Technical Support Document for

Louisiana Regional Haze: CAMx Best Available Retrofit Technology Modeling

(CAMx Modeling TSD)

Prepared and Reviewed by:

Erik Snyder
Michael Feldman
Robert Imhoff

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(Revised May 2017 and June 2017 to include Entergy Nelson)

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1. Introduction

To address the first implementation period, the State of Louisiana submitted a Regional Haze (RH) State Implementation Plan (SIP) on June 13, 2008 (hereafter referred to as the 2008 Louisiana Regional Haze SIP). EPA acted on that submittal in two separate actions: a limited disapproval (77 FR 33642 (June 7, 2012)) because the SIP relied on the Clean Air Interstate Rule (CAIR) to address the impact of emissions from the State's electric generating units (EGUs); and a partial limited approval/partial disapproval (77 FR 39425 (July 3, 2012)) noting deficiencies in the SIP revision that did not meet the applicable requirements of the CAA and EPA's regulations as set forth in sections 169A and 169B of the CAA and in 40 CFR 51.300-308. In our final action on June 7, 2012, we found that the requirements of section 169A of the CAA were not met because the 2008 Louisiana Regional Haze SIP did not include fully approvable measures for meeting the requirements of 40 CFR 51.308(d)(3) and 51.308(e) with respect to emissions of NOx and SO2 from electric generating units (EGUs). We also determined that the Cross State Air Pollution Rule (CSAPR or the Transport Rule)[1], a rule issued in 2011 to address the interstate transport of NOx and SO2 in the eastern United States would, like CAIR, provide for greater reasonable progress towards the national goal than would BART for states in which CSAPR applies. 76 FR 82219. EPA finalized that rule on May 30, 2012 (77 FR 33642). Based on this finding, the EPA also revised the Regional Haze Rule (RHR) to allow CSAPR states to substitute participation in the trading programs under CSAPR for source-specific BART. States such as Louisiana that are subject to the requirements of the CSAPR trading program only for ozone season nitrogen oxides (NOx) can still substitute CSAPR for BART for NO_X, but must address BART for EGUs for SO2 and other visibility impairing pollutants. 76 FR 82224.

States are required to identify all BART-eligible sources within their boundaries by utilizing the three eligibility criteria in the BART Guidelines (70 FR 39158) and the Regional Haze regulations (40 CFR 51.301): (1) One or more emission units at the facility fit within one of the 26 categories listed in the BART Guidelines; (2) the emission unit(s) began operation on or after August 6, 1962, and the unit was in existence on August 6, 1977; and (3) the potential emissions of any visibility-impairing pollutant from subject units are 250 tons or more per year. Sources that meet these three criteria are considered BART-eligible. In our proposed partial disapproval and partial limited approval (77 FR 11839) of the 2008 Louisiana Regional Haze SIP, we approved LDEQ's identification of 76 BART-eligible sources.

Once a list of BART-eligible sources within a state has been compiled, states must determine whether to make BART determinations for all of them or to consider exempting some of them from BART because they may not reasonably be anticipated to cause or contribute to any visibility impairment in a Class I area. The BART guidelines discuss several approaches available to exempt sources from the BART determination process, including modeling individual sources and the use of model plants. To determine which sources are anticipated to contribute to visibility impairment the BART guidelines state you can use CALPUFF or other appropriate model to estimate the visibility impacts from a single source at a Class I area.

[1] 76 FR 48207, 48208 (August 8, 2011).

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Louisiana's 2008 Regional Haze SIP submittal did not include a determination of which BART eligible EGUs were subject to BART, and Louisiana cannot rely on CSAPR as a substitute for BART for SO2. On May 19, 2015, EPA Region 6 sent CAA Section 114 letters to several BART-eligible sources in Louisiana. In those letters we noted our understanding that the sources were actively working with LDEQ to develop a SIP. However, in order to be in a position to develop a FIP, should that be necessary, EPA requested information regarding the BART-eligible sources. The Section 114 letters required sources to conduct modeling to determine if the sources were subject to BART, and included a CALPUFF modeling protocol. The letters also requested that a BART analysis in accordance with the BART Guidelines be performed for those sources determined to be subject to BART. The LDEQ worked closely with the BART facilities and with EPA Region 6. On February 10, 2017, Louisiana submitted a SIP revision (February 2017 Louisiana Regional Haze SIP) intended to cure the deficiencies noted in our partial limited approval/partial disapproval, and supplemented that submittal by a SIP revision submitted for parallel processing on June 20, 2017 to address BART requirements at the Entergy Nelson facility. On behalf of each BART facility, Trinity Consultants (or CB&I on behalf of NRG Big Cajun I and Big Cajun II), performed CALPUFF BART screening modeling for BART-eligible sources and five-factor analyses for subject-to-BART sources to address the BART requirements for EGU sources in the state. These modeling analyses were included as part of the 2017 Louisiana Regional Haze SIP. As part of our proposed action, we have reviewed the CALPUFF BART analyses performed by Trinity Consultants and CB&I that have been provided to us via the SIP submittal. CALPUFF modeling was also utilized to assess the anticipated visibility benefit of controls for those sources determined to be subject to BART. See the CALPUFF Modeling TSD for a review of the modeling protocol, model inputs, and results.

As discussed above, Louisiana relied on CALPUFF modeling to inform BART determinations consistent with the BART Guidelines. However, the use of CALPUFF is typically used for distances less than 300-400 km. Some of the BART-eligible sources in Louisiana are far away from a Class I area yet have high enough emissions that they may significantly impact visibility at Class I areas in Louisiana and surrounding states. For example, the Cleco Brame source is located 352 km from Caney Creek and 422 km from Breton. The table below shows the distances from these large coal-fired EGU sources in Louisiana to nearby Class I areas. CAMx provides a scientifically defendable platform for assessment of visibility impacts over a wide range of source to receptor distances. CAMx is also more suited than some other modeling approaches for evaluating the impacts of SO_2, NOx, VOC and PM emissions as it has a more robust chemistry mechanism than CALPUFF. The CAMx PM Source Apportionment Technology (PSAT) modeling was conducted for BART-eligible sources. A BART-eligible source that is shown not to contribute significantly to visibility impairment at any of the Class I areas using CAMx modeling may be excluded from further steps in the BART process. For the largest emission sources, NRG Big Cajun II, Entergy Nelson and Cleco Brame Energy, we performed our own CAMx modeling following the BART Guidelines and consistent with previously agreed techniques and metrics of the Texas CAMx BART screening protocol (EPA,

Texas, and FLM representatives approved)[2, 3], to provide additional information on visibility impacts and impairment and address possible concerns with utilizing CALPUFF to assess visibility impacts at Class I areas located far from theses emission sources. CAMx modeling was also performed to evaluate the anticipated visibility benefits of controls for subject-to-BART units, as described below and in the CALPUFF Modeling TSD. This TSD provides additional information on EPA's CAMx modeling protocol, inputs, and model results.

Table 1-1. Distances from BART-eligible coal-fired sources to Class I areas (km)

Facility Name	**Breton Island**	**Caney Creek**
Cleco Rodemacher/Brame	422	352
Entergy Nelson	427	460
Louisiana Generating (NRG) Big Cajun II	263	476

In addition to the CALPUFF modeling included in the 2017 Louisiana Regional Haze SIP submittal, the results of CAMx modeling performed by Trinity consultants[4] was included in the submittal as additional screening analyses[5] that purport to demonstrate that the baseline visibility impacts from Cleco Brame and a number of the Entergy sources[6] are significantly less than the 0.5 dv threshold established by Louisiana. However, this modeling was not conducted in accordance with the BART Guidelines and a previous modeling protocol developed for the use

[2] Texas had over 120 BART eligible facilities located at a wide range of distances to the nearest class I areas in their original Regional Haze SIP. Due to the distances between sources and Class I areas and the number of sources, Texas worked with EPA and FLM representatives to develop a modeling protocol to conduct BART screening of sources using CAMx photochemical modeling. Texas was the only state that screened sources using CAMx and had a protocol developed for how the modeling was to be performed and what metrics had to be evaluated for determining if a source screened out. See Guidance for the Application of the CAMx Hybrid Photochemical Grid Model to Assess Visibility Impacts of Texas BART Sources at Class I Areas, ENVIRON International, December 13, 2007, available in the docket for this action.

[3] EPA, TCEQ, and FLM representatives verbally approved the approach in 2006 and in email exchange with TCEQ representatives in February 2007 (see email from Erik Snyder (EPA) to Greg Nudd of TCEQ Feb. 13, 2007 and response email from Greg Nudd to Erik Snyder Feb. 15, 2007, available in the docket for this action).

[4] Where we reference CAMx modeling performed by Trinity Consultants, this also includes modeling and analysis performed by Trinity and All4 Inc.

[5] See October 10, 2016 Letter from Cleco Corporation to Vivian Aucoin and Vennetta Hayes, LDEQ, RE: Cleco Corporation Louisiana BART CAMx Modeling, included in Appendix B of the 2017 Louisiana Regional Haze SIP submittal; CAMx Modeling Report, prepared for Entergy Services by Trinity Consultants, Inc. and All 4 Inc, October 14, 2016, included in Appendix D of the 2017 Louisiana Regional Haze SIP submittal

[6] Entergy's CAMx modeling included model results for Michoud, Little Gypsy, R.S. Nelson, Ninemile Point, Willow Glen, and Waterford.

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of CAMx modeling for BART screening (EPA, Texas, and FLM representatives approved)[7,8], and does not properly assess the maximum baseline impacts. Therefore, we consider the submitted CAMx modeling to be invalid for supporting any determination of visibility impacts below 0.5 dv. We agree with LDEQ's decision to not rely on this CAMx modeling, but rather rely on the CALPUFF modeling included in the 2017 Louisiana Regional Haze SIP for BART determinations.[9] We provide a detailed discussion of our review of this CAMx modeling in Section 4 of this document.

Throughout this document, we may use language such as, "we find" or other similar phrases that on the surface would suggest a final determination has been made. However, all aspects of our TSDs should be considered to be part of our proposal and are subject to change based on comments and other information we may receive during our public comment period

2. Visibility Impairment Threshold

The preamble to the BART Guidelines advises that, "for purposes of determining which sources are subject to BART, States should consider a 1.0 deciview change or more from an individual source to 'cause' visibility impairment, and a change of 0.5 deciviews to 'contribute' to impairment." It further advises that "States should have discretion to set an appropriate threshold depending on the facts of the situation," and describes situations in which states may wish to exercise that discretion, mainly in situations in which a number of sources in an area were all contributing fairly equally to the visibility impairment of a Class I area. In Louisiana's initial 2008 Regional Haze SIP submittal, the LDEQ used a contribution threshold of 0.5 dv for determining which sources are subject to BART, and we approved this threshold in our previous action.[10] We find that the use of the same threshold is appropriate for these EGU sources. The 2017 SIP revision includes a BART determination for each of the State's BART- eligible EGUs whose visibility impacts exceed the 0.5dv threshold.

3. CAMx Modeling Protocol

[7] Texas had over 120 BART eligible facilities located at a wide range of distances to the nearest class I areas in their original Regional Haze SIP. Due to the distances between sources and Class I areas and the number of sources, Texas worked with EPA and FLM representatives to develop a modeling protocol to conduct BART screening of sources using CAMx photochemical modeling. Texas was the only state that screened sources using CAMx and had a protocol developed for how the modeling was to be performed and what metrics had to be evaluated for determining if a source screened out. See Guidance for the Application of the CAMx Hybrid Photochemical Grid Model to Assess Visibility Impacts of Texas BART Sources at Class I Areas, ENVIRON International, December 13, 2007, available in the docket for this action.

[8] EPA, TCEQ, and FLM representatives verbally approved the approach in 2006 and in email exchange with TCEQ representatives in February 2007 (see email from Erik Snyder (EPA) to Greg Nudd of TCEQ Feb. 13, 2007 and response email from Greg Nudd to Erik Snyder Feb. 15, 2007, available in the docket for this action).

[9] See Response to Comments in Appendix A of the 2017 Louisiana Regional Haze SIP submittal

[10] See, 77 FR 11839, 11849 (February 28, 2012).

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The Texas Commission on Environmental Quality (TCEQ) developed a modeling protocol in 2006/7 using CAMx to evaluate non-EGU BART sources, as well as evaluate VOC and PM impacts from all BART-eligible sources to inform their Texas Regional Haze SIP.[11] TCEQ requested to use CAMx due to the number of BART sources in Texas (over 120 facilities) and most of the facilities were on the edge or outside of the range CALPUFF is used for BART screening. The modeling protocol was reviewed by TCEQ, EPA and FLM representatives specialized in air quality analyses and BART. EPA and FLMs agreed with the use of CAMx for screening BART sources in 2006/7 and approved of the protocol using the maximum (not 98th percentile) daily visibility impacts.[12] The Texas protocol addressed modeling for sources that did not usually have CEM data for the pollutants, so as an approximation of maximum 24-hour emissions we indicated doubling annual was generally acceptable in the absence of better data. In our modeling we are evaluating NOx, SO_2 and PM emissions and have utilized CEM data for NOx and SO_2 (maximum 24-hour emissions from the 2000-2004 baseline period) and doubled the annual PM emission rate consistent with past practices and protocols. We approved Texas' subject-to-BART analysis for non-EGU sources which relied on this CAMx modeling in our January 5, 2016 rulemaking.[13] Our subject-to-BART screening modeling for EGU-sources in Louisiana using CAMx is consistent with the protocol developed and utilized by Texas and used by us in evaluating EGU BART sources in Texas.[14] The evaluation of Louisiana BART-eligible EGUs using CAMx relied on the same CAMx modeling utilized in our recent evaluation of BART-eligible EGU sources in Texas.

The EPA BART screening analysis was built upon the regional photochemical modeling utilized in our earlier action on Texas Reasonable Progress ("EPA R6 Texas RH study")[15]; which was built from the 2002 annual regional photochemical modeling database developed for CENRAP and utilized by Texas for their Regional Haze SIP and BART screening with CAMx.[16] CENRAP developed a 2002 annual modeling database for CAMx on the 36 km unified national Regional Planning Organization (RPO) grid that covers the continental United States. The CENRAP

[11] See TX RH SIP Appendix 9-5, "Screening Analysis of Potential BART-Eligible Sources in Texas"; Revised Draft Final Modeling Protocol Screening Analysis of Potentially BART-Eligible Sources in Texas, Environ Sept. 27, 2006; and Guidance for the Application of the CAMx Hybrid Photochemical Grid Model to Assess Visibility Impacts of Texas BART Sources at Class I Areas, Environ December 13, 2007 all available in the docket for this action.

[12] We note that in February 2007 EPA raised concern with using the 98th percentile for sources analyzed with CAMx, rather than the maximum or 1st high. TCEQ and EPA agreed that evaluation and screening would be done using the Maximum (1st High). See EPA-Snyder 2007, TCEQ-Knud 2007, TCEQ BART Screening Clarification 2007

[13] 81 FR 296

[14] *See* 82 FR 912 (January 4, 2017).

[15] ENVIRON. 2013. "Memorandum: 2002 Baseline CAMx Simulation, Texas Regional Haze Evaluation", prepared by ENVIRON International Corporation for EPA Region 6 (RTI Contract EP-W-011-029). February 21, 2013.

