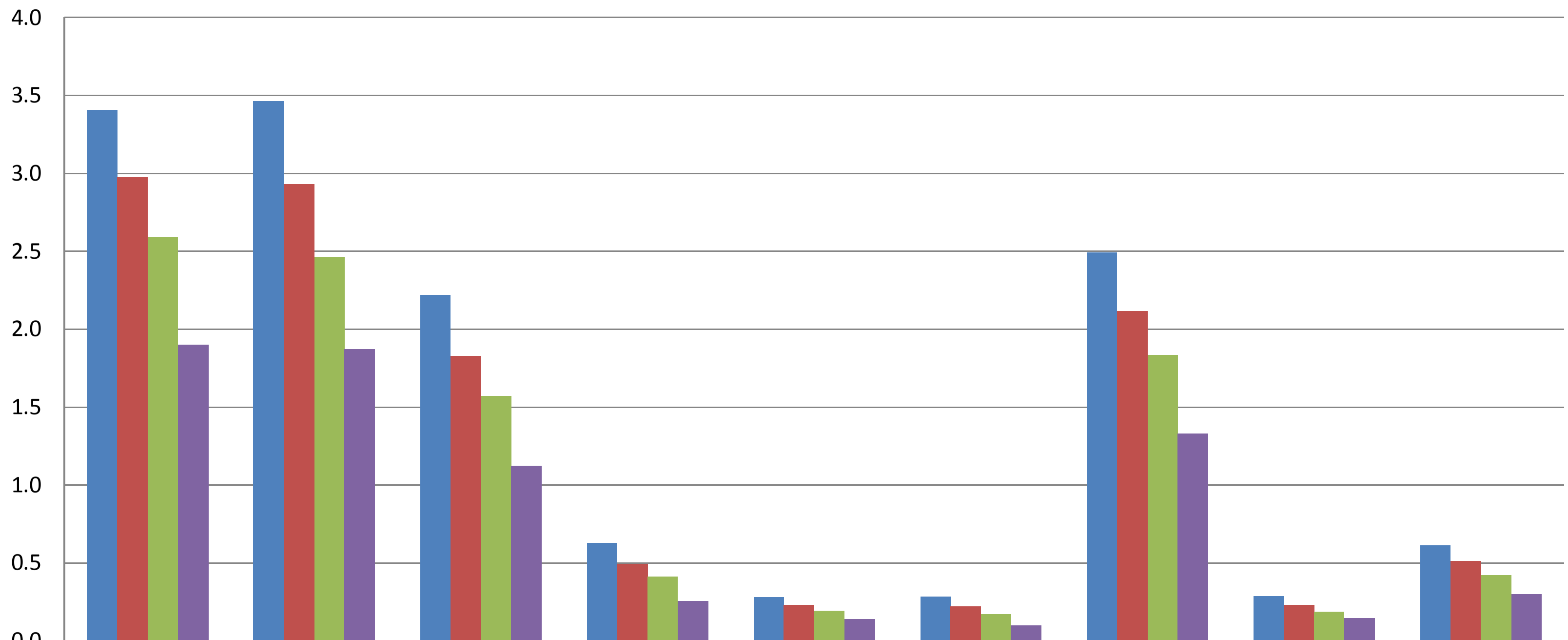
Visibility method:	**Control Scenario**																			
vis8, 20best	**base: Base (OFA)**					**ctrl1_r: LNB**					**ctrl2_r: SNCR**					**ctrl3_s: SCR; w/SO4**				
Class I Area	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg
Chiricahua NM	72	78	75	225	**75**	59	65	64	188	**63**	45	54	52	151	**50**	26	39	41	106	**35**
Chiricahua Wild.	71	65	67	203	**68**	64	57	53	174	**58**	50	42	43	135	**45**	37	35	29	101	**34**
Galiuro Wild.	26	19	27	72	**24**	20	18	24	62	**21**	14	14	18	46	**15**	6	9	13	28	**9**
Gila Wild.	0	5	0	5	**2**	0	4	0	4	**1**	0	3	0	3	**1**	0	0	0	0	**0.0**
Mazatzal Wild.	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Mount Baldy Wild.	1	0	0	1	**0.3**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Saguaro NP	51	47	56	154	**51**	41	42	51	134	**45**	37	35	42	114	**38**	19	24	28	71	**24**
Sierra Ancha Wild.	1	1	0	2	**0.7**	0	1	0	1	**0.3**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Superstition Wild.	2	2	2	6	**2**	1	2	0	3	**1**	1	1	0	2	**0.7**	0	0	0	0	**0.0**
Maximum	72	78	75	225	**75**	64	65	64	188	**63**	50	54	52	151	**50**	37	39	41	106	**35**
Cumulative (sum)	224	217	227	668	**223**	185	189	192	566	**189**	147	149	155	451	**150**	88	107	111	306	**102**

Visibility Benefits, # Days ≥ 1.0 dv

Visibility method:	**Control Scenario**																			
vis8, 20best	**base: Base (OFA)**					**ctrl1_r: LNB**					**ctrl2_r: SNCR**					**ctrl3_s: SCR; w/SO4**				
Class I Area	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg
Chiricahua NM						13	13	11	37	**12**	27	24	23	74	**25**	46	39	34	119	**40**
Chiricahua Wild.						7	8	14	29	**10**	21	23	24	68	**23**	34	30	38	102	**34**
Galiuro Wild.						6	1	3	10	**3**	12	5	9	26	**9**	20	10	14	44	**15**
Gila Wild.						0	1	0	1	**0**	0	2	0	2	**1**	0	5	0	5	**2**
Mazatzal Wild.						0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
Mount Baldy Wild.						1	0	0	1	**0**	1	0	0	1	**0**	1	0	0	1	**0**
Saguaro NP						10	5	5	20	**7**	14	12	14	40	**13**	32	23	28	83	**28**
Sierra Ancha Wild.						1	0	0	1	**0**	1	1	0	2	**1**	1	1	0	2	**1**
Superstition Wild.						1	0	2	3	**1**	1	1	2	4	**1**	2	2	2	6	**2**
Maximum						13	13	14	37	**12**	27	24	24	74	**25**	46	39	38	119	**40**
Cumulative (sum)						39	28	35	102	**34**	77	68	72	217	**72**	136	110	116	362	**121**

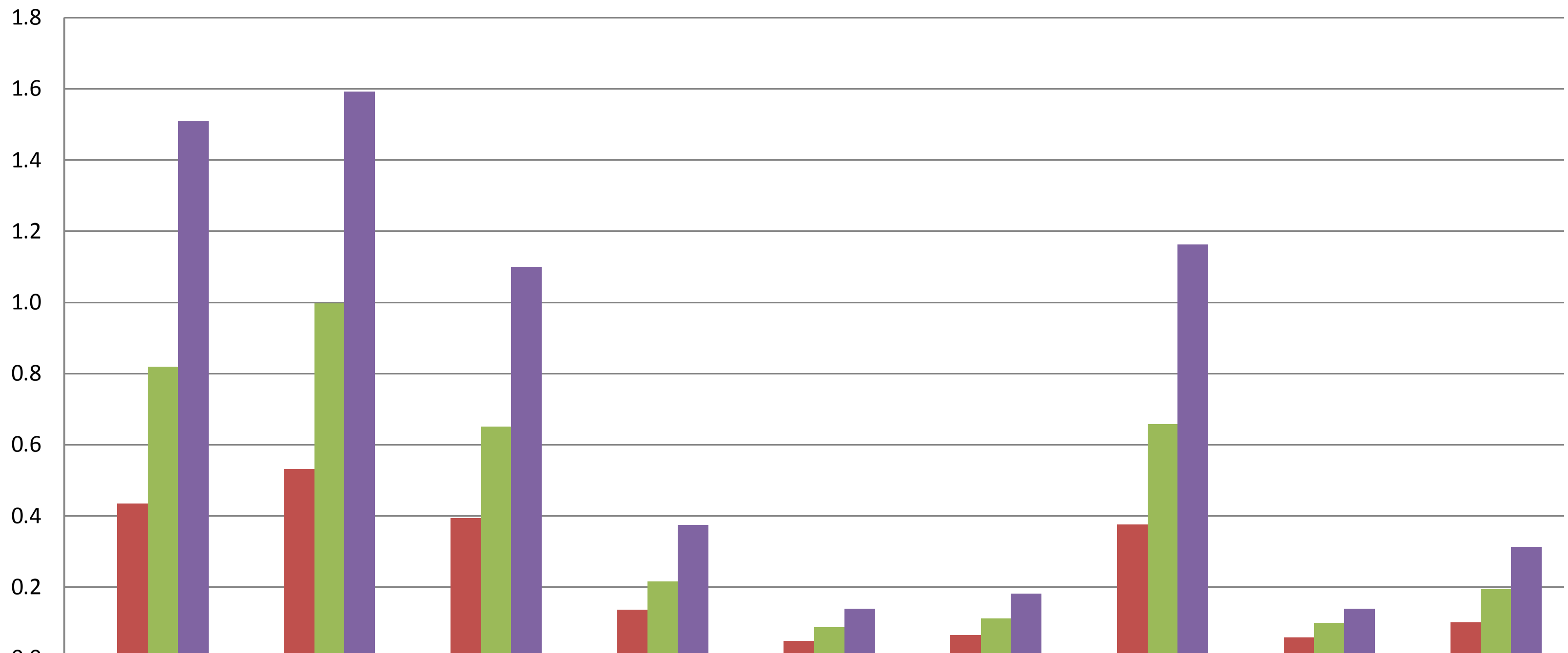
Chiricahua NM has the greatest **number of days** over 1.0 dv for the base case and all control scenarios.
Chiricahua NM has the greatest **decrease in number of days** over 1.0 dv for all control scenarios.