[16] ENVIRON and CERT. 2007. "Technical Support Document for CENRAP Emissions and Air Quality Modeling to Support Regional Haze State Implementation Plans", prepared for the Central Regional Air Planning Association, prepared by ENVIRON International Corporation, and the University of California, Riverside. September 12.

modeling protocol[17], CENRAP modeling Quality Assurance Program Plan (QAPP)[18]; Morris and Tonnesen, 2004), and base model evaluation[19] reports provide details on the development of the CENRAP 2002 36-km annual modeling database. Emissions inputs for the CENRAP study were based on 2002 Base G Typical (Typ02G) annual emissions database. Numerous iterations of the emissions modeling were conducted using interim databases before arriving at the final Base G emission inventories[20]. For the EPA R6 Texas RH study, ENVIRON updated the CENRAP 36 km annual CAMx photochemical modeling database to include a 12 km nested-grid that covers Texas, Louisiana and other nearby states and Class I areas in and near Texas (see figure below for modeling domain).

ENVIRON made the following updates to the CENRAP emissions data for the EPA R6 Texas RH study:

- Updated from SMOKE version 2.3 to version 3.1, although some SMOKE modules came from an older version to maintain compatibility with the format of data from CENRAP.
- CB05 chemical speciation profiles for area and point sources
- Processed point source emissions in CAMx input format to preserve stack parameters and location
- Changed the earth sphere variable (IOAPI_ISPH) in SMOKE from 19 to 20. CENRAP SMOKE setup used IOAPI_ISPH=19 that could cause inconsistencies between point source locations and the meteorological points. IOAPI_ISPH=20 assumes a 6740 km earth radius consistent with MM5 and CAMx
- Tagged Plume-in-Grid (PiG) for large SO_2 and NOx sources
- Added organic aerosol precursor emissions from biogenic sources based on CENRAP BEIS CB4 emissions
- Adjusted primary organic aerosol mass from POC to POA mass

In the process of developing this modeling analysis for evaluating BART-eligible sources in Louisiana, we received assistance in conducting modeling runs from University of North Carolina at Chapel Hill, Institute for the Environment (UNC-IE), a consultant to RTI International under EP-D-11-084 Work Assignment No. 4-17. UNC-IE used the EPA R6 Texas RH study database as a starting point for the CAMx modeling performed for this study.[21] For

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[17] Morris, R.E., G.E. Mansell, B. Koo, G. Tonnesen, M. Omary and Z. Wang. 2004. Modeling Protocol for the CENRAP 2002 Annual Emissions and Air Quality Modeling, Draft 2.0. (http://pah.cert.ucr.edu/aqm/cenrap/docs/CENRAP_Draft2.0_Modeling_Protocol_1208 4.pdf). December 8.

[18] Morris, R.E. and G. Tonnesen. 2004. Quality Assurance Project Plan (Draft) for Central Regional Air Planning Association (CENRAP) Emissions and Air Quality Modeling. (http://pah.cert.ucr.edu/aqm/cenrap/docs/CENRAP_QAPP_Nov_24_2004.pdf). December 23

[19] ENVIRON and CERT. 2007. "Technical Support Document for CENRAP Emissions and Air Quality Modeling to Support Regional Haze State Implementation Plans", prepared for the Central Regional Air Planning Association, prepared by ENVIRON International Corporation, and the University of California, Riverside. September 12.

[20] e.g., Morris, R.E., A. Hoats, S. Lau, B. Koo, G. Tonnesen, C-J. Chien and M. Omary. 2005. Air Quality Modeling Analysis for CENRAP – Preliminary 2002 Base Case CMAQ and CAMx Modeling of the Continental US 36 km Domain and Model Performance Evaluation. ENVIRON International Corporation, Novato, California. April 30.

[21] The evaluation of Louisiana BART-eligible EGUs using CAMx relied on the same CAMx modeling utilized in our evaluation of BART-eligible EGU sources in Texas. See the BART Modeling TSD and BART Screening TSD

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emissions processing, the only difference between this study and the EPA R6 Texas RH study is to integrate updates from EPA R6 to the emissions rates and stack parameters for some sources in Texas and Louisiana in the EGU BART point source emissions inventory See Appendix A for emission rates and stack parameters for sources in Louisiana. Additional information on emission inputs for sources in Texas is available in the BART Screening TSD and BART Modeling TSD that accompanied our proposed action on Texas BART.[22] UNC-IE used CAMx v6.30 for this study because it is the most recent version of the model and updated science available at the initiation of the project.

The December 7, 2016 UNC-IE memorandum documents the BART screening modeling setup and results.[23] From this point this memo will be referred to as "UNC Task 2 BART Screening Memo". Please see the UNC Task 2 BART Screening Memo for full details. We touch on some specific issues that we analyzed and made decisions in the discussion below.

We utilized PiG for all the selected BART-eligible sources in order to utilize the PSAT within the PiG. We also utilized PiG for other large point sources of NOx and SO_2 within the modeling domain as would typically be done in current day SIP modeling. Selection of sources and emissions thresholds for PiG treatment (for other than the selected BART-eligible sources) was based on balancing PiG treatment with model run time. The BART Guidelines in 40 CFR 51 Appendix Y recommends that States use the 24-hour average actual emission rate from the highest emitting day of the meteorological period modeled, unless this rate reflects periods start-up, shutdown, or malfunction. For the selected BART-eligible sources we used the maximum actual 24-hr emission rates for NOx and SO_2 from the 2000-2004 baseline period for each source as identified through a review of the daily emission data for each BART-eligible unit from EPA's Air Markets Program Data and modeled these emission rates as constant emission rates for the entire modeled year, consistent with the emissions identified by the sources and utilized in the CALPUFF modeling performed by Trinity consultants (or CB&I) on behalf of the facilities.[24] To estimate maximum PM emissions the annual average emission rate in pounds per hour from the CENRAP 2002 modeling emission inventory was doubled to estimate the 24-hr maximum emission rate.[25]. Documentation of these emission rates, preprocessors and other model selection options is included in the UNC BART Screening Memo.[26] Additional

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that accompanied that action (identified by Docket No. EPA-R06-OAR-2016-0611, at *http://www.regulations.gov*) for additional information, including information on emissions for Texas sources included in the modeling

[22] *See* 82 FR 912 (January 4, 2017);

[23] "Regional Haze Evaluation Under Contract EP-D-11-084 Work Assignment No. 4-17: TASK 5, Subtask 2: Conducting CAMx PiG with PSAT Source Apportionment for BART screening (CAMx Run #1)", Memorandum from Zac Adelman and Uma Shankar, UNC Institute for the Environment to Erik Snyder, EPA Region 6, December 7, 2016. Available in the docket for this action as "EPA-R6_RH_Task2_Memo_UNC_07Dec2016.pdf"

[24] Emissions data available at https://ampd.epa.gov/ampd/

[25] Based on evaluation of some sources that had both annual and maximum 24-hour actual data, EPA recommended that sources could use an emission rate that was double the annual emission rate to approximate the maximum 24-hour actual emission rates for some sources for CALPUFF modeling when there was not enough data to generate a maximum 24-hr actual emission rate. For additional information on this approach see the Technical Support Document for the Oklahoma and Texas Regional Haze Federal Implementation Plans (TX RH FIP TSD, page A-36. Available at http://www.regulations.gov/#!documentDetail;D=EPA-R06-OAR-2014-0754-0007)

[26] "Regional Haze Evaluation Under Contract EP-D-11-084 Work Assignment No. 4-17: TASK 5, Subtask 2: Conducting CAMx PiG with PSAT Source Apportionment for BART screening (CAMx Run #1)", Memorandum

information on emission inputs for sources in Texas is available in the BART screening TSD and BART modeling TSDs that accompanied our proposed action on Texas BART.[27] See Appendix A for a summary of emissions and stack parameters used for the selected BART-eligible sources in Louisiana. In addition to the modeling results from the initial base case modeling (CAMx base case modeling is also referred to as BART Screening Modeling and Run 1), as discussed in more detail elsewhere, we also had additional control scenario modeling performed (low control is also referred to as "Run 4", high control is also referred to as "Run 3") to estimate the benefits of emission reductions from controls representing a high level and intermediate level of control.[28]

Below is a map of our CAMx 36/12 km modeling domain and the locations of the Class I area receptors:

from Zac Adelman and Uma Shankar, UNC Institute for the Environment to Erik Snyder, EPA Region 6, December 7, 2016. Available in the docket for this action as "EPA-R6_RH_Task2_Memo_UNC_07Dec2016.pdf"

[27] *See* 82 FR 912; and TSDs (contained in Docket No. EPA-R06-OAR-2016-0611, at *http://www.regulations.gov*)

[28] These additional runs are documented by UNC in "Regional Haze Evaluation Under Contract EP-D-11-084 Work Assignment No. 4-17: TASK 5, Subtask 4: Conducting CAMx PiG with PSAT Source Apportionment for BART Control Evaluations (CAMx Run #3 and #4)", Memorandum from Zac Adelman and Uma Shankar, UNC Institute for the Environment to Erik Snyder, EPA Region 6, December 8, 2016. Available in the docket for this action as "EPA-R6_RH_Task4_Memo_UNC_08Dec2016.pdf"

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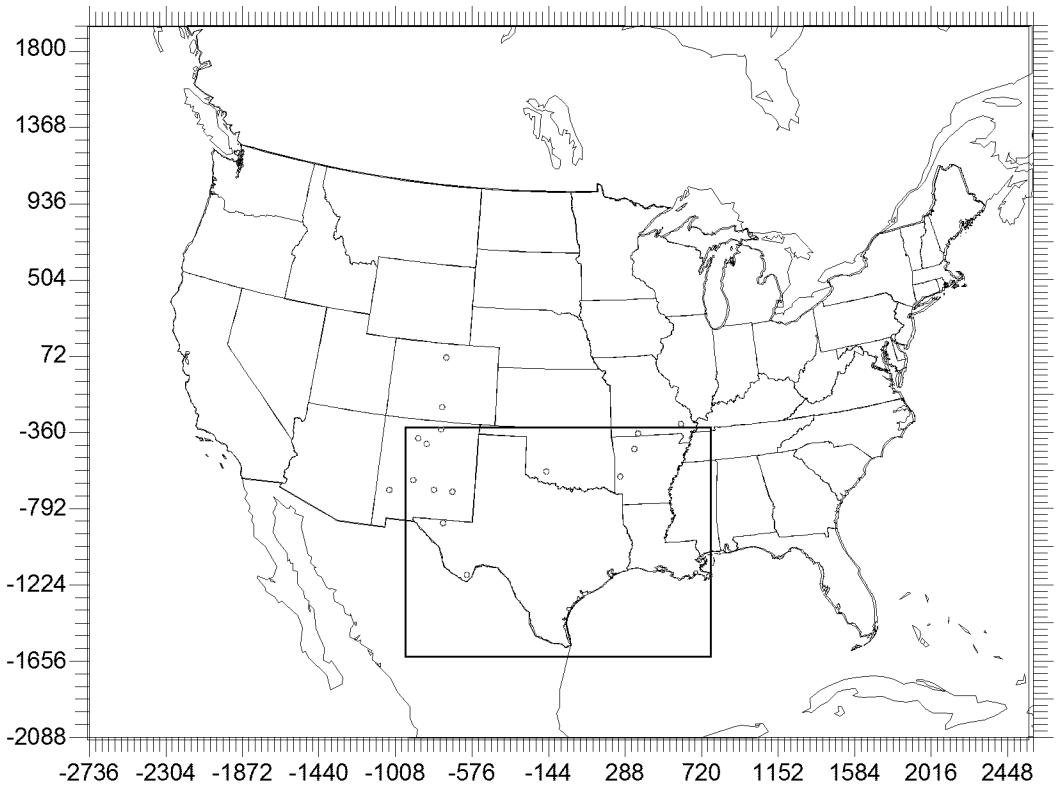
Figure 3-1. CAMx Modeling 36/12 km modeling domain and locations of Class I area receptors.



36km: SW = (-2736,-2088) NX,NY = (148x112) DX,DY = (36x36)
12km: SW = (-936,-1620) NX,NY = (144,108) DX,DY = (12x12)
LCP Definition: (-97.0,40.0,45.0,33.0)

Table 3-1. Class I area receptors for CAMx modeling

Site	State	Code	County	Lat	Lon	Grid	Annual Average Natural visibility conditions[1]
Breton Wilderness Area	LA	BRET1	St. Bernard Parish	29.1189	-89.2066	12km	8.275 dv
Big Bend National Park	TX	BIBE1	Brewster County	29.3027	-103.178	12km	4.015 dv
Guadalupe Mountains	TX	GUMO1	Culberson County	31.833	-104.809	12km	3.412 dv
Wichita Mountains Wilderness	OK	WIMO1	Comanche County	34.7323	-98.713	12km	5.082 dv
Caney Creek Wilderness Area	AR	CACR1	Polk County	34.4544	-94.1429	12km	7.619 dv
Upper Buffalo Wilderness Area	AR	UPBU1	Newton County	35.8258	-93.203	12km	7.534 dv
Bandelier Wilderness Area	NM	BAND1	Los Alamos County	35.7797	-106.266	12km	3.367 dv
Salt Creek Wilderness Area	NM	SACR1	Grant County	33.4598	-104.404	12km	4.156 dv
Wheeler Peak Wilderness Area	NM	WHPE1	Taos County	36.5854	-105.452	12km	2.337 dv
White Mountain Wilderness Area	NM	WHIT1	Lincoln County	33.4687	-105.535	12km	3.309 dv
Hercules-Glades Wilderness Area	MO	HEGL1	Taney County	36.6138	-92.9221	12km	7.572 dv
Mingo	MO	MING1	Stoddard County	36.9717	-90.1432	12km	7.894 dv
Great Sand Dunes	CO	GRSA1	Saguache County	37.7249	-105.519	36km	3.465 dv
Carlsbad Caverns National Park[2]	NM	GUMO1	Culberson County	31.833	-104.809	12km	3.412 dv
Pecos Wilderness Area[2]	NM	WHPE1	Taos County	36.5854	-105.452	12km	2.337 dv

[1] NC II, or new IMPROVE natural visibility conditions are available at: http://vista.cira.colostate.edu/Docs/IMPROVE/Aerosol/NaturalConditions/NaturalConditionsII_Format2_v2.xls, which is also available in our docket.
[2] Carlsbad Caverns shares a monitor with the Guadalupe Mountains. Pecos Wilderness shares a monitor with Wheeler Peak

The CAMx Particulate Matter Source Apportionment Tool (PSAT) is designed to track emissions of the following PM species from primary sources to defined receptor locations:

- Sulfate (SO_4)
- Particulate nitrate (NO_3)
- Ammonium (NH_4)
- Particulate mercury (Hg(p))
- Secondary organic aerosol (SOA)
- Six categories of primary particulate matter (PM):
    - Elemental carbon (EC)
    - Primary organic aerosol (POA)

- Fine crustal PM (FCRS)
- Fine other primary PM (FPRM)
- Coarse crustal PM (CCRS)
- Coarse other primary PM (CPRM)

PSAT performs PM source apportionment (also called source tagging) for selected source groups. A source group may consist of a combination of geographic regions and emissions source categories. For this study, we initially selected 29 units in Texas and Louisiana (see map and table below) to assign to unique PSAT source groups.

The PSAT uses "reactive tracers" that are added for each source category/region combination (i). In general, a single tracer can track primary PM species, whereas secondary PM species require several tracers to track the relationship between gaseous precursors and the resulting PM. Particulate nitrate and secondary organics are the most complex species to apportion because the emitted precursor gases (NOx and VOCs) are several steps removed from the resulting PM species (NO_3 and SOA). There is a PSAT convention that tracer names for particulate species begin with the letter "P."

One fundamental assumption in PSAT is that PM is apportioned back to the primary precursor for each type of PM. For example, SO_4 is apportioned to SO_x emissions, NO_3 is apportioned to NO_x emissions, NH_4 is apportioned to NH_3 emissions, etc.

The PSAT results from the BART Screening CAMx run are used directly to estimate the impacts of the BART sources on visibility at the Class I Area receptors. The PSAT tagged species concentrations are extracted for every day of the year from the grid cells that contain the Class I area receptors listed in the table above. The CAMx 12-km simulation results are used for all of the receptors but Great Sand Dunes National Monument (GRSA1), which uses the 36-km CAMx simulation. UNC-IE time-shifted the CAMx results from GMT to local time at each monitor and computed 24-hour average concentrations for each PSAT tracer species. The daily average tracer concentrations were then used to compute the visibility impacts of each source at the monitor using the revised IMPROVE equation discussed above. Daily average tracer concentrations from BART-eligible units at the same facility were summed to assess the impact from the BART-eligible source. UNC-IE and developed a new post-processing and analysis approach to extract variables from the CAMx output files and to calculate visibility impacts from the PSAT tracers for each model run.[29] We used these data to develop spreadsheets to analyze the modeled visibility impairment from each source and unit.[30]

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[29] Data files from UNC-IE: Run 3: camx_v630.EPA-R6-2016.TX-BART.CAMxRun3.36-12.PiG-PSAT.2002001-2002365.data.template.bext_dv.xlsx; Run 4: camx_v630.EPA-R6-2016.TX-BART.CAMxRun4.36-12.PiG-PSAT.2002001-2002365.data.template.bext_dv.xlsx; Run 1: camx_v630.EPA-R6-2016.TX-BART.CAMxRun1.2002001-2002365.no2mod.data.template.bext_dv.xlsx; and EPA R6 Texas RH 2002 base: camx.v5.41.txhaze.12FE.2002001-2002364.camv5bs.data.template.v3.bext_dv.txt

[30] EPA Worksheets: LA_summary CAMx vis daily.xlsx; LA summary CAMx vis daily_Brame_Big_CajunII.xlsx; Run 3: camx_v630.EPA-R6-2016.TX-BART.CAMxRun3.final.xlsx; Run4: camx_v630.EPA-R6-2016.TX-BART.CAMxRun4.final.xlsx, Run1: camx_v630.EPA-R6-2016.TX-BART.CAMxRun1.final.xlsx; and EPA R6 Texas RH 2002 base: camx_v630.EPA-R6-2016.TX-BART.CAMxv5bs.xlsx

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The Haze Index (HI) for each source is calculated in deciviews from the source's extinction plus natural background using the following formula:

$$HIsource = 10 \ln[(bsource + bnatural)/10]$$

Here, bnatural is the Class I area specific clean natural visibility background (natural conditions); we rely on the adjusted default estimates for the new IMPROVE equation from the Natural Conditions II committee for the annual average natural conditions.[31] Natural conditions (bnatural) are listed by Class I areas and assume clean conditions with no man-made or weather interference.

The source's HI is compared against natural conditions to assess the significance of the source's visibility impact. The visibility significance metric for evaluating BART sources is the change in deciview (delta-dv) from the source's and natural conditions Haze Indices:

$$delta\text{-}dv = HIsource - HInatural =$$

$$10 \ln[(bsource + bnatural)/10] - 10 \ln[bnatural/10] = 10 \ln[(bsource + bnatural)/bnatural]$$

The maximum delta-dv impact from each BART-eligible source is compared to the 0.5 dv threshold to determine if the source is reasonably anticipated to cause or contribute to visibility impairment at a Class I area and is therefore Subject-to-BART. The use of the maximum impact is consistent with the BART screening protocol developed by the TCEQ in consultation with EPA and the FLMs in 2006/7 and used in their Regional Haze SIP and our TX BART FIP. The BART Guidelines proposed to use the maximum impact from CALPUFF modeling (and other modeling).[32] The Final BART Guidelines took into account concerns raised about CALPUFF's simple chemistry and an overestimation concern in nitrates and likely to provide conservative (higher) results for peak impacts and EPA did not want to use these likely overestimated maximum impacts which would be on the tail end of the impact data, so EPA chose the less conservative 98th percentile to address the concerns with CALPUFF.[33] Since CAMx utilizes a more robust chemistry mechanism, the concerns that drove the selection of the 98th percentile value for CALPUFF based modeling are not applicable and we are using the maximum impacts. As previously discussed Texas agreed to use the maximum impacts with their CAMx modeling as we are now doing in our CAMx modeling. We approved the use of the maximum impact and the screening of non-EGU BART-eligible sources in our previous action on the TX RH SIP.[34]

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[31] Regional Haze Rule Natural Level Estimates Using the Revised IMPROVE Aerosol Reconstructed Light Extinction Algorithm, Copeland, S. A., et al, Final Paper # 48, available in our docket.; NC II, or new IMPROVE natural visibility conditions are available at: http://vista.cira.colostate.edu/Docs/IMPROVE/Aerosol/NaturalConditions/NaturalConditionsII_Format2_v2.xls, which is also available in our docket.

[32] FR Vol. 69, No. 87 pages 25193-25195, 25218 (Wednesday May 5, 2004)

[33] "Most important, the simplified chemistry in the model tends to magnify the actual visibility effects of that source. Because of these features and the uncertainties associated with the model, we believe it is appropriate to use the 98th percentile—a more robust approach that does not give undue weight to the extreme tail of the distribution." 70 FR 39104, 39121.

[34] We note that in February 2007 EPA raised concern with using the 98th percentile for sources analyzed with CAMx, rather than the maximum or 1st high. TCEQ and EPA agreed that evaluation and screening would be done

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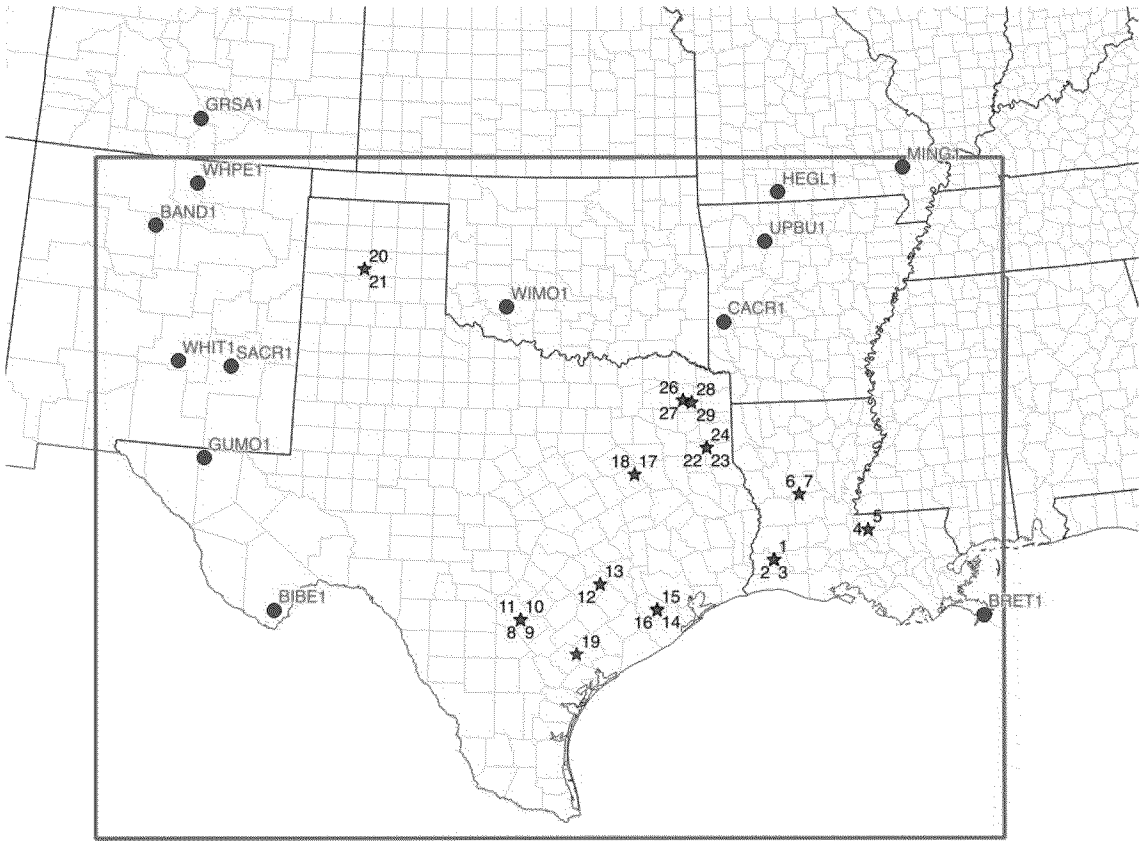
The map and table below show the BART-eligible units that were tagged for the CAMx BART screening analysis. We note that this modeling also included tagged sources in Texas needed for a separate evaluation of those facilities in support of the proposed TX BART FIP.

Figure 3-2. CAMx modeled sources



In the above, locations of Class I area receptors are represented by green circles and BART-eligible sources/units are represented by red stars. The 12-km resolution CAMx modeling domain, is shown in blue. Sources 8 through 29 are located in Texas and were modeled to support a separate action.

Table 3-2. BART-eligible sources and units in Louisiana for CAMx BART screening Modeling

Index	Plant Name	Unit
1	ENTERGY R.S. Nelson	Aux Boiler
2	ENTERGY R.S. Nelson	4
3	ENTERGY R.S. Nelson	6
4	NRG Big Cajun II	1
5	NRG Big Cajun II	2

using the Maximum (1st High). See EPA-Snyder 2007, TCEQ -Knud 2007, TCEQ BART Screening Clarification 2007

6	Cleco Brame - Nesbitt	1
7	Cleco Brame - Rodemacher	2

3.1. CAMx Model Evaluation

CAMx Model Performance Analysis

To understand the performance of the current CAMx modeling in the context of two previous rounds of CAMx and Community Multi-scale Air Quality modeling system (CMAQ) regional haze modeling and expected model performance EPA and its contractor have conducted evaluations of the model results.

UNC-IE Analysis

Because the current CAMx modeling performed by UNC used the EPA R6 Texas RH CAMx[35] as a platform for the modeling for the impact of the Texas and Louisiana BART sources with (a) changes to the model version, (b) conversion of inputs from the previous version of the model to be used in the current version and, most significantly, (c) modifications to the emission inventory for the BART sources to allow modeling for screening of maximum visibility impacts, analysis was conducted to determine the performance relative to EPA modeling guidelines and determine the relative performance of the modeling system to that of the previous CAMx modeling using the platform. UNC, the EPA contractor, conducted an evaluation documented in the UNC Task 2 BART Screening Memo. [36] Below we briefly summarize UNC's analysis and give further interpretation and supporting information.

In the UNC Task 2 BART Screening Memo several different lines of comparison and evaluation were pursued.

- Ozone model performance (since the atmospheric chemistry of ozone and regional haze are linked.)
    - Normalized Bias to EPA's model performance guidelines for ozone modeling and monthly average concentrations versus observations. *On a monthly average basis the current CAMx run met the EPA ozone modeling performance guideline in all months except October for the 12km domain.*
    - Comparison of spatial concentration plots of the current and previous CAMx modeling. *The current and previous CAMx modeling maximum daily 8-hour ozone results are comparable.*
- PM model performance

[35] The regional photochemical modeling utilized in our earlier action on Texas Reasonable Progress. ENVIRON. 2013. "Memorandum: 2002 Baseline CAMx Simulation, Texas Regional Haze Evaluation", prepared by ENVIRON International Corporation for EPA Region 6 (RTI Contract EP-W-011-029). February 21, 2013.

[36] "Regional Haze Evaluation Under Contract EP-D-11-084 Work Assignment No. 4-17: TASK 5, Subtask 2: Conducting CAMx PiG with PSAT Source Apportionment for BART screening (CAMx Run #1)", Memorandum from Zac Adelman and Uma Shankar, UNC Institute for the Environment to Erik Snyder, EPA Region 6, December 7, 2016. Available in the docket for this action as "EPA-R6_RH_Task2_Memo_UNC_07Dec2016.pdf"

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- Comparison of normalized bias to EPAR6 Texas RH CAMx and EPA's model performance guidelines for particulate matter modeling and monthly average concentrations versus observations. *The CAMx Run1 12km simulation meets the model performance goal for total $PM_{2.5}$ in the months of March through September but has an overly high bias in the cooler months of the year.*
- Seasonal analysis of speciated PM2.5 concentrations from the model versus observations. *The modeled total $PM_{2.5}$ positive biases during the winter and fall are driven by overestimates of particulate nitrate (NO_3) and dust and sea salt. During the warmer months all of the inorganic species – including nitrate and sulfate – were underestimated.*
- Comparison of spatial concentrations plots of the current and previous CAMx modeling
  - Max 24-hour PM2.5
  - Annual average PM2.5

The overall result of the comparison is that the current modeling tends to have higher PM2.5 levels with similar patterns for the locations with the highest concentrations.

- Visibility
  - Comparison by Class I site of model and observed speciated light extinction
    - 20% best visibility days
    - 20% worst visibility days
    - All days

The speciation results correspond closely to those from the previous modeling. The species plots show that overall the CAMx model tended to underestimate visibility impacts on the worst days and overestimate visibility impacts on the best days. Sulfate is underestimated in the warmer months; nitrate overestimated in the cooler months.

EPA and UNC's overall conclusion was that, with limited exceptions, the current CAMx modeling performance corresponds to the previous modeling and that it meets the EPA performance guidelines. We address the exceptions below.

According to the analysis in the UNC Task 2 BART Screening Memo there are two instances where the current CAMx modeling is significantly differently from the previous modeling; for one of which the performance does not meet the EPA model guidelines. In the first, although CAMx was found to have a high bias for nitrates in the cooler season in the previous modeling, the current result shows an even higher bias which is above the modeling guideline. This finding is explained by considering the emissions that were used in the BART analysis. The NOx emissions in the modeling do not represent the emissions that actually occurred on a daily basis. Rather, due to the requirements of the BART analysis to determine potential impact, maximum observed NOx emissions instead of actual emissions were used across all days. A high bias should be expected versus observed if these sources are impacting the Class I areas and causing

visibility impairment. The analysis of seasonally speciated PM2.5 shows that overestimates of nitrate are important to the high bias in cooler seasons. The increase in the bias in which nitrates play a major role is consistent with the conclusions that these sources are causing impairment.

In the second, the PM2.5 spatial plots show that the current modeling concentrations are elevated relative to the previous modeling. Similar to the explanation for the elevated nitrates, the SO2, NOx, and primary particulate emissions were modeled for the maximum observed emissions for the BART analysis. It would be expected that when modeled emissions are raised for sources which have significant impacts on PM2.5 concentrations that the modeled ambient concentrations would also rise.

EPA Region 6 Model Performance Evaluation versus CENRAP modeling

In 2006/7 an evaluation was conducted by ENVIRON for CENRAP of CMAQ and CAMx modeling for the Regional Haze project. CENRAP's evaluation found that the performance of CMAQ and CAMx were equivalent and published the overall results of the CMAQ evaluation and the source apportionment results of CAMx modeling in their final TSD[37]. Because the current CAMx modeling conducted by UNC for Region 6 relies upon the EPA R6 Texas RH modeling, which depended on the CENRAP Regional Haze modeling dataset as a platform, EPA Region 6 as part of the current CAMx modeling, conducted an analysis to (a) determine the performance relative to EPA modeling guidelines and (b) determine the relative performance of the modeling system to that of the CENRAP CMAQ modeling using the platform. A synopsis of the intercomparison is given below using soccer goal plots[38] summarizing overall model performance for sulfates, nitrates, and organic carbon. In order to represent different prevalent meteorological conditions, four months were compared: January, April, July, and October, the same months documented in the CENRAP TSD. The sites used for the comparisons were the IMPROVE sites in the respective regions of interest e.g. the CENRAP states and portions of the Region 6 states potentially affected by the Texas and Louisiana BART eligible sources. Since the Class I area sets for CENRAP and the Run 1 (base case or BART Screening run) from the CAMx modeling performed by Region 6 differ substantially in the sources impacting them and in source to monitor transport, the comparison is not one-to-one. In addition, the emissions from the tagged BART-eligible sources have been enhanced with more emissions for the purposes of the BART impact analysis in Run 1.