AEPCO Apache 2001-2003 Visibility Impacts, EPA RH FIP July 2012 (dv) Visibility method: vis8, 20best



	Chiricahua NM	Chiricahua Wild.	Galiuro	Gila	Mazatzal	Mount Baldy	Saguaro NP	Sierra Ancha	Superstition
base: Base (OFA)	3.41	3.46	2.22	0.63	0.28	0.28	2.49	0.29	0.61
ctrl1_r: LNB	2.97	2.93	1.83	0.49	0.23	0.22	2.12	0.23	0.51
ctrl2_r: SNCR	2.59	2.47	1.57	0.41	0.19	0.17	1.84	0.19	0.42
ctrl3_s: SCR; w/SO4	1.90	1.87	1.12	0.26	0.14	0.10	1.33	0.15	0.30

AEPCO Apache 2001-2003 Visibility Benefits, EPA RH FIP July 2012 (dv)
Visibility method: vis8, 20best



	Chiricahua NM	Chiricahua Wild.	Galiuro	Gila	Mazatzal	Mount Baldy	Saguaro NP	Sierra Ancha	Superstition
base: Base (OFA)									
ctrl1_r: LNB	0.44	0.53	0.39	0.14	0.05	0.07	0.38	0.06	0.10
ctrl2_r: SNCR	0.82	1.00	0.65	0.22	0.09	0.11	0.66	0.10	0.19
ctrl3_s: SCR; w/SO4	1.51	1.59	1.10	0.37	0.14	0.18	1.16	0.14	0.31

APS Cholla, Arizona RH FIP, July 2012

98th percentile delta deciviews (Average of 8th highs for 2001, 2002, 2003; 22nd high for 2001-2003)

Visibility Impacts, dv

Visibility method: vis8, 20best	Control Scenario base_R: Base (LNB)		ctrl1_r: SNCR		ctrl2_r2: SCR	
Class I Area	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**
Capitol Reef NP	1.33	**1.46**	1.08	**1.19**	0.60	**0.70**
Galiuro Wild.	0.44	**0.45**	0.37	**0.40**	0.30	**0.31**
Gila Wild.	0.71	**0.70**	0.61	**0.61**	0.47	**0.48**
Grand Canyon NP	2.49	**2.22**	2.10	**1.85**	1.30	**1.16**
Mazatzal Wild.	1.20	**1.19**	1.04	**1.03**	0.75	**0.76**
Mesa Verde NP	1.33	**1.34**	1.07	**1.08**	0.61	**0.63**
Mount Baldy Wild.	1.20	**1.21**	0.97	**0.95**	0.69	**0.70**
Petrified Forest NP	4.49	**4.53**	4.06	**4.06**	3.22	**3.19**
Pine Mountain Wild.	0.84	**0.85**	0.72	**0.73**	0.52	**0.54**
Saguaro NP	0.30	**0.30**	0.27	**0.28**	0.22	**0.25**
Sierra Ancha Wild.	1.37	**1.36**	1.16	**1.17**	0.82	**0.85**
Superstition Wild.	1.20	**1.27**	1.04	**1.10**	0.75	**0.76**
Sycamore Canyon Wild.	1.36	**1.42**	1.10	**1.15**	0.73	**0.75**
Maximum	4.49	**4.53**	4.06	**4.06**	3.22	**3.19**
Cumulative (sum)	18.26	**18.30**	15.59	**15.59**	10.99	**11.09**

Visibility Benefits, dv

Visibility method: vis8, 20best	Control Scenario base_R: Base (LNB)		ctrl1_r: SNCR		ctrl2_r2: SCR	
Class I Area	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**
Capitol Reef NP			0.25	**0.27**	0.73	**0.76**
Galiuro Wild.			0.07	**0.05**	0.14	**0.14**
Gila Wild.			0.10	**0.09**	0.25	**0.22**
Grand Canyon NP			0.39	**0.37**	1.19	**1.06**
Mazatzal Wild.			0.16	**0.16**	0.45	**0.43**
Mesa Verde NP			0.26	**0.26**	0.72	**0.70**
Mount Baldy Wild.			0.23	**0.27**	0.50	**0.52**
Petrified Forest NP			0.43	**0.47**	1.27	**1.34**
Pine Mountain Wild.			0.12	**0.12**	0.32	**0.31**
Saguaro NP			0.03	**0.02**	0.08	**0.05**
Sierra Ancha Wild.			0.21	**0.20**	0.55	**0.51**
Superstition Wild.			0.16	**0.17**	0.45	**0.51**
Sycamore Canyon Wild.			0.26	**0.27**	0.62	**0.68**
Maximum			0.43	**0.47**	1.27	**1.34**
Cumulative (sum)			2.67	**2.71**	7.27	**7.21**

Petrified Forest has the greatest 22nd high **impacts** for the base case, and for the control scenarios.
Petrified Forest has the greatest **benefit** in 22nd high for all the control scenarios.

APS Cholla, Arizona RH FIP, July 2012

Number of days with delta deciview impacts greater than or equal to 0.5 dv in 2001-2003; Average

Visibility Impacts, # Days ≥ 0.5 dv

Visibility method: vis8, 20best	base_R: Base		ctrl1_r: SNCR		ctrl2_r2: SCR	
Class I Area	Sum	**Avg**	Sum	**Avg**	Sum	**Avg**
Capitol Reef NP	56	**19**	52	**17**	32	**11**
Galiuro Wild.	15	**5**	12	**4**	7	**2**
Gila Wild.	50	**17**	39	**13**	19	**6**
Grand Canyon NP	84	**28**	74	**25**	57	**19**
Mazatzal Wild.	104	**35**	89	**30**	57	**19**
Mesa Verde NP	99	**33**	77	**26**	36	**12**
Mount Baldy Wild.	86	**29**	73	**24**	45	**15**
Petrified Forest NP	756	**252**	739	**246**	696	**232**
Pine Mountain Wild.	58	**19**	45	**15**	25	**8**
Saguaro NP	11	**4**	6	**2**	3	**1**
Sierra Ancha Wild.	122	**41**	107	**36**	74	**25**
Superstition Wild.	77	**26**	68	**23**	47	**16**
Sycamore Canyon Wild.	73	**24**	59	**20**	36	**12**
Maximum	756	**252**	739	**246**	696	**232**
Cumulative (sum)	1591	**530**	1440	**480**	1134	**378**

Visibility Benefits, # Days ≥ 0.5 dv

Visibility method: vis8, 20best	base_R: Base		ctrl1_r: SNCR		ctrl2_r2: SCR	
Class I Area	Sum	**Avg**	Sum	**Avg**	Sum	**Avg**
Capitol Reef NP			4	**1**	24	**8**
Galiuro Wild.			3	**1**	8	**3**
Gila Wild.			11	**4**	31	**10**
Grand Canyon NP			10	**3**	27	**9**
Mazatzal Wild.			15	**5**	47	**16**
Mesa Verde NP			22	**7**	63	**21**
Mount Baldy Wild.			13	**4**	41	**14**
Petrified Forest NP			17	**6**	60	**20**
Pine Mountain Wild.			13	**4**	33	**11**
Saguaro NP			5	**2**	8	**3**
Sierra Ancha Wild.			15	**5**	48	**16**
Superstition Wild.			9	**3**	30	**10**
Sycamore Canyon Wild.			14	**5**	37	**12**
Maximum			22	**7**	63	**21**
Cumulative (sum)			151	**50**	457	**152**

Petrified Forest has the greatest **number of days** over 0.5 dv for the base case and all control scenarios.
Mesa Verde has the greatest **decrease in number of days** over 0.5 dv for all control scenarios.

APS Cholla, Arizona RH FIP, July 2012

98th percentile delta deciviews (8th high for each of 2001, 2002, 2003; their Average; and 22nd high for 2001-2003 period)

Visibility Impacts, dv

Visibility method: vis8, 20best	Control Scenario base_R: Base (LNB)					ctrl1_r: SNCR					ctrl2_r2: SCR				
Class I Area	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**
Capitol Reef NP	1.29	0.89	1.81	1.33	**1.46**	1.03	0.71	1.49	1.08	**1.19**	0.60	0.39	0.80	0.60	**0.70**
Galiuro Wild.	0.49	0.40	0.43	0.44	**0.45**	0.42	0.35	0.35	0.37	**0.40**	0.36	0.30	0.23	0.30	**0.31**
Gila Wild.	0.65	0.73	0.76	0.71	**0.70**	0.57	0.63	0.64	0.61	**0.61**	0.39	0.50	0.51	0.47	**0.48**
Grand Canyon NP	3.86	2.10	1.52	2.49	**2.22**	3.26	1.76	1.29	2.10	**1.85**	1.92	1.10	0.88	1.30	**1.16**
Mazatzal Wild.	1.24	1.19	1.17	1.20	**1.19**	1.09	1.01	1.02	1.04	**1.03**	0.74	0.72	0.79	0.75	**0.76**
Mesa Verde NP	0.97	1.35	1.66	1.33	**1.34**	0.77	1.08	1.34	1.07	**1.08**	0.44	0.63	0.75	0.61	**0.63**
Mount Baldy Wild.	1.42	1.24	0.93	1.20	**1.21**	1.11	1.03	0.77	0.97	**0.95**	0.70	0.71	0.67	0.69	**0.70**
Petrified Forest NP	4.54	4.06	4.87	4.49	**4.53**	4.17	3.65	4.37	4.06	**4.06**	3.23	3.00	3.44	3.22	**3.19**
Pine Mountain Wild.	0.82	1.05	0.66	0.84	**0.85**	0.70	0.88	0.58	0.72	**0.73**	0.48	0.61	0.49	0.52	**0.54**
Saguaro NP	0.36	0.26	0.27	0.30	**0.30**	0.34	0.24	0.23	0.27	**0.28**	0.30	0.19	0.16	0.22	**0.25**
Sierra Ancha Wild.	1.47	1.44	1.20	1.37	**1.36**	1.22	1.23	1.04	1.16	**1.17**	0.81	0.85	0.79	0.82	**0.85**
Superstition Wild.	1.37	1.32	0.93	1.20	**1.27**	1.16	1.14	0.84	1.04	**1.10**	0.85	0.77	0.64	0.75	**0.76**
Sycamore Canyon Wild.	1.42	1.65	1.01	1.36	**1.42**	1.18	1.30	0.81	1.10	**1.15**	0.72	0.95	0.53	0.73	**0.75**
Maximum	4.54	4.06	4.87	4.49	**4.53**	4.17	3.65	4.37	4.06	**4.06**	3.23	3.00	3.44	3.22	**3.19**
Cumulative (sum)	19.89	17.68	17.20	18.26	**18.30**	17.01	14.99	14.76	15.59	**15.59**	11.54	10.73	10.69	10.99	**11.09**