[37] Technical Support Document for CENRAP Emissions and Air Quality Modeling to Support Regional Haze State Implementation Plans available in the docket for this action

[38] The soccer plot is so named because the dotted lines illustrating performance goals resemble a soccer goal. The plot is a convenient way to visualize model performance of both bias and error on a single plot. As bias and error approach zero, the points are plotted closer to or within the "goal", represented by the dashed boxes. Tesche, T.W., Morris, R., Tonnesen, G., McNally, D., Boylan, J., Brewer, P., 2006. CMAQ/CAMx annual 2002 performance evaluation over the eastern US. Atmospheric Environment 40, 4906-4919 and https://www3.epa.gov/scram001/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf (page 72)

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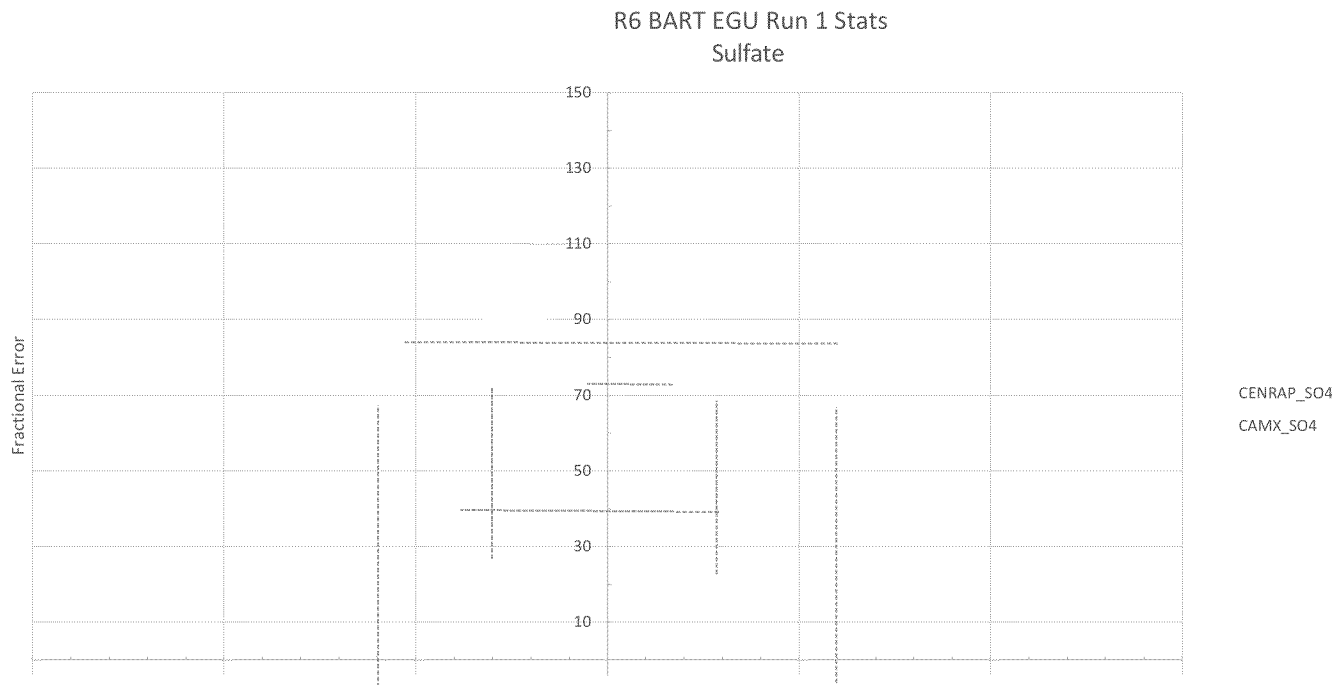
Figure 3.1-1. Comparison of Improve monitoring sites used for model performance analyses for CENRAP (left) and Region 6 Run 1(right). The Run 1 sites are contained within the rectangle (12 km domain).

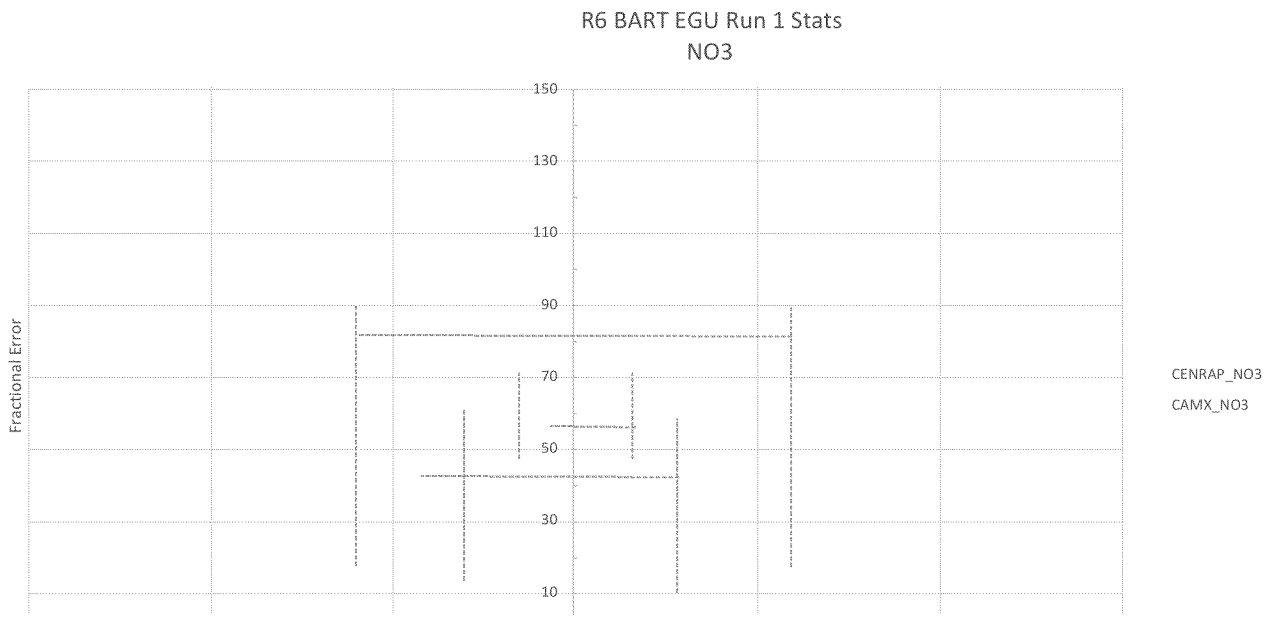
(1) Sulfate

	CENRAP CMAQ		R6 CAMX Run1	
Month	Frac Bias	Frac Error	Frac Bias	Frac Error
January	-12.4	41.9	16	47.2
April	-51.6	58.2	-38.5	54.4
July	-49.6	59.4	-83.2	85.3
October	-6.1	39.6	17.6	62.0



The intercomparison shows that the performance of Run 1 and the CENRAP CMAQ runs were similar for most months except that in the cooler months Run1 had a lower bias than did the CENRAP runs and that for July Run 1 had a larger low bias – outside of the 60% fractional bias / 80% fractional error performance goal for regional particulate modeling.

	CENRAP		R6 CAMX	
Month	Frac Bias	Frac Error	Frac Bias	Frac Error
January	37.8	92.9	76.6	104
April	-67.4	115.2	-78.7	113
July	-140.5	148.4	-137	142
October	39.3	103.6	25.4	115



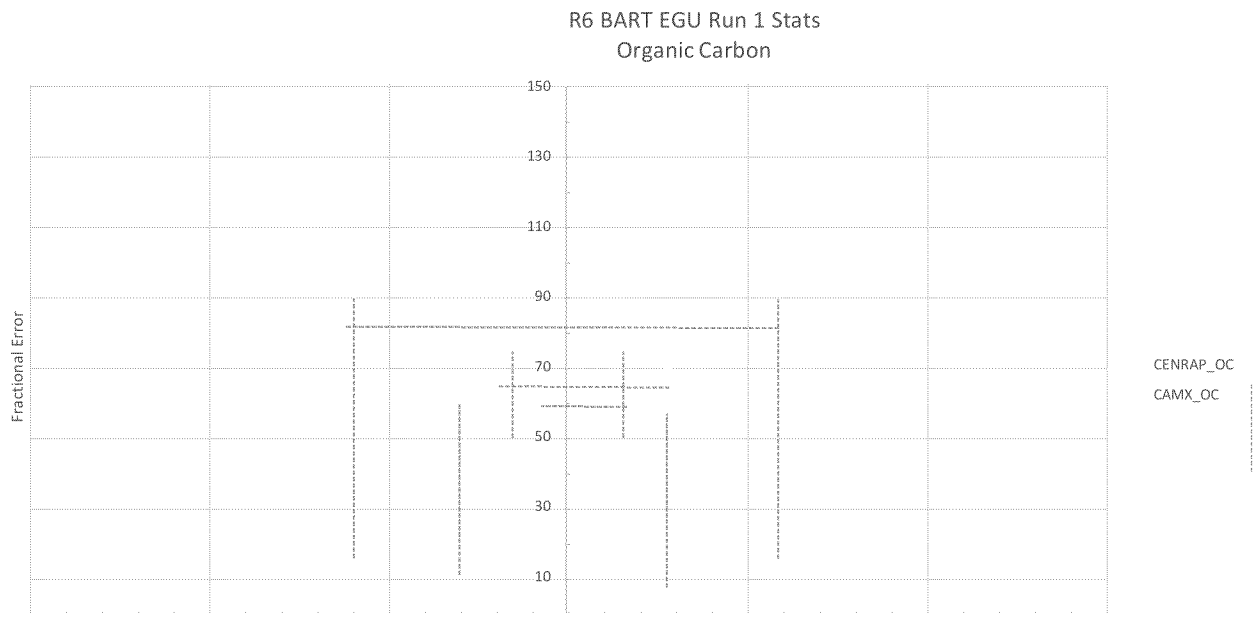
(2) Nitrate

For nitrate, both models had similar performance with underestimates in the summer months and overestimates in the winter months. The performance for all months for both models was outside of the desired performance goal.[39]

[39] See Section 3 of the Technical Support Document for CENRAP Emissions and Air Quality Modeling to Support Regional Haze State Implementation Plans (available in the docket for this action) for additional discussion of model evaluation.

(3) Organic Carbon

	CENRAP		R6 CAMX	
Month	Frac Bias	Frac Error	Frac Bias	Frac Error
January	-0.2	52.0	24.5	46.7
April	-6.6	53.3	21.5	50.6
July	-17.7	51.2	33.1	72.0
October	5.9	44.6	39.2	61.6



The organic carbon model performance comparison shows that the Run 1 organic carbon was biased high and that the fractional error was higher for July and October versus the CENRAP run.

Because of the differences in the models, chemical mechanism, emissions, and the domain sites used for the performance evaluation the CENRAP and Run1 results are not directly comparable. It is useful for general observation on relative model performance given the caveats. The underestimation of sulfates in Run1 for the warmer months (when maximum sulfate impacts tend to occur) indicates that for the Region 6 Class I areas that the model on the average is underestimating the impact of sources of SO_2 on particulate sulfate concentrations. Extensive QC was done by UNC on the various inputs and model parameters to determine if an inadvertent error may have been introduced in the modeling for the warmer months. No problems were found. Since we are using the absolute values of the modeling, this underestimate of sulfate impacts in the summer results in: (a) the impacts of the BART-eligible sources are likely

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underestimated and the actual impacts would be greater, and (b) the visibility benefits modeled for the BART-eligible facilities are likely underestimated, the actual benefits would be greater, when the reduced emission runs, Run 3 and Run 4, are compared to Run 1.[40] The latter is pertinent even in the presence of the high bias for nitrates in the cooler months since the emission reductions being considered are for SO_2 which is a precursor for sulfates.

The Effect of Overall Model Emissions on CAMx Modeled Visibility Impacts

As discussed above, additional CAMx modeling was completed by UNC-IE to evaluate the potential visibility benefit of controls for subject to BART units in Texas and Louisiana. For three tagged units located in Texas we utilized the same emission rates in the base case (Run 1 or BART Screening run) and the low control (Run 4) model scenarios to evaluate the impact of overall increased emission levels to the modeling results.[41] Because the base case model scenario utilized maximum actual daily emission rates year round, the total modeled emissions for SO_2 and NOx in the base case scenario were higher than the typical/actual emission inventory for 2002. This change in overall emissions could impact the overall chemistry and competition for reactants (e.g. ammonia) that lead to formation of visibility impairing particulate. The low control scenario (Run 4) total emissions for the tagged sources are approximately 50% of the base case scenario and are much more similar to the typical/actual emission inventory for 2002. The three figures below compare the maximum modeled impacts in deciviews at each Class I area for the base case (Run 1) and low control runs for the three units in Texas (Run 4) that were modeled at the same emission rates between the two runs.[42] Visibility impacts are similar between the two runs, with the largest differences at those Class I areas (e.g. Caney Creek, Upper Buffalo, Wichita Mountains) most impacted by the large EGU sources concentrated in Northeast Texas and therefore most impacted by the overall emission changes at these sources. For these Class I areas, the low control scenario and lower overall emissions result in higher modeled visibility impacts from the three tagged units with unchanged emissions, possibly due to the cleaner ambient conditions resulting in somewhat less competition for reactants that lead to formation of visibility impairing particulate. The effect of this is seen more for Welsh Unit 2, which is located in in Northeast Texas. The base case modeled impacts for these sources may be underestimated due to the higher overall emissions of SO_2 and NO_x in the base case model scenario. Therefore, we do not believe that the results of our subject-to-BART screening analysis and conclusion on which sources are subject to BART based on CAMx modeling would be impacted by higher overall emissions in the base case modeling.

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[40] In addition to the modeling results from the initial base case modeling (CAMx base case modeling is also referred to as BART Screening Modeling and Run 1), as discussed in more detail elsewhere, we also had additional control scenario modeling performed (low control is also referred to as Run 4, high control is also referred to as Run 3) to estimate the benefits of emission reductions from controls representing a high level and intermediate level of control. These runs are documented by UNC in "Regional Haze Evaluation Under Contract EP-D-11-084 Work Assignment No. 4-17: TASK 5, Subtask 4: Conducting CAMx PiG with PSAT Source Apportionment for BART Control Evaluations (CAMx Run #3 and #4)", Memorandum from Zac Adelman and Uma Shankar, UNC Institute for the Environment to Erik Snyder, EPA Region 6, December 8, 2016. Available in the docket for this action as "EPA-R6_RH_Task4_Memo_UNC_08Dec2016.pdf"

[41] Texas BART sources, Fayette units 1 and 2 and Welsh Unit 2 were selected. Fayette units already have scrubbers installed and Welsh 2 is shut down. There is no need to examine a low control scenario for these units.

[42] See the BART Modeling TSD and BART Screening TSD that accompanied our proposed action for Texas EGU sources (identified by Docket No. EPA-R06-OAR-2016-0611, at *http://www.regulations.gov*) for additional information, including information on emissions for Texas sources included in the modeling and model results.