Visibility Benefits, dv

Visibility method: vis8, 20best	Control Scenario base_R: Base (LNB)					ctrl1_r: SNCR					ctrl2_r2: SCR				
Class I Area	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**
Capitol Reef NP						0.25	0.18	0.32	0.25	**0.27**	0.69	0.50	1.01	0.73	**0.76**
Galiuro Wild.						0.07	0.05	0.08	0.07	**0.05**	0.13	0.10	0.19	0.14	**0.14**
Gila Wild.						0.09	0.10	0.12	0.10	**0.09**	0.27	0.23	0.25	0.25	**0.22**
Grand Canyon NP						0.60	0.34	0.23	0.39	**0.37**	1.94	1.00	0.64	1.19	**1.06**
Mazatzal Wild.						0.15	0.18	0.15	0.16	**0.16**	0.49	0.47	0.38	0.45	**0.43**
Mesa Verde NP						0.20	0.26	0.32	0.26	**0.26**	0.53	0.71	0.91	0.72	**0.70**
Mount Baldy Wild.						0.31	0.22	0.16	0.23	**0.27**	0.72	0.53	0.26	0.50	**0.52**
Petrified Forest NP						0.38	0.41	0.50	0.43	**0.47**	1.31	1.06	1.43	1.27	**1.34**
Pine Mountain Wild.						0.13	0.17	0.07	0.12	**0.12**	0.35	0.44	0.17	0.32	**0.31**
Saguaro NP						0.02	0.03	0.04	0.03	**0.02**	0.06	0.07	0.11	0.08	**0.05**
Sierra Ancha Wild.						0.25	0.21	0.15	0.21	**0.20**	0.66	0.58	0.41	0.55	**0.51**
Superstition Wild.						0.21	0.18	0.09	0.16	**0.17**	0.51	0.56	0.28	0.45	**0.51**
Sycamore Canyon Wild.						0.24	0.35	0.19	0.26	**0.27**	0.70	0.70	0.48	0.62	**0.68**
Maximum						0.60	0.41	0.50	0.43	**0.47**	1.94	1.06	1.43	1.27	**1.34**
Cumulative (sum)						2.89	2.69	2.43	2.67	**2.71**	8.35	6.96	6.51	7.27	**7.21**

Petrified Forest has the greatest 22nd high **impacts** for the base case, and for the control scenarios.

Petrified Forest has the greatest **benefit** in 22nd high for all the control scenarios.

APS Cholla, Arizona RH FIP, July 2012

Number of days with delta deciview impacts greater than or equal to 0.5 dv; for each of 2001, 2002, 2003; their Sum, and their Average (roun

Visibility Impacts, # Days ≥ 0.5 dv

Visibility method: **vis8, 20best**	**Control Scenario** **base_R: Base (LNB)**					**ctrl1_r: SNCR**					**ctrl2_r2: SCR**				
Class I Area	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg
Capitol Reef NP	27	11	18	56	**19**	24	10	18	52	**17**	12	7	13	32	**11**
Galiuro Wild.	5	7	3	15	**5**	3	7	2	12	**4**	1	5	1	7	**2**
Gila Wild.	16	17	17	50	**17**	13	13	13	39	**13**	5	6	8	19	**6**
Grand Canyon NP	36	26	22	84	**28**	30	23	21	74	**25**	23	19	15	57	**19**
Mazatzal Wild.	34	46	24	104	**35**	28	41	20	89	**30**	17	24	16	57	**19**
Mesa Verde NP	28	39	32	99	**33**	17	32	28	77	**26**	4	15	17	36	**12**
Mount Baldy Wild.	33	31	22	86	**29**	26	28	19	73	**24**	14	17	14	45	**15**
Petrified Forest NP	232	256	268	756	**252**	228	252	259	739	**246**	213	235	248	696	**232**
Pine Mountain Wild.	18	26	14	58	**19**	14	19	12	45	**15**	6	12	7	25	**8**
Saguaro NP	5	5	1	11	**4**	1	4	1	6	**2**	0	2	1	3	**1**
Sierra Ancha Wild.	45	44	33	122	**41**	40	40	27	107	**36**	29	26	19	74	**25**
Superstition Wild.	31	28	18	77	**26**	27	26	15	68	**23**	18	17	12	47	**16**
Sycamore Canyon Wild.	20	29	24	73	**24**	18	23	18	59	**20**	12	14	10	36	**12**
Maximum	232	256	268	756	**252**	228	252	259	739	**246**	213	235	248	696	**232**
Cumulative (sum)	530	565	496	1591	**530**	469	518	453	1440	**480**	354	399	381	1134	**378**

Visibility Benefits, # Days ≥ 0.5 dv

Visibility method: **vis8, 20best**	**Control Scenario** **base_R: Base (LNB)**					**ctrl1_r: SNCR**					**ctrl2_r2: SCR**				
Class I Area	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg
Capitol Reef NP						3	1	0	4	**1**	15	4	5	24	**8**
Galiuro Wild.						2	0	1	3	**1**	4	2	2	8	**3**
Gila Wild.						3	4	4	11	**4**	11	11	9	31	**10**
Grand Canyon NP						6	3	1	10	**3**	13	7	7	27	**9**
Mazatzal Wild.						6	5	4	15	**5**	17	22	8	47	**16**
Mesa Verde NP						11	7	4	22	**7**	24	24	15	63	**21**
Mount Baldy Wild.						7	3	3	13	**4**	19	14	8	41	**14**
Petrified Forest NP						4	4	9	17	**6**	19	21	20	60	**20**
Pine Mountain Wild.						4	7	2	13	**4**	12	14	7	33	**11**
Saguaro NP						4	1	0	5	**2**	5	3	0	8	**3**
Sierra Ancha Wild.						5	4	6	15	**5**	16	18	14	48	**16**
Superstition Wild.						4	2	3	9	**3**	13	11	6	30	**10**
Sycamore Canyon Wild.						2	6	6	14	**5**	8	15	14	37	**12**
Maximum						11	7	9	22	**7**	24	24	20	63	**21**
Cumulative (sum)						61	47	43	151	**50**	176	166	115	457	**152**

Petrified Forest has the greatest **number of days** over 0.5 dv for the base case and all control scenarios.
Mesa Verde has the greatest **decrease in number of days** over 0.5 dv for all control scenarios.

APS Cholla, Arizona RH FIP, July 2012

Number of days with delta deciview impacts greater than or equal to 1.0 dv; for each of 2001, 2002, 2003; their Sum, and their Average (roun

Visibility Impacts, # Days ≥ 1.0 dv

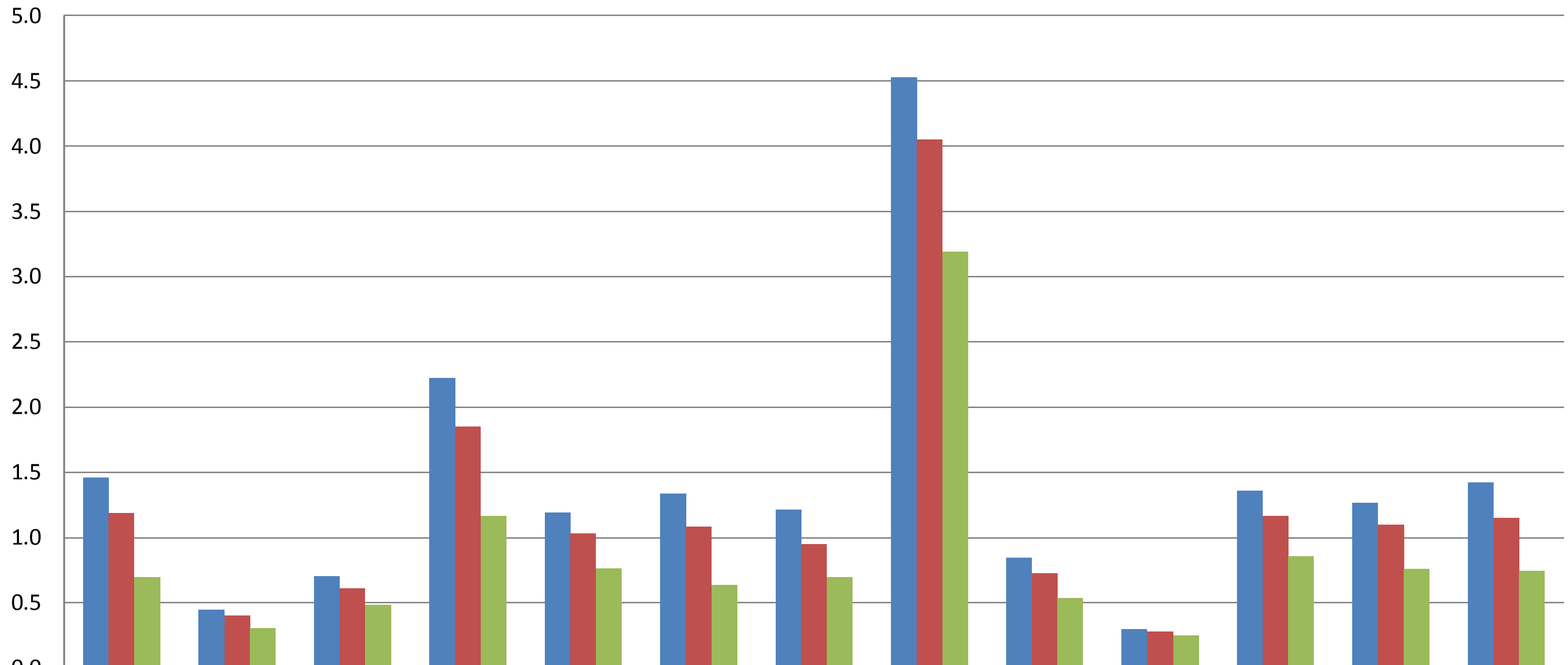
Visibility method:	Control Scenario														
vis8, 20best	**base_R: Base (LNB)**					**ctrl1_r: SNCR**					**ctrl2_r2: SCR**				
Class I Area	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg
Capitol Reef NP	12	7	11	30	**10**	8	7	11	26	**9**	3	2	6	11	**4**
Galiuro Wild.	0	3	0	3	**1**	0	1	0	1	**0.3**	0	0	0	0	**0.0**
Gila Wild.	2	4	4	10	**3**	1	4	3	8	**3**	1	1	2	4	**1**
Grand Canyon NP	20	17	13	50	**17**	19	16	11	46	**15**	13	8	4	25	**8**
Mazatzal Wild.	13	14	11	38	**13**	9	8	9	26	**9**	2	1	2	5	**2**
Mesa Verde NP	5	15	18	38	**13**	3	9	11	23	**8**	2	1	3	6	**2**
Mount Baldy Wild.	8	11	6	25	**8**	8	8	5	21	**7**	2	5	1	8	**3**
Petrified Forest NP	197	218	225	640	**213**	188	212	217	617	**206**	164	199	191	554	**185**
Pine Mountain Wild.	3	8	5	16	**5**	2	5	3	10	**3**	0	0	1	1	**0.3**
Saguaro NP	0	1	0	1	**0.3**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Sierra Ancha Wild.	20	18	9	47	**16**	14	12	9	35	**12**	6	3	5	14	**5**
Superstition Wild.	13	13	6	32	**11**	12	9	4	25	**8**	3	3	2	8	**3**
Sycamore Canyon Wild.	11	13	8	32	**11**	8	11	5	24	**8**	3	7	2	12	**4**
Maximum	197	218	225	640	**213**	188	212	217	617	**206**	164	199	191	554	**185**
Cumulative (sum)	304	342	316	962	**321**	272	302	288	862	**287**	199	230	219	648	**216**