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Figure 3.1-2. Maximum CAMx modeled impact (dv)– Fayette Unit 1

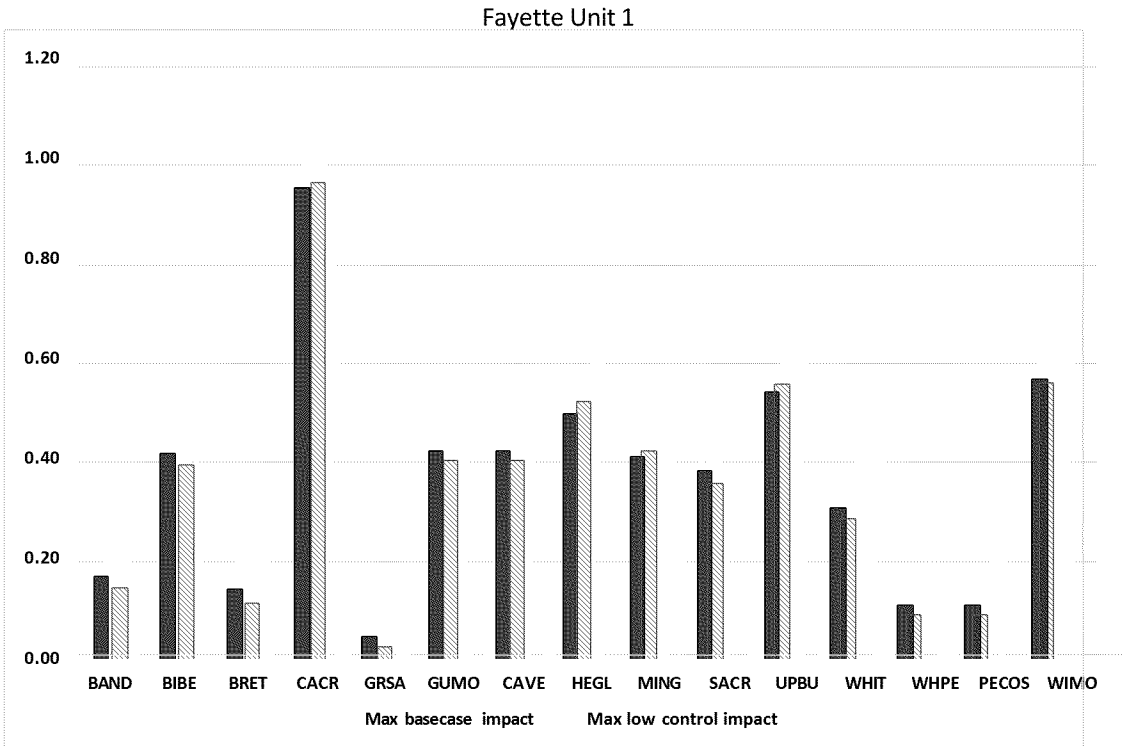

Figure 3.1-3. Maximum CAMx modeled impact (dv)– Fayette Unit 2

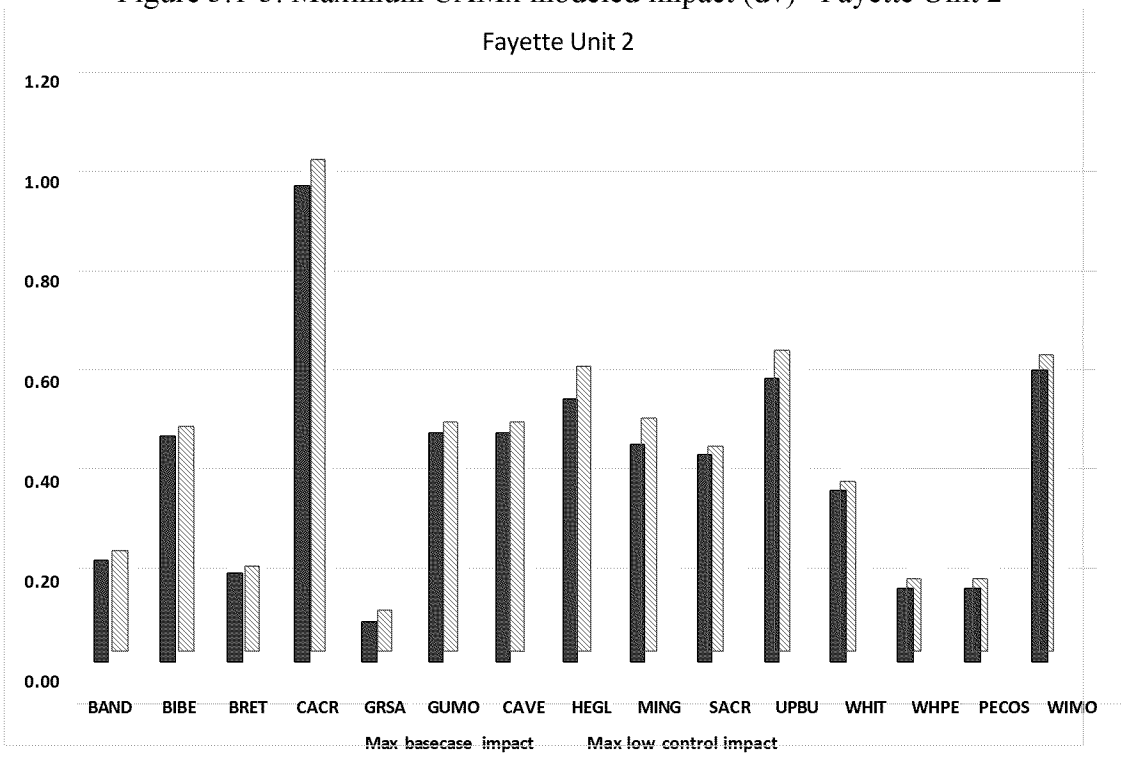

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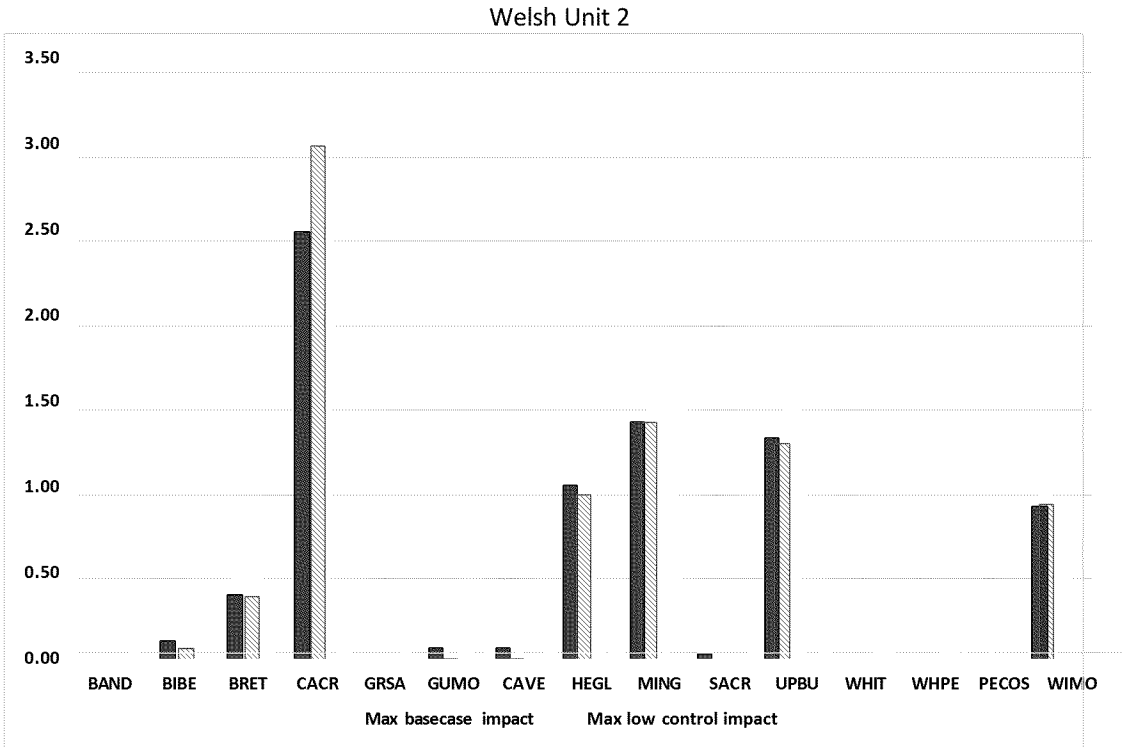
Figure 3.1-4. Maximum CAMx modeled impact (dv)– Welsh Unit 2



3.2. Summary of CAMx BART Screening Model Results

CAMx model results were post-processed to obtain the maximum 24-hour average of delta deciviews relative to natural background for each source and each unit at each Class I area. The table below shows the maximum impacted Class I area for each modeled BART-eligible source. See Appendix B for additional CAMx modeling results.[43]

[43] See ""LA_summary CAMx vis daily.xlsx"" for daily modeled visibility impairment for each source/unit at each class I area; "camx_v630.EPA-R6-2016.TX-BART.CAMxRun1.final.xlsx" for additional model results including daily concentrations for each visibility impairing pollutant from each source/unit at each class I area

Table 3.2-1. Summary of BART screening CAMx results, 2000-2004 basecase

BART-eligible source	Units	Most impacted Class I area	Maximum delta-dv	Less than 0.5 dv?	Number of modeled days over 0.5 dv	Number of modeled days over 1.0 dv
NRG Big Cajun II	1 & 2	BRET	1.644[44]	No	16	2
Cleco Brame	Rodemacher & Nesbitt	CACR	2.833	No	30	10
Entergy Nelson	4,6, and auxiliary boiler	CACR	2.220	No	31	9

We note that all of these sources had impacts equal to or above 0.5 dv that ranged from 16 days to 31 days out of the 365 days modeled at the most impacted Class I area. We discuss additional screening modeling performed to reflect current emission limits at NRG Big Cajun II later in this document.

4. Review of Entergy and Cleco CAMx Modeling

BART Modeling is focused on identifying the maximum potential impact from the source by modeling steady-state[45] maximum actual emissions over a range of meteorological conditions. CALPUFF modeling is performed over a 3-year meteorological period. CAMx modeling is typically done over a period of one year and requires a demonstration that that year is a good representation of the baseline period.[46] Maximum daily impacts are assessed by examining model results on all modeled days. Visibility impairment is calculated using the revised IMPROVE equation to convert concentrations of visibility impairing species into light extinction. The total light extinction is then converted to deciview impacts compared to natural visibility conditions

The BART Guidelines describe the process for individual source attribution, stating:

> *With the accepted protocol and compare the predicted visibility impacts with your threshold for ''contribution.''* **You should calculate daily visibility values for each receptor as the change in deciviews compared against natural visibility conditions**. You can use EPA's ''Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule,'' EPA–454/B–03–005 (September 2003) in making this calculation.

[44] Big Cajun II base case CAMx modeled impact utilizes 2000-2004 emission data. We note that CALPUFF modeling utilizing current emission limits and reflecting controls required to meet CD requirements estimates impacts less than 0.5 dv. See CALPUFF TSD for additional information. See Section 6.1 of this TSD for additional analysis of modeled impacts utilizing current emission limits.
[45] A continual release of emissions at the same rate all the time.
[46] See Section 1.3.6 of the Technical Support Document for CENRAP Emissions and Air Quality Modeling to Support Regional Haze State Implementation Plans available in the docket for this action for additional discussion on the selection of the 2002 modeling year for the baseline period.

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To determine whether a source may reasonably be anticipated to cause or contribute to visibility impairment at Class I area, you then compare the impacts predicted by the model against the threshold that you have selected.

The emissions estimates used in the models are intended to reflect steady-state operating conditions during periods of high capacity utilization. We do not generally recommend that emissions reflecting periods of start-up, shutdown, and malfunction be used, as such emission rates could produce higher than normal effects than would be typical of most facilities. **We recommend that States use the 24 hour average actual emission rate from the highest emitting day of the meteorological period modeled**, unless this rate reflects periods start-up, shutdown, or malfunction.

After our initial review of Trinity's initial CAMx modeling[47] provided to us before LDEQ proposed its SIP, we provided additional guidance to LDEQ and Entergy/Cleco/Trinity and also provided the CAMx modeling protocol developed in 2006/2007 by TCEQ and agreed upon by Region 6, FLMs and OAQPS for BART sources in Texas[48,49] as an example of an approved protocol utilizing CAMx modeling for BART screening. Our guidance that we provided to LDEQ, the source owners and Trinity is consistent with the BART Guidelines and is summarized below:

- Use emissions representative of actual 24-hr maximum emissions from the baseline period
- Evaluate the maximum impact for all modeled days, not just the 20% worst days
- Calculation of deciview impact based on natural background visibility conditions
- Analyze direct model results of the baseline modeling

In response to this guidance, Trinity revised their modeling for the Entergy and Cleco units and provided updated model results to LDEQ and us. [50] A description of this revised modeling and a summary of model results is provided in the Louisiana 2017 Regional Haze SIP. The general approach followed by Trinity is described below:

- Used twice the 2002 actual annual emission rate
- Calculated deciview impact based on natural background visibility conditions

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[47]See Updated BART Applicability Screening Analysis Prepared by Trinity Consultants, November 9, 2015. Available in Appendix D of the 2017 Louisiana Regional Haze SIP

[48] Texas had over 120 BART eligible facilities located at a wide range of distances to the nearest class I areas in their original Regional Haze SIP. Due to the distances between sources and Class I areas and the number of sources, Texas worked with EPA and FLM representatives to develop a modeling protocol to conduct BART screening of sources using CAMx photochemical modeling. Texas was the only state that screened sources using CAMx and had a protocol developed for how the modeling was to be performed and what metrics had to be evaluated for determining if a source screened out. See Guidance for the Application of the CAMx Hybrid Photochemical Grid Model to Assess Visibility Impacts of Texas BART Sources at Class I Areas, ENVIRON International, December 13, 2007, available in the docket for this action.

[49] EPA, TCEQ, and FLM representatives verbally approved the approach in 2006 and in email exchange with TCEQ representatives in February 2007 (see email from Erik Snyder (EPA) to Greg Nudd of TCEQ Feb. 13, 2007 and response email from Greg Nudd to Erik Snyder Feb. 15, 2007, available in the docket for this action).

[50] See October 10, 2016 Letter from Cleco Corporation to Vivian Aucoin and Vennetta Hayes, LDEQ, RE: Cleco Corporation Louisiana BART CAMx Modeling, included in Appendix B of the 2017 Louisiana Regional Haze SIP submittal; CAMx Modeling Report, prepared for Entergy Services by Trinity Consultants, Inc. and All 4 Inc, October 14, 2016, included in Appendix D of the 2017 Louisiana Regional Haze SIP submittal

- Used a Relative Reduction Factor (RRF) approach rather than direct modeling
- Developed RRF values for the 20% best and 20% worst days, averaged them, and then applied these RRF values to all monitored days through-out the year

We note that Trinity did not provide model inputs, such as emissions or stack parameters, or provide worksheets utilized for post-processing, or any of the actual CAMx modeling files so our review is limited only to general description of the modeling protocol provided in the various CAMx modeling reports provided by Entergy.