Visibility Benefits, # Days ≥ 1.0 dv

Visibility method:	Control Scenario														
vis8, 20best	**base_R: Base (LNB)**					**ctrl1_r: SNCR**					**ctrl2_r2: SCR**				
Class I Area	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg
Capitol Reef NP						4	0	0	4	**1**	9	5	5	19	**6**
Galiuro Wild.						0	2	0	2	**1**	0	3	0	3	**1**
Gila Wild.						1	0	1	2	**1**	1	3	2	6	**2**
Grand Canyon NP						1	1	2	4	**1**	7	9	9	25	**8**
Mazatzal Wild.						4	6	2	12	**4**	11	13	9	33	**11**
Mesa Verde NP						2	6	7	15	**5**	3	14	15	32	**11**
Mount Baldy Wild.						0	3	1	4	**1**	6	6	5	17	**6**
Petrified Forest NP						9	6	8	23	**8**	33	19	34	86	**29**
Pine Mountain Wild.						1	3	2	6	**2**	3	8	4	15	**5**
Saguaro NP						0	1	0	1	**0**	0	1	0	1	**0**
Sierra Ancha Wild.						6	6	0	12	**4**	14	15	4	33	**11**
Superstition Wild.						1	4	2	7	**2**	10	10	4	24	**8**
Sycamore Canyon Wild.						3	2	3	8	**3**	8	6	6	20	**7**
Maximum						9	6	8	23	**8**	33	19	34	86	**29**
Cumulative (sum)						32	40	28	100	**33**	105	112	97	314	**105**

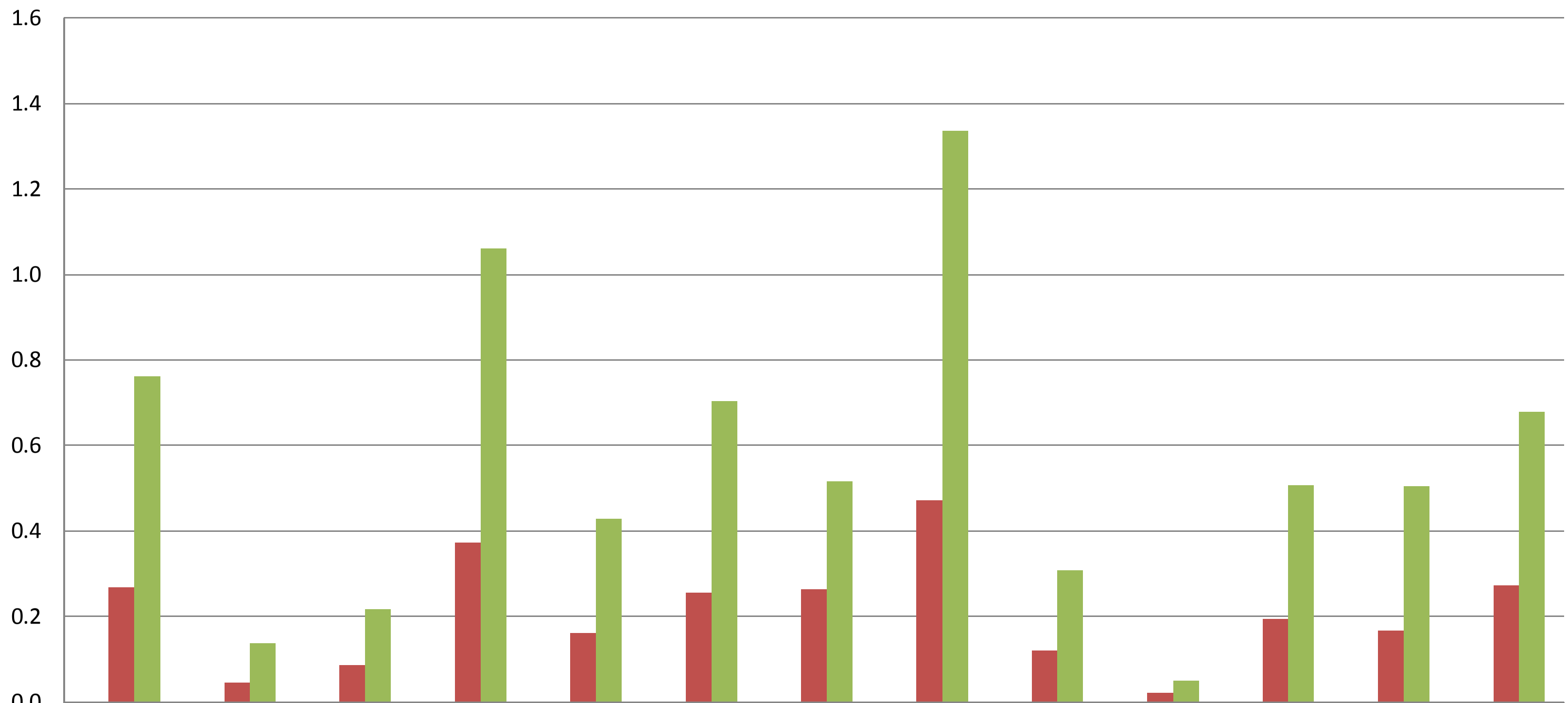
Petrified Forest has the greatest **number of days** over 1.0 dv for the base case and all control scenarios.
Petrified Forest has the greatest **decrease in number of days** over 0.5 dv for all control scenarios.

APS Cholla 2001-2003 Visibility Impacts, EPA RH FIP July 2012 (dv) Visibility method: vis8, 20best



	Capitol Reef	Galiuro	Gila	Grand Canyon	Mazatzal	Mesa Verde	Mount Baldy	Petrified Forest	Pine Mountain	Saguaro	Sierra Ancha	Superstitio n	Sycamore Canyon
base_R: Base (LNB)	1.46	0.45	0.70	2.22	1.19	1.34	1.21	4.53	0.85	0.30	1.36	1.27	1.42
ctrl1_r: SNCR	1.19	0.40	0.61	1.85	1.03	1.08	0.95	4.06	0.73	0.28	1.17	1.10	1.15
ctrl2_r2: SCR	0.70	0.31	0.48	1.16	0.76	0.63	0.70	3.19	0.54	0.25	0.85	0.76	0.75

APS Cholla 2001-2003 Visibility Benefits, EPA RH FIP July 2012 (dv) Visibility method: vis8, 20best



	Capitol Reef	Galiuro	Gila	Grand Canyon	Mazatzal	Mesa Verde	Mount Baldy	Petrified Forest	Pine Mountain	Saguaro	Sierra Ancha	Superstitio n	Sycamore Canyon
base_R: Base (LNB)													
ctrl1_r: SNCR	0.27	0.05	0.09	0.37	0.16	0.26	0.27	0.47	0.12	0.02	0.20	0.17	0.27
ctrl2_r2: SCR	0.76	0.14	0.22	1.06	0.43	0.70	0.52	1.34	0.31	0.05	0.51	0.51	0.68

SRP Coronado, Arizona RH FIP, July 2012

98th percentile delta deciviews (Average of 8th highs for 2001, 2002, 2003; 22nd high for 2001-2003)

Visibility Impacts, dv

Visibility method: vis8, 20best	Control Scenario: base_rs: SCR .08 u2 w/SO4		ctrl1_rs: SNCR u1; w/SO4		ctrl2_rs: SCR .05 u1; w/SO4		ctrl5_rs: SCR .05 w/SO4		ctrl6_rs: SCR -90%; w/SO4	
Class I Area	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**
Bandelier NM	0.34	**0.37**	0.28	**0.30**	0.19	**0.19**	0.17	**0.17**	0.15	**0.15**
Chiricahua NM	0.20	**0.20**	0.16	**0.16**	0.14	**0.13**	0.12	**0.12**	0.11	**0.11**
Chiricahua Wild.	0.22	**0.21**	0.18	**0.18**	0.14	**0.14**	0.13	**0.12**	0.11	**0.11**
Galiuro Wild.	0.19	**0.20**	0.16	**0.18**	0.11	**0.12**	0.11	**0.11**	0.10	**0.10**
Gila Wild.	1.08	**1.23**	0.91	**1.00**	0.63	**0.64**	0.55	**0.57**	0.47	**0.49**
Grand Canyon NP	0.22	**0.24**	0.19	**0.20**	0.13	**0.15**	0.12	**0.13**	0.12	**0.12**
Mazatzal Wild.	0.20	**0.20**	0.18	**0.19**	0.14	**0.14**	0.13	**0.13**	0.13	**0.12**
Mesa Verde NP	0.39	**0.40**	0.31	**0.33**	0.21	**0.21**	0.19	**0.20**	0.17	**0.17**
Mount Baldy Wild.	0.83	**0.87**	0.68	**0.71**	0.46	**0.46**	0.43	**0.43**	0.37	**0.38**
Petrified Forest NP	1.28	**1.22**	1.07	**1.05**	0.71	**0.74**	0.65	**0.66**	0.57	**0.59**
Pine Mountain Wild.	0.14	**0.14**	0.13	**0.13**	0.11	**0.10**	0.11	**0.10**	0.10	**0.09**
Saguaro NP	0.12	**0.12**	0.11	**0.10**	0.09	**0.08**	0.08	**0.08**	0.07	**0.07**
San Pedro Parks Wild.	0.49	**0.54**	0.40	**0.43**	0.24	**0.26**	0.23	**0.23**	0.20	**0.20**
Sierra Ancha Wild.	0.23	**0.24**	0.21	**0.21**	0.18	**0.18**	0.17	**0.18**	0.16	**0.17**
Superstition Wild.	0.21	**0.21**	0.18	**0.19**	0.16	**0.16**	0.15	**0.15**	0.15	**0.14**
Sycamore Canyon Wild.	0.17	**0.16**	0.15	**0.15**	0.11	**0.11**	0.10	**0.10**	0.09	**0.09**
Maximum	1.28	**1.23**	1.07	**1.05**	0.71	**0.74**	0.65	**0.66**	0.57	**0.59**
Cumulative (sum)	6.29	**6.54**	5.29	**5.52**	3.74	**3.80**	3.47	**3.47**	3.08	**3.11**

Visibility Benefits, dv

Visibility method: vis8, 20best	Control Scenario: base_rs: SCR .08 u2 w/SO4		ctrl1_rs: SNCR u1; w/SO4		ctrl2_rs: SCR .05 u1; w/SO4		ctrl5_rs: SCR .05 w/SO4		ctrl6_rs: SCR -90%; w/SO4	
Class I Area	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**	'01-'03 Avg	**'01-'03 22nd**
Bandelier NM			0.06	**0.07**	0.16	**0.18**	0.17	**0.20**	0.19	**0.22**
Chiricahua NM			0.03	**0.03**	0.06	**0.07**	0.07	**0.08**	0.09	**0.09**
Chiricahua Wild.			0.04	**0.03**	0.08	**0.07**	0.09	**0.09**	0.10	**0.09**
Galiuro Wild.			0.03	**0.02**	0.08	**0.08**	0.09	**0.09**	0.09	**0.09**
Gila Wild.			0.17	**0.22**	0.45	**0.59**	0.52	**0.66**	0.60	**0.73**
Grand Canyon NP			0.04	**0.03**	0.09	**0.09**	0.10	**0.11**	0.11	**0.12**
Mazatzal Wild.			0.03	**0.01**	0.06	**0.06**	0.07	**0.07**	0.07	**0.08**
Mesa Verde NP			0.07	**0.07**	0.18	**0.19**	0.19	**0.20**	0.22	**0.23**
Mount Baldy Wild.			0.14	**0.16**	0.36	**0.42**	0.40	**0.44**	0.46	**0.50**
Petrified Forest NP			0.20	**0.17**	0.57	**0.47**	0.62	**0.56**	0.70	**0.63**
Pine Mountain Wild.			0.01	**0.02**	0.03	**0.04**	0.03	**0.05**	0.04	**0.06**
Saguaro NP			0.01	**0.01**	0.04	**0.03**	0.05	**0.04**	0.05	**0.04**
San Pedro Parks Wild.			0.09	**0.11**	0.24	**0.28**	0.26	**0.30**	0.29	**0.34**
Sierra Ancha Wild.			0.03	**0.03**	0.05	**0.06**	0.06	**0.07**	0.07	**0.08**
Superstition Wild.			0.02	**0.02**	0.05	**0.06**	0.05	**0.06**	0.06	**0.07**
Sycamore Canyon Wild.			0.02	**0.01**	0.06	**0.05**	0.06	**0.06**	0.07	**0.07**
Maximum			0.20	**0.22**	0.57	**0.59**	0.62	**0.66**	0.70	**0.73**
Cumulative (sum)			1.00	**1.02**	2.55	**2.74**	2.83	**3.07**	3.22	**3.43**

Gila Wilderness has the greatest 22nd high **impacts** for the base case; Petrified Forest has the greatest for the control scenarios.
Gila Wilderness has the greatest **benefit** in 22nd high for all the control scenarios.

SRP Coronado, Arizona RH FIP, July 2012

Number of days with delta deciview impacts greater than or equal to 0.5 dv in 2001-2003; Average

Visibility Impacts, # Days ≥ 0.5 dv

Visibility method: vis8, 20best	base_rs: SCR .08 u2 w/SO4		ctrl1_rs: SNCR u1; w/SO4		ctrl2_rs: SCR .05 u1; w/SO4		ctrl5_rs: SCR .05 w/SO4		ctrl6_rs: SCR - 90%; w/SO4	
Class I Area	Sum	**Avg**	Sum	**Avg**	Sum	**Avg**	Sum	**Avg**	Sum	**Avg**
Bandelier NM	10	**3**	5	**2**	1	**0.3**	1	**0.3**	0	**0.0**
Chiricahua NM	3	**1**	1	**0.3**	0	**0.0**	0	**0.0**	0	**0.0**
Chiricahua Wild.	6	**2**	3	**1**	0	**0.0**	0	**0.0**	0	**0.0**
Galiuro Wild.	5	**2**	3	**1**	1	**0.3**	0	**0.0**	0	**0.0**
Gila Wild.	80	**27**	61	**20**	32	**11**	25	**8**	21	**7**
Grand Canyon NP	8	**3**	6	**2**	1	**0.3**	1	**0.3**	0	**0.0**
Mazatzal Wild.	2	**0.7**	0	**0.0**	0	**0.0**	0	**0.0**	0	**0.0**
Mesa Verde NP	17	**6**	14	**5**	3	**1**	0	**0.0**	0	**0.0**
Mount Baldy Wild.	52	**17**	46	**15**	16	**5**	14	**5**	8	**3**
Petrified Forest NP	83	**28**	70	**23**	43	**14**	37	**12**	29	**10**
Pine Mountain Wild.	0	**0.0**	0	**0.0**	0	**0.0**	0	**0.0**	0	**0.0**
Saguaro NP	2	**0.7**	2	**0.7**	1	**0.3**	0	**0.0**	0	**0.0**
San Pedro Parks Wild.	25	**8**	13	**4**	1	**0.3**	1	**0.3**	1	**0.3**
Sierra Ancha Wild.	5	**2**	3	**1**	1	**0.3**	0	**0.0**	0	**0.0**
Superstition Wild.	1	**0.3**	0	**0.0**	0	**0.0**	0	**0.0**	0	**0.0**
Sycamore Canyon Wild.	1	**0.3**	0	**0.0**	0	**0.0**	0	**0.0**	0	**0.0**
Maximum	83	**28**	70	**23**	43	**14**	37	**12**	29	**10**
Cumulative (sum)	300	**100**	227	**76**	100	**33**	79	**26**	59	**20**

Visibility Benefits, # Days ≥ 0.5 dv

Visibility method: vis8, 20best	base_rs: SCR .08 u2 w/SO4		ctrl1_rs: SNCR u1; w/SO4		ctrl2_rs: SCR .05 u1; w/SO4		ctrl5_rs: SCR .05 w/SO4		ctrl6_rs: SCR - 90%; w/SO4	
Class I Area	Sum	**Avg**	Sum	**Avg**	Sum	**Avg**	Sum	**Avg**	Sum	**Avg**
Bandelier NM			5	**2**	9	**3**	9	**3**	10	**3**
Chiricahua NM			2	**1**	3	**1**	3	**1**	3	**1**
Chiricahua Wild.			3	**1**	6	**2**	6	**2**	6	**2**
Galiuro Wild.			2	**1**	4	**1**	5	**2**	5	**2**
Gila Wild.			19	**6**	48	**16**	55	**18**	59	**20**
Grand Canyon NP			2	**1**	7	**2**	7	**2**	8	**3**
Mazatzal Wild.			2	**1**	2	**1**	2	**1**	2	**0.7**
Mesa Verde NP			3	**1**	14	**5**	17	**6**	17	**6**
Mount Baldy Wild.			6	**2**	36	**12**	38	**13**	44	**15**
Petrified Forest NP			13	**4**	40	**13**	46	**15**	54	**18**
Pine Mountain Wild.			0	**0**	0	**0**	0	**0**	0	**0.0**
Saguaro NP			0	**0**	1	**0**	2	**1**	2	**0.7**
San Pedro Parks Wild.			12	**4**	24	**8**	24	**8**	24	**8**
Sierra Ancha Wild.			2	**1**	4	**1**	5	**2**	5	**2**
Superstition Wild.			1	**0**	1	**0**	1	**0**	1	**0.3**
Sycamore Canyon Wild.			1	**0**	1	**0**	1	**0**	1	**0.3**
Maximum			19	**6**	48	**16**	55	**18**	59	**20**
Cumulative (sum)			73	**24**	200	**67**	221	**74**	241	**80**

Petrified Forest has the greatest **number of days** over 0.5 dv for the base case and all control scenarios.
Gila Wilderness has the greatest **decrease in number of days** over 0.5 dv for all control scenarios.