4.1. Baseline emissions for BART-eligible sources

Trinity's revised CAMx modeling performed for Entergy and Cleco utilized 2 times the 2002 actual annual emission rate as "representative estimates of the maximum 24-hr emissions." There is no need for estimated data as CEM data is available to identify maximum 24-hr emissions for NOx and SO2 during the baseline period. In fact, this CEM data was used to identify emission rates utilized in CALPUFF modeling performed by Trinity for Entergy and Cleco sources. We note that for Texas non-EGU BART modeling as described in the Texas BART modeling protocol, no CEM data was available and therefore an estimate, such as using twice the annual emission rate was acceptable. For EGU sources, the use of 2 times the annual emission rate may over or under estimate the 24-hr maximum actual emissions. For the Entergy BART-eligible gas-fired units that occasionally burn fuel oil, 2 times annual emission rate severely underestimates the maximum 24-hr emissions and results in an underestimate of the maximum modeled impacts.[51] The table below illustrates this underestimate by comparing the annual emission rate for SO2 emission from the Entergy Waterford units to the maximum actual emission rate identified from the CEM data. In the case of Waterford unit 2, the maximum 24-hr emission rate is over 6000 times larger than the annual emissions rate.

Table 4.1-1. Comparison of Waterford modeling emission inputs

	2002 annual emissions of SO2 (tons)	2002 Annual Emission rate (lb/hr)	24-hr maximum emission rate (lb/hr) (CAMD, 2000-2004)	Ratio of actual max emissions to annual emission rate
Waterford Unit 1	46.324	15.04	5,274.5	**350.6**
Waterford Unit 2	3.032	0.73	4,532.75	**6237.8**

4.2. Comparison of EPA and Trinity's post-processing approach

Maximum visibility impact at each Class I area should be identified from 2002 baseline modeling and examining all modeled days. Rather than utilize direct modeled results as we advised and as was utilized in the Texas BART modeling protocol we provided, Trinity used a Relative Reduction Factor (RRF) approach that multiplies monitor data by

[51] Entergy's CAMx modeling included model results for Michoud, Little Gypsy, R.S. Nelson, Ninemile Point, Willow Glen, and Waterford.

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the ratio of model results (2018 divided by 2002). Monitoring data is only available for every third day so 240 days of the year have no monitoring data and cannot be assessed using the RRF approach.

EPA's Direct Modeling Approach (and Texas EGU PM and non-EGU BART approach):

a. Model maximum actual 24-hour emissions for each BART unit and 2002 baseline emissions for all other sources, and use source apportionment (PSAT) for each BART unit. PSAT tracks contributions to overall concentrations at the Class I areas due to each source.
b. Using revised IMPROVE equation and daily average concentrations from each source at each Class I area, calculate the daily extinction impact from each source.
c. CALPUFF modeling typically used Highest 8th High (98th percentile) from three years of modeling. Due to the more robust chemistry in CAMx and that CAMx analysis is for one year instead of 3 years the maximum daily impacts (1st Daily Max) was used for screening and analysis instead of 98th percentile.

Trinity's RFF Approach:

a. Use Modeled Attainment Test Software *(*MATS*)* to compute model-estimated relative response factors (RRFs) that are the ratio of the model-estimated 24-hour $PM_{2.5}$ concentrations for the future-year (2018) to the baseline (2002) emission scenarios for only the 20% worst days and 20% best days.
b. Calculate 2018 modeled visibility conditions and projected visibility conditions (using RRF approach) for 20% worst (W20%) and 20% best (B20%) days
c. To get individual source or group of sources contributions, subtract the PSAT results from the 2018 CAMx output for the source of interest, rerun MATS, and calculate differences of projected visibility conditions by repeating b.

For example, (for illustration purposes only):

	Modeled visibility condition (average 20% worst days)	RRF (2018 divided by 2002)	Monitored visibility condition	Projected visibility condition (monitored x RRF)	Impact from BART source
2002	140 Mm^{-1}	---	150 Mm^{-1}		---
2018	120 Mm^{-1}	0.857	---	128.5 Mm^{-1}	---
2018 (not including BART source #1)	110 Mm^{-1}	0.786	---	117.9 Mm^{-1}	10.6 Mm^{-1}
2018 (not including BART source #2)	119 Mm-1	0.85		127.5 Mm-1	1.0 Mm-1

This extinction impact is then converted to deciview impacts using the following equation, where b_{source} is extinction from the source and $b_{natural}$ is natural background extinction:

$$\text{del-dv} = 10*\ln[(b_{source} + b_{natural})/b_{natural}]$$

The RRF approach attempts to capture the relative change in model results in response to a change in emissions on a specific day or group of days with certain conditions and then apply that change to monitored data for that day or group of days. These conditions include not only meteorology, but also source emissions and background concentrations transported into the modeling domain that can impact the model response to changes in emissions due to differences in transport and chemistry. The RRF value should only be applied to monitored days that have the same set of conditions as those modeled to derive the RRF. In other words, the RRF should only be applied to the monitored days that directly correspond to the modeled days included in the RRF calculation. Trinity developed RRF values for the 20% best and 20% worst days, averaged them, and then applied these RRF values to all monitored days through-out the year.

This approach has a number of short comings when trying to identify the maximum impact from a source over the modeled period:

- The RRF values only capture model behavior and impacts from sources on the 20% best and 20% worst days as defined by monitored data for 2002. Approximately 24 days of monitored data comprise the 20% worst or best days at each Class I area. It is very likely that maximum impact from each BART source occurs on days not included in the small set of days (48 of 365 days or less than 14% of the days) that are included in the 20% worst or 20% best monitored days.
    - Impacts from the Louisiana EGU BART sources are not anticipated to have significant impacts on the 20% best days because, by definition, these are days with the least impact from all sources. These days are representative of days with minimal impacts, not days with the maximum impacts.
    - The 20% worst days at Caney Creek represent days with significant impacts from Northeast Texas or the Eastern U.S. These days do not have meteorological conditions that would result in significant transport from Louisiana EGU BART sources. A subset of 20% worst days at Breton may have significant impacts from Louisiana EGU sources, but many of these days have significant impacts from Eastern U.S. sources. The 20% worst days may not capture the highest impact days from all LA BART sources.
    - The RRF from the 20% worst days and 20% best days were averaged and applied to all monitored days. Since the RRF values for the 20% worst days may not include days with the maximum impacts, use of this RRF approach fails to consider model response on days most conducive to high impacts from each source. The use of the 20% worst days RRF as representative of model response on all days underestimates the maximum impact. Averaging in the RRF value for the 20% best days exacerbates this issue as these days are not anticipated to have any impact from the BART sources and is representative of days with minimal impacts from the BART sources.

- While modeling data is available for 365 days, monitor data is only available for every third day. Trinity's analysis applied the RRF approach to "all available monitored data in order to calculate individual visibility impacts" and therefore applies and inappropriate RRF value to approximately 120 monitored days and fails to estimate visibility impacts from the sources on the remaining 240 days of the year. Even if a day-specific RRF approach was used to capture model response on specific days and applied to the monitored data, visibility impacts would not be assessed for the 240 days without monitored data.

4.3. Comparison of Trinity and EPA's CAMx modeling:

Table 4.3-1. Trinity's CAMx modeling impact for Cleco Brame Rodemacher Unit 2 and Nelson Unit 6

Class I Area	Rodemacher Unit 2	Nelson Unit 6
	Maximum impact (dv)	Maximum impact (dv)
Caney Creek	0.2673	0.3261
Breton	0.0885	0.1343

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Table 4.3-2. EPA modeled visibility impact from Cleco Brame Rodemacher Unit 2 and Nelson Unit 6 at most impacted Class I areas (CAMx)

Class I area	Rodemacher Unit 2		Nelson Unit 6	
	Baseline Impact dv) (maximum)	Baseline Impact (dv) (average top ten impacted days)	Baseline Impact dv) (maximum)	Baseline Impact (dv) (average top ten impacted days)
Breton	0.713	0.315	0.599	0.314
Caney Creek	2.051	1.005	2.179	1.302
Mingo	0.711	0.460	1.468	0.785
Upper Buffalo	1.102	0.613	1.219	0.934
Hercules-Glade	0.687	0.508	1.287	0.777
Wichita Mountains	0.578	0.274	0.575	0.412
Cumulative[52]	6.733	3.664	8.939	5.444

Table 4.3-3. EPA modeled visibility impact from Cleco Brame Rodemacher Unit 2 and Nelson Unit 6 at most impacted Class I areas – number of days impacted over 0.5 and 1.0 dv (CAMx)

Class I area	Rodemacher Unit 2		Nelson Unit 6	
	Baseline - # of days impacted over		Baseline - # of days impacted over	
	1 dv	0.5 dv	1 dv	0.5 dv
Breton	0	2	0	1
Caney Creek	3	15	6	30
Mingo	0	2	1	9
Upper Buffalo	1	7	4	18
Hercules-Glade	0	5	1	9

[52] Cumulative benefit is calculated as the difference in the maximum visibility impacts from the baseline and control scenario runs summed across 15 Class I areas included in the CAMx modeling.

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Wichita Mountains	0	1	0	2
Cumulative[53]	4	32	12	69

5. Analysis of Visibility Benefits for Potential Controls

Once the subject-to-BART sources were identified, we modeled the visibility impacts of the subject-to-BART sources under different control scenarios to evaluate the degree of visibility benefit anticipated due to the use of controls at each source. We developed emission scenarios to model that spanned the potential control scenarios for each unit. This information would be used to estimate the amount of visibility benefit that could be expected from installation of controls on each of the subject-to-BART units. The BART guidelines recommend the use of CALPUFF or other appropriate dispersion models to determine the visibility improvement expected at a Class I area from the potential BART control technology applied to the source.

5.1. Background and Introduction

LDEQ used the CALPUFF model to analyze the visibility impacts and benefits of controls at the subject-to-BART sources consistent with the approach recommended by the BART Guidelines for comparing visibility improvement from control alternatives at a single source.[54] The BART guidelines recommend use of the CALPUFF air quality dispersion model to estimate the visibility improvements at each Class I area, typically within roughly a 300 km (186 mile) or larger radius of the source, of alternative control technologies, and to compare these to each other and to the impact of the baseline, or current, source configuration. Under the BART guidelines, the measure of the visibility impact to be used in comparisons is the 98th percentile of impacts expressed as 24-hour averages of delta deciviews relative to natural background, as estimated using the CALPUFF air quality modeling system. The CALPUFF modeling protocol followed is described in detail in the CALPUFF Modeling TSD.

As discussed above, some of the BART sources in Louisiana are far away from a Class I area yet have high enough emissions that they may significantly impact visibility at Class I areas in Louisiana and surrounding states. However, the use of CALPUFF is not typically recommended for distances much greater than 300 km - 400km. CAMx provides a scientifically defendable platform for assessment of visibility impacts over a wide range of source to receptor distances. CAMx is also more suited than some other modeling approaches for evaluating the impacts of SO_2, NOX, VOC and PM emissions as it has a more robust chemistry mechanism. The CAMx PM Source Apportionment Technology (PSAT) modeling was conducted for those subject-to-

[53] Cumulative benefit is calculated as the difference in the maximum visibility impacts from the baseline and control scenario runs summed across 15 Class I areas included in the CAMx modeling.
[54] 70 FR 39170 (July 6, 2005). CALPUFF is the single source air quality model that is recommended in the BART Guidelines. For CALPUFF modeling used for this analysis, the modeling results were post-processed in a manner consistent with the BART Guidelines.

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BART sources located outside of the recommended range of CALPUFF to evaluate the visibility benefits of controls. We also used CAMx PSAT modeling on the other coal-fired power plants (within the typical range of CALPUFF) to provide additional data and analysis for these large emission sources. The CAMx modeling protocol followed is described in detail above. See the UNC-IE memorandum that documents these additional CAMx runs.[55]

Regarding how to use modeling to assess visibility benefits from controls, the BART guidelines state: [56]

- For each source, run the model, at pre-control and post-control emission rates according to the accepted methodology in the protocol.
  Use the 24-hour average actual emission rate from the highest emitting day of the meteorological period modeled (for the pre-control scenario). Calculate the model results for each receptor as the change in deciviews compared against natural visibility conditions. Post-control emission rates are calculated as a percentage of pre-control emission rates. For example, if the 24-hr pre-control emission rate is 100 lb/hr of SO_2, then the post control rate is 5 lb/hr if the control efficiency being evaluated is 95 percent.
- Make the net visibility improvement determination.
  Assess the visibility improvement based on the modeled change in visibility impacts for the pre-control and post-control emission scenarios. You have flexibility to assess visibility improvements due to BART controls by one or more methods. You may consider the frequency, magnitude, and duration components of impairment.

We used modeling results from the initial base case modeling (CAMx base case modeling is also referred to as BART Screening Modeling and Run 1) and the control scenario modeling (low control is also referred to as Run 4, high control is also referred to as Run 3) to estimate the benefits of emission reductions from controls/control upgrades. We note that for Entergy Nelson, "run 1" contained an error in some of the stack parameter inputs and therefore, "run 4" utilized base case emissions to model the base case visibility impairment due to the Nelson BART-eligible source and units. Below we present a summary of our analysis and our proposed findings regarding the estimated visibility benefits of emission reductions based on the CALPUFF and/or CAMx modeling results.

5.2. Emission Calculation Methodology

[55] "Regional Haze Evaluation Under Contract EP-D-11-084 Work Assignment No. 4-17: TASK 5, Subtask 4: Conducting CAMx PiG with PSAT Source Apportionment for BART Control Evaluations (CAMx Run #3 and #4)", Memorandum from Zac Adelman and Uma Shankar, UNC Institute for the Environment to Erik Snyder, EPA Region 6, December 8, 2016. Available in the docket for this action as "EPA-R6_RH_Task4_Memo_UNC_08Dec2016.pdf"

[56] 40 CFR part 51 Appendix Y Section IV.D.5

2000-2004 baseline Emissions

To estimate baseline period visibility impacts from BART-eligible sources, the BART Guidelines in 40 CFR 51 Appendix Y recommend that States use the 24-hour average actual emission rate from the highest emitting day of the meteorological period modeled, unless this rate reflects periods start-up, shutdown, or malfunction. The maximum 24-hour emission rate (lb/hr) for NOx and the maximum 24-hour emission rate (lb/hr) for SO_2 (not paired in time) from the 2000-2004 baseline period for each source was identified through a review of the daily emission data for each BART-eligible unit from EPA's Air Markets Program Data[57], consistent with emissions identified by the sources for the CALPUFF modeling. Because daily emissions are not available for PM, PM emissions were estimated based on permit limits, maximum heat input and AP-42 factors, and/or stack testing.[58]

See Appendix A (CAMx) for a full summary of emissions modeled for the visibility impact analysis and visibility benefit analysis of controls. Below we describe the methodology applied to estimate the emission reductions anticipated from controls used for visibility modeling.

SO_2 emissions

As explained below and in more detail in the TSD, we determined that high level controls on all unscrubbed units of 95% control efficiency not to go below 0.06 lb/MMBtu for SDA and 98% control efficiency not to go below 0.04 lb/MMbtu for WFGD were achievable on these units. For low level controls, we evaluated DSI at the control efficiency identified by the source in their BART five-factor analysis. For high level controls, the 0.04 lb/MMBtu emission rate (or 0.06 lb/MMBtu in the case of SDA) was multiplied by the maximum heat input (MMBtu/hr).

UNC-IE assisted EPA in conducting two additional CAMx runs, with one run being based on using a low SO_2 control such as DSI (Run 4) and one run based on a high SO_2 control that would reflect SDA or wet FGD scrubbing (Run 3). For those units also modeled with CALPUFF, CAMx modeled SO_2 emissions rates are consistent with emission rates used in the CALPUFF modeling. The table below summarizes the SO_2 emissions provided to UNC-IE for the two control scenario CAMx runs and the baseline CAMx run. See Appendix A for a full summary of CAMx modeled emissions for these sources.