SRP Coronado, Arizona RH FIP, July 2012

98th percentile delta deciviews (8th high for each of 2001, 2002, 2003; their Average; and 22nd high for 2001-2003 period)

Visibility Impacts, dv

Visibility method: vis8, 20best	Control Scenario base_rs: SCR .08 u2 w/SO4					ctrl1_rs: SNCR u1; w/SO4					ctrl2_rs: SCR .05 u1; w/SO4					ctrl5_rs: SCR .05 w/SO4					ctrl6_rs: SCR -90%; w/SO4				
Class I Area	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**
Bandelier NM	0.21	0.37	0.46	0.34	**0.37**	0.18	0.30	0.37	0.28	**0.30**	0.14	0.19	0.24	0.19	**0.19**	0.13	0.17	0.23	0.17	**0.17**	0.12	0.16	0.19	0.15	**0.15**
Chiricahua NM	0.16	0.21	0.23	0.20	**0.20**	0.14	0.17	0.18	0.16	**0.16**	0.13	0.11	0.17	0.14	**0.13**	0.12	0.10	0.16	0.12	**0.12**	0.10	0.08	0.15	0.11	**0.11**
Chiricahua Wild.	0.18	0.21	0.25	0.22	**0.21**	0.15	0.18	0.20	0.18	**0.18**	0.14	0.11	0.17	0.14	**0.14**	0.13	0.10	0.16	0.13	**0.12**	0.12	0.09	0.14	0.11	**0.11**
Galiuro Wild.	0.22	0.21	0.16	0.19	**0.20**	0.19	0.17	0.14	0.16	**0.18**	0.12	0.12	0.10	0.11	**0.12**	0.12	0.11	0.10	0.11	**0.11**	0.11	0.10	0.09	0.10	**0.10**
Gila Wild.	0.95	1.27	1.01	1.08	**1.23**	0.79	1.05	0.90	0.91	**1.00**	0.52	0.66	0.70	0.63	**0.64**	0.47	0.58	0.61	0.55	**0.57**	0.40	0.49	0.53	0.47	**0.49**
Grand Canyon NP	0.33	0.20	0.14	0.22	**0.24**	0.28	0.17	0.12	0.19	**0.20**	0.18	0.11	0.10	0.13	**0.15**	0.16	0.11	0.10	0.12	**0.13**	0.14	0.11	0.10	0.12	**0.12**
Mazatzal Wild.	0.17	0.21	0.22	0.20	**0.20**	0.14	0.19	0.20	0.18	**0.19**	0.11	0.15	0.15	0.14	**0.14**	0.11	0.15	0.14	0.13	**0.13**	0.11	0.13	0.14	0.13	**0.12**
Mesa Verde NP	0.45	0.37	0.35	0.39	**0.40**	0.36	0.31	0.28	0.31	**0.33**	0.21	0.24	0.18	0.21	**0.21**	0.20	0.21	0.18	0.19	**0.20**	0.17	0.17	0.17	0.17	**0.17**
Mount Baldy Wild.	0.83	0.87	0.78	0.83	**0.87**	0.70	0.71	0.65	0.68	**0.71**	0.48	0.45	0.46	0.46	**0.46**	0.44	0.39	0.45	0.43	**0.43**	0.38	0.33	0.40	0.37	**0.38**
Petrified Forest NP	1.22	1.71	0.90	1.28	**1.22**	1.05	1.40	0.78	1.07	**1.05**	0.70	0.86	0.58	0.71	**0.74**	0.66	0.75	0.55	0.65	**0.66**	0.57	0.66	0.49	0.57	**0.59**
Pine Mountain Wild.	0.11	0.15	0.15	0.14	**0.14**	0.10	0.14	0.14	0.13	**0.13**	0.09	0.13	0.12	0.11	**0.10**	0.09	0.12	0.11	0.11	**0.10**	0.08	0.11	0.11	0.10	**0.09**
Saguaro NP	0.11	0.16	0.11	0.12	**0.12**	0.10	0.14	0.10	0.11	**0.10**	0.08	0.10	0.07	0.09	**0.08**	0.08	0.09	0.07	0.08	**0.08**	0.07	0.08	0.07	0.07	**0.07**
San Pedro Parks Wild.	0.34	0.58	0.54	0.49	**0.54**	0.28	0.47	0.43	0.40	**0.43**	0.17	0.29	0.27	0.24	**0.26**	0.16	0.25	0.27	0.23	**0.23**	0.14	0.22	0.22	0.20	**0.20**
Sierra Ancha Wild.	0.20	0.26	0.24	0.23	**0.24**	0.18	0.23	0.21	0.21	**0.21**	0.15	0.20	0.19	0.18	**0.18**	0.15	0.18	0.19	0.17	**0.18**	0.15	0.17	0.18	0.16	**0.17**
Superstition Wild.	0.23	0.20	0.19	0.21	**0.21**	0.20	0.18	0.17	0.18	**0.19**	0.18	0.14	0.16	0.16	**0.16**	0.17	0.14	0.15	0.15	**0.15**	0.16	0.13	0.15	0.15	**0.14**
Sycamore Canyon Wild.	0.14	0.19	0.16	0.17	**0.16**	0.12	0.16	0.15	0.15	**0.15**	0.10	0.10	0.12	0.11	**0.11**	0.09	0.10	0.12	0.10	**0.10**	0.09	0.09	0.10	0.09	**0.09**
Maximum	1.22	1.71	1.01	1.28	**1.23**	1.05	1.40	0.90	1.07	**1.05**	0.70	0.86	0.70	0.71	**0.74**	0.66	0.75	0.61	0.65	**0.66**	0.57	0.66	0.53	0.57	**0.59**
Cumulative (sum)	5.83	7.15	5.90	6.29	**6.54**	4.95	5.94	5.00	5.29	**5.52**	3.49	3.95	3.78	3.74	**3.80**	3.27	3.55	3.58	3.47	**3.47**	2.88	3.13	3.22	3.08	**3.11**

Visibility Benefits, dv

Visibility method: vis8, 20best	Control Scenario base_rs: SCR .08 u2 w/SO4					ctrl1_rs: SNCR u1; w/SO4					ctrl2_rs: SCR .05 u1; w/SO4					ctrl5_rs: SCR .05 w/SO4					ctrl6_rs: SCR -90%; w/SO4				
Class I Area	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**	2001	2002	2003	Avg	**22nd '01-'03**
Bandelier NM						0.03	0.07	0.09	0.06	**0.07**	0.07	0.18	0.21	0.16	**0.18**	0.08	0.20	0.23	0.17	**0.20**	0.09	0.21	0.27	0.19	**0.22**
Chiricahua NM						0.02	0.04	0.05	0.03	**0.03**	0.03	0.10	0.06	0.06	**0.07**	0.04	0.11	0.07	0.07	**0.08**	0.06	0.13	0.08	0.09	**0.09**
Chiricahua Wild.						0.03	0.04	0.05	0.04	**0.03**	0.05	0.10	0.09	0.08	**0.07**	0.05	0.11	0.10	0.09	**0.09**	0.07	0.12	0.12	0.10	**0.09**
Galiuro Wild.						0.03	0.04	0.03	0.03	**0.02**	0.10	0.09	0.06	0.08	**0.08**	0.10	0.10	0.06	0.09	**0.09**	0.11	0.11	0.07	0.09	**0.09**
Gila Wild.						0.16	0.23	0.12	0.17	**0.22**	0.43	0.61	0.31	0.45	**0.59**	0.48	0.69	0.40	0.52	**0.66**	0.55	0.78	0.48	0.60	**0.73**
Grand Canyon NP						0.06	0.03	0.02	0.04	**0.03**	0.15	0.09	0.04	0.09	**0.09**	0.17	0.09	0.04	0.10	**0.11**	0.19	0.09	0.04	0.11	**0.12**
Mazatzal Wild.						0.03	0.02	0.03	0.03	**0.01**	0.06	0.06	0.08	0.06	**0.06**	0.06	0.06	0.08	0.07	**0.07**	0.06	0.07	0.09	0.07	**0.08**
Mesa Verde NP						0.09	0.06	0.07	0.07	**0.07**	0.24	0.13	0.17	0.18	**0.19**	0.25	0.16	0.17	0.19	**0.20**	0.28	0.19	0.17	0.22	**0.23**
Mount Baldy Wild.						0.13	0.16	0.14	0.14	**0.16**	0.35	0.42	0.33	0.36	**0.42**	0.39	0.48	0.33	0.40	**0.44**	0.45	0.54	0.38	0.46	**0.50**
Petrified Forest NP						0.17	0.31	0.13	0.20	**0.17**	0.52	0.85	0.33	0.57	**0.47**	0.56	0.96	0.35	0.62	**0.56**	0.65	1.04	0.42	0.70	**0.63**
Pine Mountain Wild.						0.01	0.01	0.01	0.01	**0.02**	0.03	0.02	0.03	0.03	**0.04**	0.03	0.02	0.04	0.03	**0.05**	0.03	0.03	0.04	0.04	**0.06**
Saguaro NP						0.00	0.02	0.01	0.01	**0.01**	0.02	0.06	0.04	0.04	**0.03**	0.03	0.07	0.04	0.05	**0.04**	0.03	0.08	0.04	0.05	**0.04**
San Pedro Parks Wild.						0.06	0.11	0.11	0.09	**0.11**	0.17	0.30	0.27	0.24	**0.28**	0.17	0.33	0.27	0.26	**0.30**	0.19	0.36	0.32	0.29	**0.34**
Sierra Ancha Wild.						0.02	0.03	0.04	0.03	**0.03**	0.04	0.06	0.05	0.05	**0.06**	0.05	0.08	0.05	0.06	**0.07**	0.05	0.09	0.06	0.07	**0.08**
Superstition Wild.						0.03	0.02	0.01	0.02	**0.02**	0.05	0.06	0.03	0.05	**0.06**	0.06	0.06	0.04	0.05	**0.06**	0.07	0.07	0.04	0.06	**0.07**
Sycamore Canyon Wild.						0.02	0.03	0.01	0.02	**0.01**	0.04	0.09	0.04	0.06	**0.05**	0.05	0.10	0.04	0.06	**0.06**	0.05	0.11	0.06	0.07	**0.07**
Maximum						0.17	0.31	0.14	0.20	**0.22**	0.52	0.85	0.33	0.57	**0.59**	0.56	0.96	0.40	0.62	**0.66**	0.65	1.04	0.48	0.70	**0.73**
Cumulative (sum)						0.89	1.21	0.89	1.00	**1.02**	2.34	3.20	2.11	2.55	**2.74**	2.57	3.60	2.32	2.83	**3.07**	2.95	4.02	2.67	3.22	**3.43**

Gila Wilderness has the greatest 22nd high **impacts** for the base case; Petrified Forest has the greatest for the control scenarios.
Gila Wilderness has the greatest **benefit** in 22nd high for all the control scenarios.

SRP Coronado, Arizona RH FIP, July 2012

Number of days with delta deciview impacts greater than or equal to 0.5 dv; for each of 2001, 2002, 2003; their Sum, and their Average (rounded to integer unless < 1)

Visibility Impacts, # Days ≥ 0.5 dv

Visibility method: vis8, 20best	Control Scenario base_rs: SCR .08 u2 w/SO4					ctrl1_rs: SNCR u1; w/SO4					ctrl2_rs: SCR .05 u1; w/SO4					ctrl5_rs: SCR .05 w/SO4					ctrl6_rs: SCR -90%; w/SO4				
Class I Area	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg
Bandelier NM	0	3	7	10	**3**	0	0	5	5	**2**	0	0	1	1	**0.3**	0	0	1	1	**0.3**	0	0	0	0	**0.0**
Chiricahua NM	0	1	2	3	**1**	0	0	1	1	**0.3**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Chiricahua Wild.	1	2	3	6	**2**	1	0	2	3	**1**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Galiuro Wild.	3	1	1	5	**2**	3	0	0	3	**1**	1	0	0	1	**0.3**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Gila Wild.	21	40	19	80	**27**	15	31	15	61	**20**	8	13	11	32	**11**	6	9	10	25	**8**	5	7	9	21	**7**
Grand Canyon NP	6	2	0	8	**3**	5	1	0	6	**2**	1	0	0	1	**0.3**	1	0	0	1	**0.3**	0	0	0	0	**0.0**
Mazatzal Wild.	0	1	1	2	**0.7**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Mesa Verde NP	7	5	5	17	**6**	4	5	5	14	**5**	1	1	1	3	**1**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Mount Baldy Wild.	20	17	15	52	**17**	16	16	14	46	**15**	5	4	7	16	**5**	4	4	6	14	**5**	3	1	4	8	**3**
Petrified Forest NP	40	25	18	83	**28**	34	22	14	70	**23**	15	16	12	43	**14**	12	15	10	37	**12**	9	14	6	29	**10**
Pine Mountain Wild.	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Saguaro NP	2	0	0	2	**0.7**	2	0	0	2	**0.7**	1	0	0	1	**0.3**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
San Pedro Parks Wild.	3	12	10	25	**8**	1	6	6	13	**4**	0	0	1	1	**0.3**	0	0	1	1	**0.3**	0	0	1	1	**0.3**
Sierra Ancha Wild.	1	3	1	5	**2**	0	2	1	3	**1**	0	1	0	1	**0.3**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Superstition Wild.	1	0	0	1	**0.3**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Sycamore Canyon Wild.	0	1	0	1	**0.3**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Maximum	40	40	19	83	**28**	34	31	15	70	**23**	15	16	12	43	**14**	12	15	10	37	**12**	9	14	9	29	**10**
Cumulative (sum)	105	113	82	300	**100**	81	83	63	227	**76**	32	35	33	100	**33**	23	28	28	79	**26**	17	22	20	59	**20**

Visibility Benefits, # Days ≥ 0.5 dv

Visibility method: vis8, 20best	Control Scenario base_rs: SCR .08 u2 w/SO4					ctrl1_rs: SNCR u1; w/SO4					ctrl2_rs: SCR .05 u1; w/SO4					ctrl5_rs: SCR .05 w/SO4					ctrl6_rs: SCR -90%; w/SO4				
Class I Area	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg
Bandelier NM						0	3	2	5	**2**	0	3	6	9	**3**	0	3	6	9	**3**	0	3	7	10	**3**
Chiricahua NM						0	1	1	2	**1**	0	1	2	3	**1**	0	1	2	3	**1**	0	1	2	3	**1**
Chiricahua Wild.						0	2	1	3	**1**	1	2	3	6	**2**	1	2	3	6	**2**	1	2	3	6	**2**
Galiuro Wild.						0	1	1	2	**1**	2	1	1	4	**1**	3	1	1	5	**2**	3	1	1	5	**2**
Gila Wild.						6	9	4	19	**6**	13	27	8	48	**16**	15	31	9	55	**18**	16	33	10	59	**20**
Grand Canyon NP						1	1	0	2	**1**	5	2	0	7	**2**	5	2	0	7	**2**	6	2	0	8	**3**
Mazatzal Wild.						0	1	1	2	**1**	0	1	1	2	**1**	0	1	1	2	**1**	0	1	1	2	**0.7**
Mesa Verde NP						3	0	0	3	**1**	6	4	4	14	**5**	7	5	5	17	**6**	7	5	5	17	**6**
Mount Baldy Wild.						4	1	1	6	**2**	15	13	8	36	**12**	16	13	9	38	**13**	17	16	11	44	**15**
Petrified Forest NP						6	3	4	13	**4**	25	9	6	40	**13**	28	10	8	46	**15**	31	11	12	54	**18**
Pine Mountain Wild.						0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0.0**
Saguaro NP						0	0	0	0	**0**	1	0	0	1	**0**	2	0	0	2	**1**	2	0	0	2	**0.7**
San Pedro Parks Wild.						2	6	4	12	**4**	3	12	9	24	**8**	3	12	9	24	**8**	3	12	9	24	**8**
Sierra Ancha Wild.						1	1	0	2	**1**	1	2	1	4	**1**	1	3	1	5	**2**	1	3	1	5	**2**
Superstition Wild.						1	0	0	1	**0**	1	0	0	1	**0**	1	0	0	1	**0**	1	0	0	1	**0.3**
Sycamore Canyon Wild.						0	1	0	1	**0**	0	1	0	1	**0**	0	1	0	1	**0**	0	1	0	1	**0.3**
Maximum						6	9	4	19	**6**	25	27	9	48	**16**	28	31	9	55	**18**	31	33	12	59	**20**
Cumulative (sum)						24	30	19	73	**24**	73	78	49	200	**67**	82	85	54	221	**74**	88	91	62	241	**80**

Petrified Forest has the greatest **number of days** over 0.5 dv for the base case and all control scenarios.

Gila Wilderness has the greatest **decrease in number of days** over 0.5 dv for all control scenarios.

SRP Coronado, Arizona RH FIP, July 2012

Number of days with delta deciview impacts greater than or equal to 1.0 dv; for each of 2001, 2002, 2003; their Sum, and their Average (rounded to integer unless < 1)

Visibility Impacts, # Days ≥ 1.0 dv

Visibility method: vis8, 20best	Control Scenario base_rs: SCR .08 u2 w/SO4					ctrl1_rs: SNCR u1; w/SO4					ctrl2_rs: SCR .05 u1; w/SO4					ctrl5_rs: SCR .05 w/SO4					ctrl6_rs: SCR -90%; w/SO4				
Class I Area	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg
Bandelier NM	0	0	1	1	**0.3**	0	0	1	1	**0.3**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Chiricahua NM	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Chiricahua Wild.	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Galiuro Wild.	1	0	0	1	**0.3**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Gila Wild.	7	11	8	26	**9**	6	9	7	22	**7**	1	2	2	5	**2**	1	2	1	4	**1**	0	1	1	2	**0.7**
Grand Canyon NP	1	0	0	1	**0.3**	1	0	0	1	**0.3**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Mazatzal Wild.	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Mesa Verde NP	1	1	2	4	**1**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Mount Baldy Wild.	2	4	6	12	**4**	2	2	5	9	**3**	0	0	1	1	**0.3**	0	0	1	1	**0.3**	0	0	0	0	**0.0**
Petrified Forest NP	11	13	6	30	**10**	8	11	4	23	**8**	3	3	1	7	**2**	2	2	1	5	**2**	1	0	0	1	**0.3**
Pine Mountain Wild.	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Saguaro NP	1	0	0	1	**0.3**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
San Pedro Parks Wild.	0	1	1	2	**0.7**	0	0	1	1	**0.3**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Sierra Ancha Wild.	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Superstition Wild.	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Sycamore Canyon Wild.	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**	0	0	0	0	**0.0**
Maximum	11	13	8	30	**10**	8	11	7	23	**8**	3	3	2	7	**2**	2	2	1	5	**2**	1	1	1	2	**1**
Cumulative (sum)	24	30	24	78	**26**	17	22	18	57	**19**	4	5	4	13	**4**	3	4	3	10	**3**	1	1	1	3	**1**