Nelson unit 4 is a primarily gas-fired unit and did not burn fuel oil during the baseline period and is not anticipated to burn fuel oil in the future so SO_2 emissions from these units were held at baseline levels for the two control scenarios. NRG Big Cajun II Unit 2 has converted to natural gas as required by a consent decree[59] so SO2 emissions from this unit in the control scenarios

[57] http://ampd.epa.gov/ampd

[58] A copy of the final version of each BART analysis performed by Trinity Consultants or CB&I on behalf of the BART sources can be found in the appendices of the submitted 2017 LA RH SIP.

[59] On March 6, 2013, Louisiana Generating entered a consent decree (CD) with EPA, the LDEQ, and others to resolve a complaint filed against Louisiana Generating for several violations of the CAA at Big Cajun II. *U.S. et al v. Louisiana Generating, LLC*, Civil Action No. 09-100-JJB-RLB (M.D. La.). Among other things, the CD requires

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reflect this change in fuels. We note that due to an error in stack parameters for the basecase modeling run for Entergy Nelson units, the high control run (Run 3) utilized baseline emissions for Nelson. Results from run 3 represent baseline visibility impacts from the Nelson source/units.

Table 5.2-1. CAMx modeled SO_2 emission rates

Source	Unit	SO_2 (tons/day)		
		Base case (run 1) (2000-2004)	**Low control (run 4)**	**High Control (run 3)**
ENTERGY R.S. NELSON	Aux. Boiler	1.28	1.28	1.28*
ENTERGY R.S. NELSON	4	0.033	0.033	0.033*
ENTERGY R.S. NELSON	6	89.32	36.44	89.32*
NRG BIG CAJUN II	1	78.97	29.28	3.08
NRG BIG CAJUN II	2	73.11	0.13	0.13
CLECO Brame Nesbit	1	40.26	0.036	0.036
CLECO Brame Rodemacher	2	64.98	32.64	3.18

*Modeled at the baseline rate in the high control scenario. Nelson units were modeled with incorrect stack exit velocity in base case modeling. High control model results represent base case visibility impacts for these units

NOx and PM Emissions for CAMx modeling

NOx emissions were held constant at baseline emission levels for all emission units, with one exception, in order to isolate visibility improvements due to SO_2 reductions from any visibility benefits that would result from reductions in NOx emissions. Because NRG Big Cajun II unit 2 has been converted to natural gas as required by a consent decree[60], the emissions of SO2, NOx, and PM were adjusted to reflect this change in operation for this unit in both the high and low control scenarios.

Louisiana Generating to refuel Big Cajun II Unit 2 to natural gas, and install and continuously operate DSI at Big Cajun II Unit 1 and maintain a 30-Day Rolling Average Emission Rate for SO2 of no greater than 0.380 lb/mmBTU no later than April 15, 2015.

[60] On March 6, 2013, Louisiana Generating entered a consent decree (CD) with EPA, the LDEQ, and others to resolve a complaint filed against Louisiana Generating for several violations of the CAA at Big Cajun II. *U.S. et al v. Louisiana Generating, LLC*, Civil Action No. 09-100-JJB-RLB (M.D. La.). Among other things, the CD requires Louisiana Generating to refuel Big Cajun II Unit 2 to natural gas, and install and continuously operate DSI at Big Cajun II Unit 1 and maintain a 30-Day Rolling Average Emission Rate for SO2 of no greater than 0.380 lb/mmBTU no later than April 15, 2015.

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For the high control scenarios for dry scrubbing and wet scrubbing retrofits for Big Cajun II unit 1 and Cleco Rodemacher unit 2, PM10 emissions were reduced by 50% to estimate an anticipated additional removal of PM. While this is not a refined estimate of the additional PM reduction anticipated for the control scenarios, PM emissions are already reduced significantly due to the existing ESP and/or baghouses and the visibility impact from direct PM emissions are a very small portion of the overall visibility impact due to the facilities emissions. Therefore, we do not anticipate a more refined approach to estimate PM emissions for these scenarios would significantly impact the modeling results. PM emissions were held at baseline emission rates for the low control scenario and for units with existing scrubbers.

6. Visibility Benefits of DSI, SDA, and Wet FGD for Coal-Fired Units

We evaluated the visibility benefits of DSI using CAMx using the control levels identified by the sources in their BART five-factor analyses included in the 2017 Louisiana Regional Haze SIP. We also evaluated the visibility benefits for scrubber retrofits for these same units. In evaluating the impacts and benefits of potential controls, we utilized a number of metrics, including change in deciviews and number of days impacted over 0.5 dv and 1.0 dv. Consistent with the BART Guidelines, the visibility impacts and benefits modeled in CALPUFF and CAMx are calculated as the change in deciviews compared against natural visibility conditions.[61]

For the CAMx modeling, the benefit is calculated as the difference between the maximum impact modeled for the baseline (Run 1) and the maximum impact level modeled under the two control scenarios (Run 3 and Run 4). The low control scenario (Run 4) estimates the visibility impacts and benefits from DSI level controls. The high control scenario (Run 3) estimates visibility impacts and benefits for WFGD/SDA level. Also summarized are the cumulative benefit and the number of days impacted over 0.5 and 1.0 dv. Cumulative benefit is calculated as the difference in the maximum visibility impacts from the baseline and control scenario summed across the 15 Class I areas included in the CAMx modeling. The baseline total cumulative number of days over 0.5 (1.0) dv is calculated as the sum of the number of modeled days at each of the 15 Class I area impacted over the threshold in the baseline modeling. The reduction in number of days is calculated as the sum of the number of days over the chosen threshold across the 15 Class I areas included in the CAMx modeling for the baseline scenario subtracted by the number of days over the threshold for the control scenario. See Appendix B for CAMx modeled maximum impact at each Class I area for each model scenario. See Appendix C for CAMx modeled number of days over 0.5 and 1.0 dv at each Class I area for each model scenario for each source and individual units.

In addition to the metrics comparing the maximum impact level of the base case to the maximum impact level of the control case, and comparing the number of days impacted over the 0.5 dv and 1 dv threshold described above, to further inform the impacts and potential benefits of emission reductions we also reviewed the modeled potential impacts from CAMx on a broader set of days to assess the potential visibility benefits that could be anticipated due to controls during varying

[61] 40 CFR 51 Appendix Y, IV.D.5: "Calculate the model results for each receptor as the change in deciviews compared against natural visibility conditions."

meteorological/transport conditions. These varying conditions affect the reaction rates and transport of pollutants which can be simulated within the photochemical grid model. While the BART analysis is focused on examination of the maximum potential visibility impairment and benefits, these additional metrics provide a sense for the potential benefit across days other than just the maximum impact day. We reviewed additional information on impacts and benefit on a broader set of the highest impact days by showing the average impact across the top ten highest impacted days at each class I area under each modeled scenario. This shows the average impact and the benefits of controls over the ten days with meteorological/transport conditions that result in the largest visibility impacts. We also reviewed the annual average impacts and benefits under the control scenarios, over a wide set of days with different meteorological/transport conditions. In order to exclude days with very low impact due to transport conditions that do not result in transport and impacts to the Class I area, the annual average only includes days during the baseline modeled scenario with impacts greater than 0.1 dv.[62] Finally, we also examined the contribution to extinction from the unit due to each visibility impairing species[63] in inverse megameters (Mm-1) on the ten highest impact days at the top two impacted Class I areas for the base case modeling scenario.[64],[65]

6.1. NRG Big Cajun II

As discussed in the 2017 Louisiana Regional Haze SIP revision, on March 6, 2013, Louisiana Generating entered a consent decree (CD) with EPA, the LDEQ, and others to resolve a complaint filed against Louisiana Generating for several violations of the CAA at Big Cajun II. *U.S. et al v. Louisiana Generating, LLC*, Civil Action No. 09-100-JJB-RLB (M.D. La.). Among other things, the CD requires Louisiana Generating to refuel Big Cajun II Unit 2 to natural gas, and install and continuously operate dry sorbent injection (DSI) at Big Cajun II Unit 1 while maintaining a 30-day rolling average emission rate of no greater than 0.380 lb of SO_2/MMBtu by no later than April 15, 2015.[66] Prior to the submittal of the 2017 Regional Haze SIP, the LDEQ and Louisiana Generating entered into an Agreed Order on Consent (AOC) that made these existing control requirements and maximum daily emission limits permanent and enforceable for BART. The AOC is included in Louisiana's 2017 Regional Haze SIP revision. Thus, if the EPA finalizes its proposed approval of this portion of the SIP submittal, the control requirements and emission limits will become permanent and federally enforceable for purposes of regional haze. As these controls were not installed to meet BART requirements, and existing enforceable

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[62] See spreadsheet: "LA summary CAMx vis daily_Brame_Big_CajunII.xlsx" in the docket for this action for these and additional model results.

[63] Ammonia nitrate (no3), ammonia sulfate (so4), elemental carbon (ec), organic carbon (oc), coarse mass (cm), soil, and nitrogen dioxide (no2)

[64] See "camx_v630.EPA-R6-2016.TX-BART.CAMxRun1.final.xlsx" for base case model results, including species specifics extinction and total visibility impairment from each unit and subject-to-BART source. Similar data for the high control model results: "camx_v630.EPA-R6-2016.TX-BART.CAMxRun3.final.xlsx" and low control model results: "camx_v630.EPA-R6-2016.TX-BART.CAMxRun4.final.xlsx" are also available in the docket for this action.

[65] See spreadsheet: "LA summary CAMx vis daily_Brame_Big_CajunII.xlsx" in the docket for this action for these and additional model results.

[66] CD paragraph 62 in the docket for this rulemaking.

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emission limits for Units 1 and 2 prevent the source from emitting at levels seen during the 2000-2004 baseline, LDEQ's screening modeling in the 2017 Regional Haze SIP submittal utilizes the current daily emission limits for these units in the AOC as representative of the anticipated 24-hr maximum emissions for screening modeling purposes. Revised CALPUFF screening modeling prepared by CB&I utilizing these emission limits is discussed in the CALPUFF Modeling TSD and demonstrate that the source has an impact less than the 0.5 dv threshold.[67]

Our CAMx modeling included modeling of a DSI control level for Unit 1 along with the conversion of Unit 2 to natural gas. However, this CAMx modeling did not utilize the NOx emission rate consistent with the AOC limit for unit 1. Instead the NOx emission rate modeled for this unit in the CAMx modeling was the higher 2000-2004 baseline NOx emission rate. Table 6.1-1 below provides a comparison between the emission rates utilized in the CALPUFF screening modeling consistent with the AOC limits and the emission rates modeled in the CAMx DSI control scenario. The SO2 emission rates modeled were the same in both modeling. The results of the DSI control scenario modeling is summarized in Table 6.1-2. CAMx modeling results show four Class I areas with maximum impacts greater than the 0.5 dv threshold, with two days impacted over 0.5 dv at Caney Creek and only one day above the threshold at the other three Class I areas. Examination of the contribution to extinction from the source for the DSI control scenario due to each visibility impairing species[68] in inverse megameters (Mm-1) on the ten highest impact days (see figures 6.1-1,6.1-2,6.1-3, and 6.1-4) show that the maximum impacted days at each Class I area have large impacts from nitrate. Had the CAMx modeling utilized the lower NOx emission rate consistent with the AOC limit (approximately 1/3 of the emission rate modeled), the nitrate impacts would be reduced such that maximum impacts at each Class I area can be anticipated to fall below the 0.5 dv threshold. We find that the results of the CAMx modeling provide additional support to the conclusion in the 2017 Louisiana Regional Haze SIP based on CALPUFF modeling that the anticipated impacts are below the 0.5 dv threshold and the source is not subject to BART. [69, 70]

[67] Revised Baseline Modeling for Big Cajun II for BART Analysis, Prepared by CB&I, July 13, 2016. Available in Appendix C of the 2017 Louisiana Regional Haze SIP submittal

[68] Ammonia nitrate (no3), ammonia sulfate (so4), elemental carbon (ec), organic carbon (oc), coarse mass (cm), soil, and nitrogen dioxide (no2)

[69] See spreadsheet: "LA summary CAMx vis daily_Brame_Big_CajunII.xlsx" in the docket for this action for these and additional model results.

[70] See "camx_v630.EPA-R6-2016.TX-BART.CAMxRun1.final.xlsx" for base case model results, including species specifics extinction and total visibility impairment from each unit and subject-to-BART source. Similar data for the high control model results: "camx_v630.EPA-R6-2016.TX-BART.CAMxRun3.final.xlsx" and low control model results: "camx_v630.EPA-R6-2016.TX-BART.CAMxRun4.final.xlsx" are also available in the docket for this action.

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Table 6.1-1. Comparison of modeled emissions for NRG Big Cajun II

	Unit	**NOx (lbs/hr)**	**SO_2 (lbs/hr)**
CD limits (CALPUFF Modeling)	**Unit 1**	963.00	2439.60
	Unit 2	963.00	10.79
DSI Control Scenario (CAMx)	**Unit 1**	2709.33	2439.60
	Unit 2	963.33	10.79

Table 6.1-2. EPA modeled anticipated visibility benefit due to DSI controls on Big Cajun Unit 1 and Unit 2 conversion to gas at most impacted Class I areas (CAMx)

Class I area	DSI Control level (maximum impact, dv)	# of Days impacted over 0.5 dv
Breton	**0.556**	**1**
Caney Creek	**0.775**	**2**
Mingo	**0.582**	**1**
Hercules-Glade	**0.605**	**1**

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Figure 6.1-1. Species Contribution (Mm-1) on ten highest impact days (DSI control case) at Caney Creek Class I area – Big Cajun II

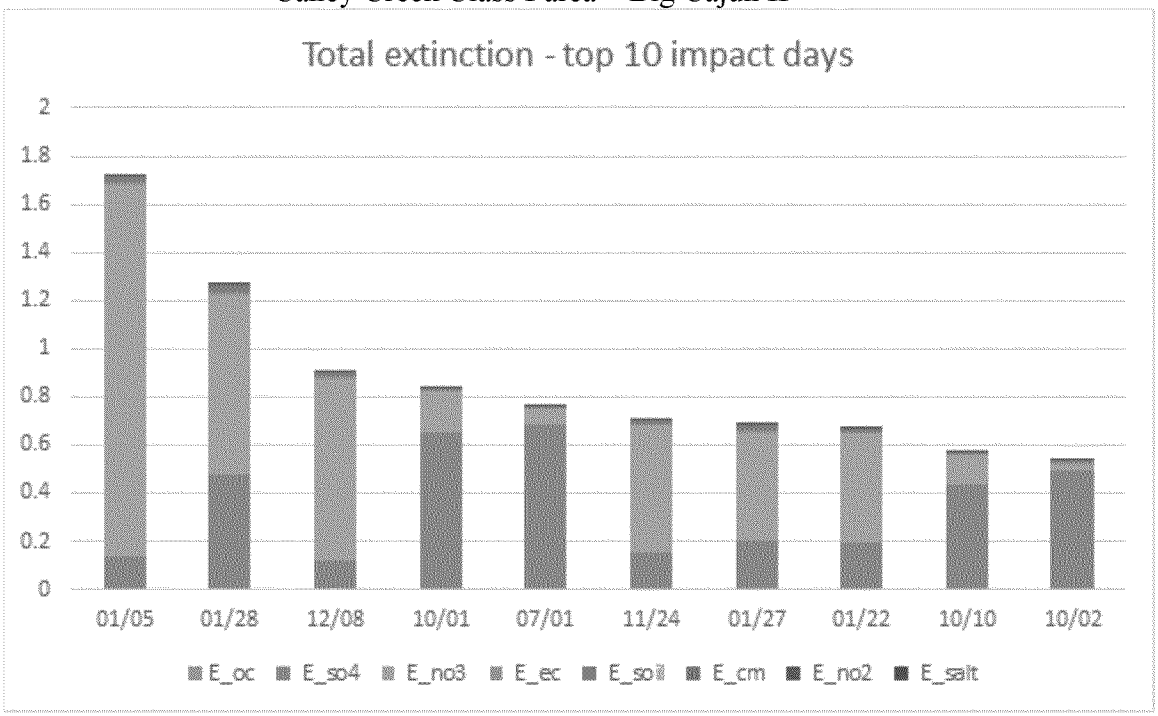


Figure 6.1-2. Species Contribution (Mm-1) on ten highest impact days (DSI control case) at Breton Class I area – Big Cajun II