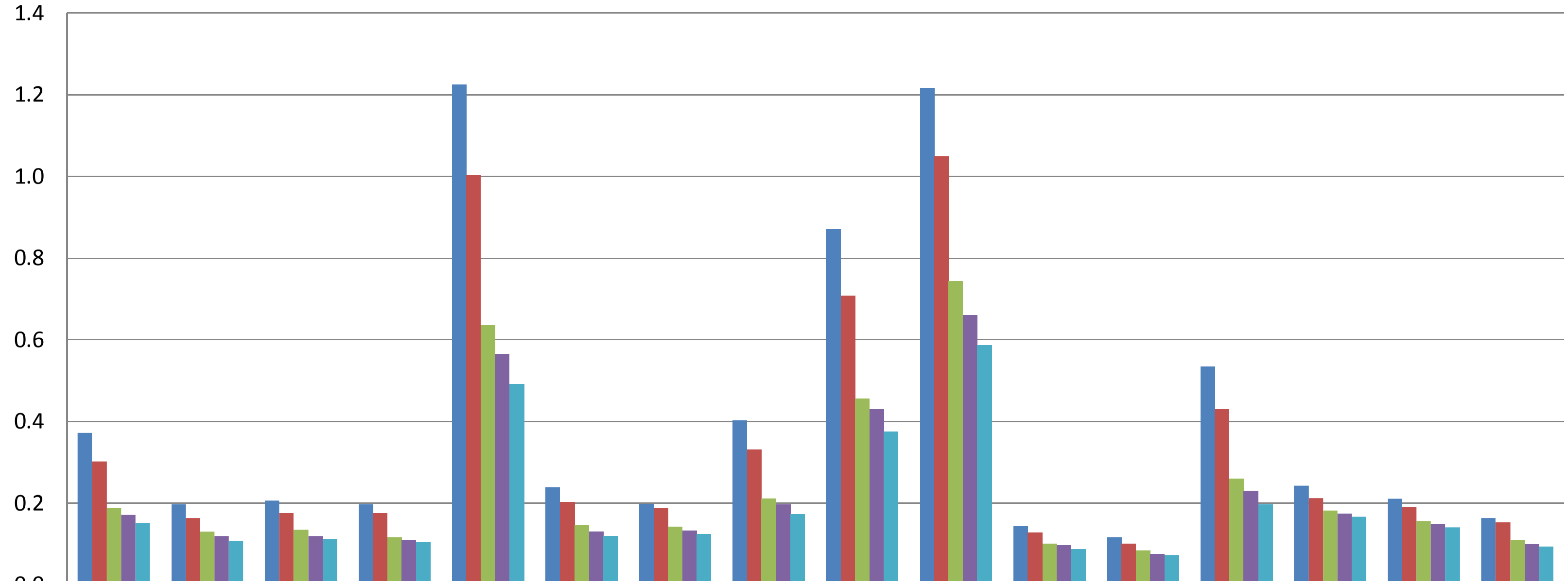
Visibility Benefits, # Days ≥ 1.0 dv

Visibility method: vis8, 20best	Control Scenario base_rs: SCR .08 u2 w/SO4					ctrl1_rs: SNCR u1; w/SO4					ctrl2_rs: SCR .05 u1; w/SO4					ctrl5_rs: SCR .05 w/SO4					ctrl6_rs: SCR -90%; w/SO4				
Class I Area	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg	2001	2002	2003	Sum	Avg
Bandelier NM						0	0	0	0	**0**	0	0	1	1	**0**	0	0	1	1	**0**	0	0	1	1	**0.3**
Chiricahua NM						0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0.0**
Chiricahua Wild.						0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0.0**
Galiuro Wild.						1	0	0	1	**0**	1	0	0	1	**0**	1	0	0	1	**0**	1	0	0	1	**0.3**
Gila Wild.						1	2	1	4	**1**	6	9	6	21	**7**	6	9	7	22	**7**	7	10	7	24	**8**
Grand Canyon NP						0	0	0	0	**0**	1	0	0	1	**0**	1	0	0	1	**0**	1	0	0	1	**0.3**
Mazatzal Wild.						0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0.0**
Mesa Verde NP						1	1	2	4	**1**	1	1	2	4	**1**	1	1	2	4	**1**	1	1	2	4	**1**
Mount Baldy Wild.						0	2	1	3	**1**	2	4	5	11	**4**	2	4	5	11	**4**	2	4	6	12	**4**
Petrified Forest NP						3	2	2	7	**2**	8	10	5	23	**8**	9	11	5	25	**8**	10	13	6	29	**10**
Pine Mountain Wild.						0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0.0**
Saguaro NP						1	0	0	1	**0**	1	0	0	1	**0**	1	0	0	1	**0**	1	0	0	1	**0.3**
San Pedro Parks Wild.						0	1	0	1	**0**	0	1	1	2	**1**	0	1	1	2	**1**	0	1	1	2	**0.7**
Sierra Ancha Wild.						0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0.0**
Superstition Wild.						0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0.0**
Sycamore Canyon Wild.						0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0.0**
Maximum						3	2	2	7	**2**	8	10	6	23	**8**	9	11	7	25	**8**	10	13	7	29	**10**
Cumulative (sum)						7	8	6	21	**7**	20	25	20	65	**22**	21	26	21	68	**23**	23	29	23	75	**25**

Petrified Forest has the greatest **number of days** over 1.0 dv for the base case and all control scenarios.

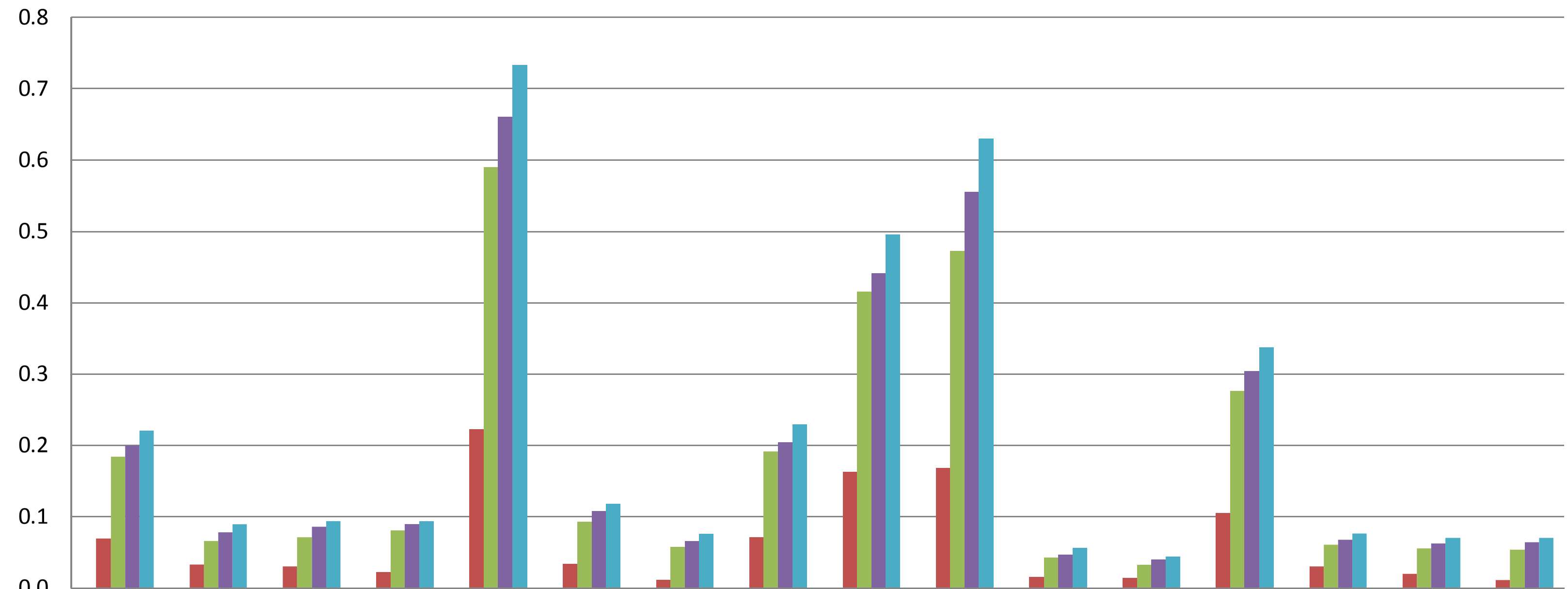
Petrified Forest has the greatest **decrease in number of days** over 1.0 dv for all control scenarios.

SRP Coronado 2001-2003 Visibility Impacts, EPA RH FIP July 2012 (dv) Visibility method: vis8, 20best



	Bandelier	Chiricahua	Chiricahua W.	Galiuro	Gila	Grand Canyon	Mazatzal	Mesa Verde	Mount Baldy	Petrified Forest	Pine Mountain	Saguaro	San Pedro Parks	Sierra Ancha	Superstition	Sycamore Canyon
base_rs: SCR .08 u2	0.37	0.20	0.21	0.20	1.23	0.24	0.20	0.40	0.87	1.22	0.14	0.12	0.54	0.24	0.21	0.16
ctrl1_rs: SNCR u1	0.30	0.16	0.18	0.18	1.00	0.20	0.19	0.33	0.71	1.05	0.13	0.10	0.43	0.21	0.19	0.15
ctrl2_rs: SCR .05 u1	0.19	0.13	0.14	0.12	0.64	0.15	0.14	0.21	0.46	0.74	0.10	0.08	0.26	0.18	0.16	0.11
ctrl5_rs: SCR .05	0.17	0.12	0.12	0.11	0.57	0.13	0.13	0.20	0.43	0.66	0.10	0.08	0.23	0.18	0.15	0.10
ctrl6_rs: SCR -90%	0.15	0.11	0.11	0.10	0.49	0.12	0.12	0.17	0.38	0.59	0.09	0.07	0.20	0.17	0.14	0.09

SRP Coronado 2001-2003 Visibility Benefits, EPA RH FIP July 2012 (dv) Visibility method: vis8, 20best



	Bandelier	Chiricahua	Chiricahua W.	Galiuro	Gila	Grand Canyon	Mazatzal	Mesa Verde	Mount Baldy	Petrified Forest	Pine Mountain	Saguaro	San Pedro Parks	Sierra Ancha	Superstition	Sycamore Canyon
base_rs: SCR .08 u2																
ctrl1_rs: SNCR u1	0.07	0.03	0.03	0.02	0.22	0.03	0.01	0.07	0.16	0.17	0.02	0.01	0.11	0.03	0.02	0.01
ctrl2_rs: SCR .05 u1	0.18	0.07	0.07	0.08	0.59	0.09	0.06	0.19	0.42	0.47	0.04	0.03	0.28	0.06	0.06	0.05
ctrl5_rs: SCR .05	0.20	0.08	0.09	0.09	0.66	0.11	0.07	0.20	0.44	0.56	0.05	0.04	0.30	0.07	0.06	0.06
ctrl6_rs: SCR -90%	0.22	0.09	0.09	0.09	0.73	0.12	0.08	0.23	0.50	0.63	0.06	0.04	0.34	0.08	0.07	0.07