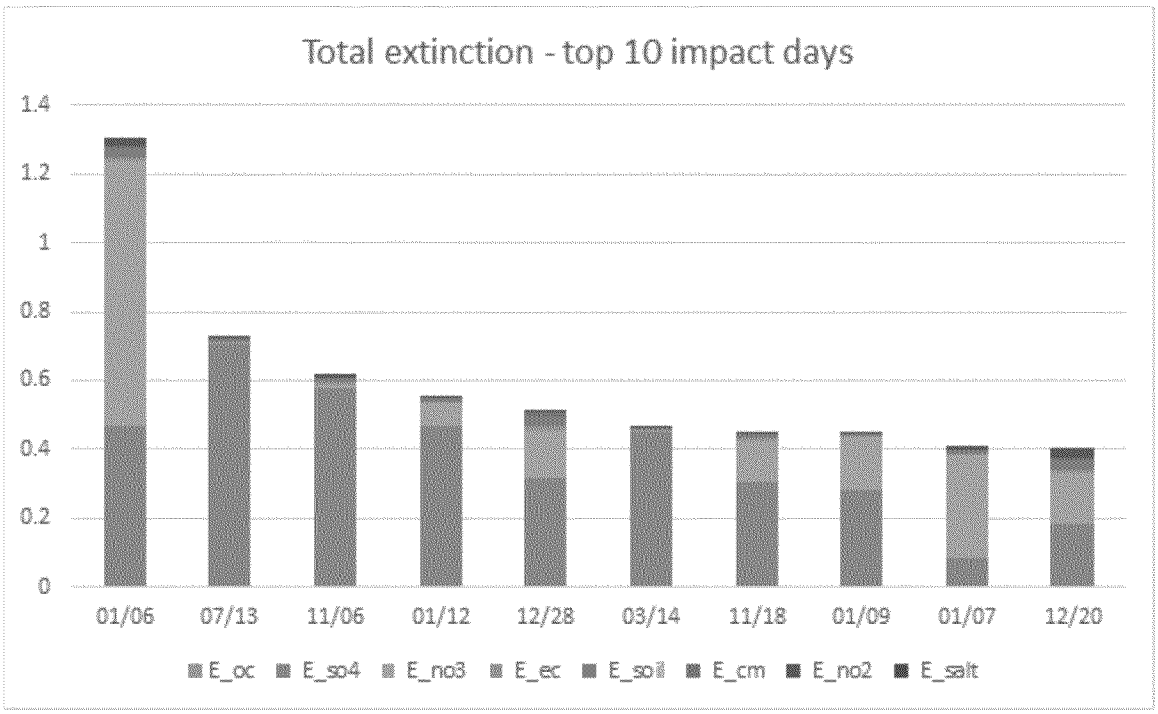


Figure 6.1-3. Species Contribution (Mm-1) on ten highest impact days (DSI control case) at Mingo Class I area – Big Cajun II

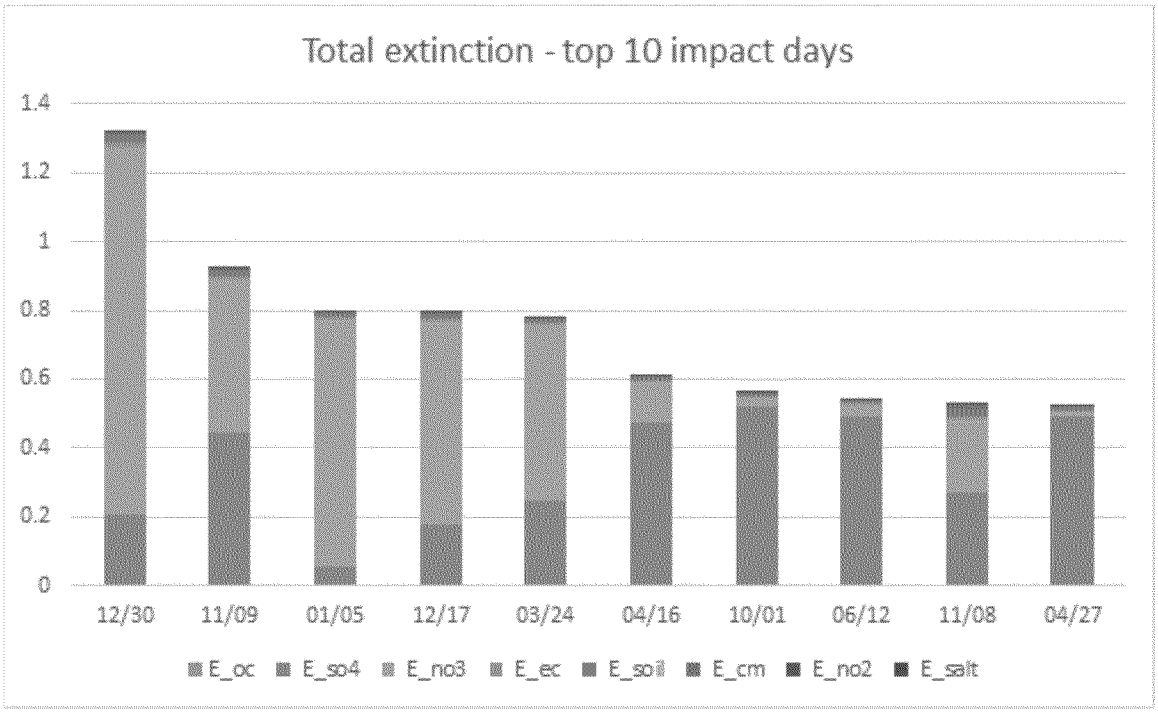
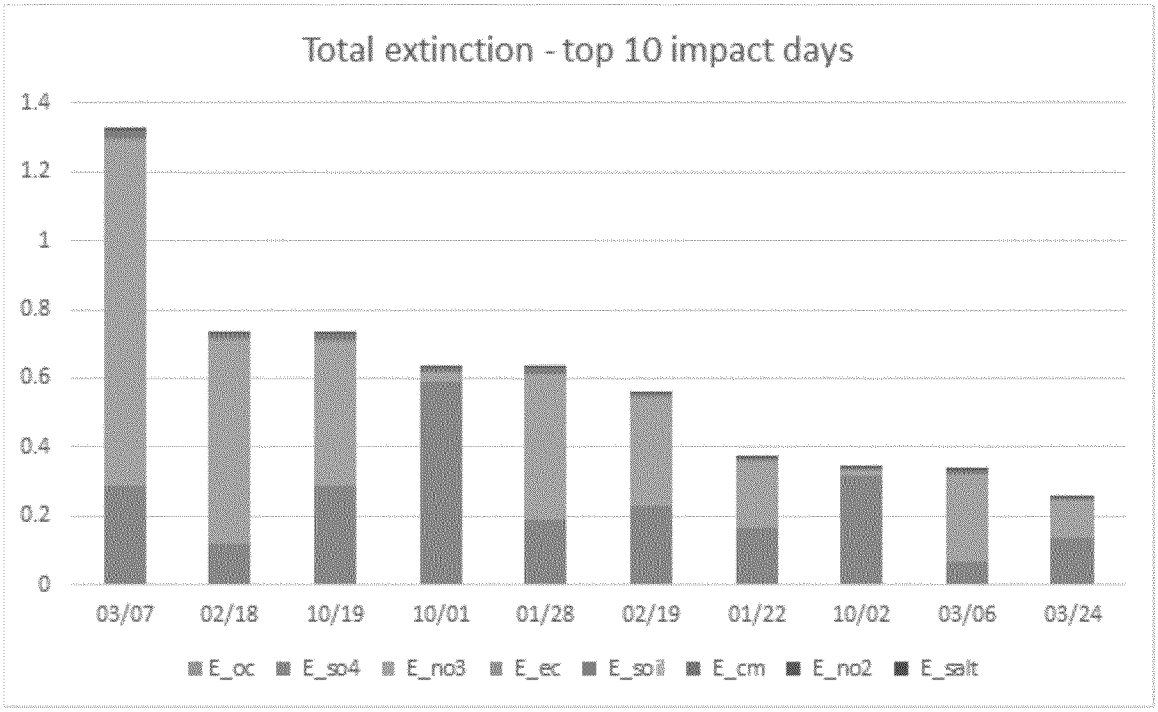


Figure 6.1-4. Species Contribution (Mm-1) on ten highest impact days (DSI control case) at Hercules Glade Class I area – Big Cajun II



6.2. Cleco Brame Energy Center

The CAMx modeled control scenarios for Cleco Nebbitt Unit 1 reflect the restriction to only burn natural gas consistent with the BART determination for this unit. No modeling evaluation of benefits of additional SO2 controls needed to be performed. The CAMx modeling analysis for Cleco Rodemacher Unit 2 evaluates the maximum baseline visibility impacts and potential benefits from two levels of controls, DSI at 0.41 lb/MMBtu and wet FGD at 0.04 lb/MMBtu, to supplement the CALPUFF modeling. [71, 72] The results of this modeling for the maximum impacts and the average across the top ten most impacted baseline days are summarized in the table below.

Table 6.2-1. Anticipated visibility benefit due to controls on Cleco Rodemacher Unit 2 (CAMx)

Class I area	Baseline Impact (dv) (maximum)	Baseline Impact (dv) (average top ten impacted days)	Visibility benefit of controls over baseline (dv) maximum impact		Visibility benefit of controls over baseline (dv) average top ten impacted days	
			DSI[73]	WFGD	DSI[74]	WFGD
Breton	0.713	0.315	0.187	0.399	0.117	0.271
Caney Creek	2.051	1.005	0.119	0.238	0.271	0.459

The CAMx-modeled visibility benefits of WFGD yield an additional 0.212 dv at Breton and 0.119 dv at Caney Creek over those from DSI for the most impacted day. Examining the top ten impacted days during the baseline period, the average benefit on this set of days of WFGD over DSI is 0.154 dv at Breton and 0.188 dv at Caney Creek. As enhanced DSI would reduce SO_2 emissions from an emission rate of 0.41 lb/MMBtu to 0.3 lb/MMBtu, enhanced DSI would lead to greater visibility benefits than DSI. Thus, the visibility benefits of WFGD compared to enhanced DSI would be smaller than those discussed above. The table below summarizes the number of days impacted over 0.5 dv and 1.0 dv for each modeled scenario. The largest difference between the two control scenarios is the elimination of 5 days over 0.5 dv at Caney Creek. We note however that the number of days impacted over 1.0 dv remains the same in both modeled control scenarios. The figures below show the modeled impacts for each modeled

[71] See spreadsheet: "LA summary CAMx vis daily_Brame_Big_CajunII.xlsx" in the docket for this action for these and additional model results.
[72] See "camx_v630.EPA-R6-2016.TX-BART.CAMxRun1.final.xlsx" for base case model results, including species specifics extinction and total visibility impairment from each unit and subject-to-BART source. Similar data for the high control model results: "camx_v630.EPA-R6-2016.TX-BART.CAMxRun3.final.xlsx" and low control model results: "camx_v630.EPA-R6-2016.TX-BART.CAMxRun4.final.xlsx" are also available in the docket for this action.
[73] DSI modeled at 0.41 lb/MMBtu, DSI and fabric filter are already installed and operational.
[74] DSI modeled at 0.41 lb/MMBtu, DSI and fabric filter are already installed and operational.

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scenario for the maximum impacts, average across the top ten impacted days, and the annual average impacts (excluding days impacted less than 0.1 dv).

Table 6.2-2. EPA modeled visibility impact from Cleco Brame Rodemacher Unit 2at most impacted Class I areas – number of days impacted over 0.5 and 1.0 dv (CAMx)

Class I area	Baseline - # of days impacted over		DSI control - # of days impacted over		WFGD control- # of days impacted over	
	1 dv	0.5 dv	1 dv	0.5 dv	1 dv	0.5 dv
Breton	0	2	0	1	0	0
Caney Creek	3	15	2	7	2	2
Mingo	0	2	0	1	0	0
Upper Buffalo	1	7	1	1	0	1
Hercules-Glade	0	5	0	1	0	1
Wichita Mountains	0	1	0	0	0	0
Cumulative[75]	4	32	3	11	2	4

[75] Cumulative benefit is calculated as the difference in the number of days impacted above the threshold from the baseline and control scenario runs summed across 15 Class I areas included in the CAMx modeling.

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Figure 6.2-1. Maximum CAMx modeled impact (dv) – Cleco Rodemacher Unit 2

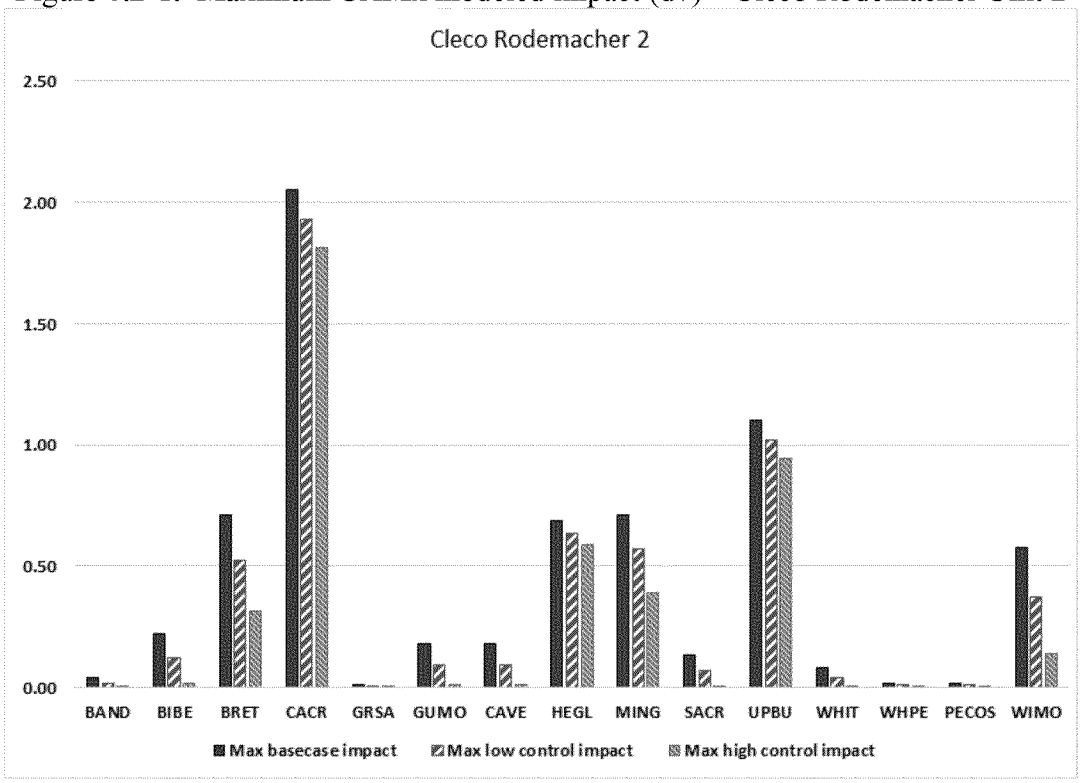


Figure 6.2-2. Average of top ten CAMx modeled impact (dv) – Cleco Rodemacher Unit 2

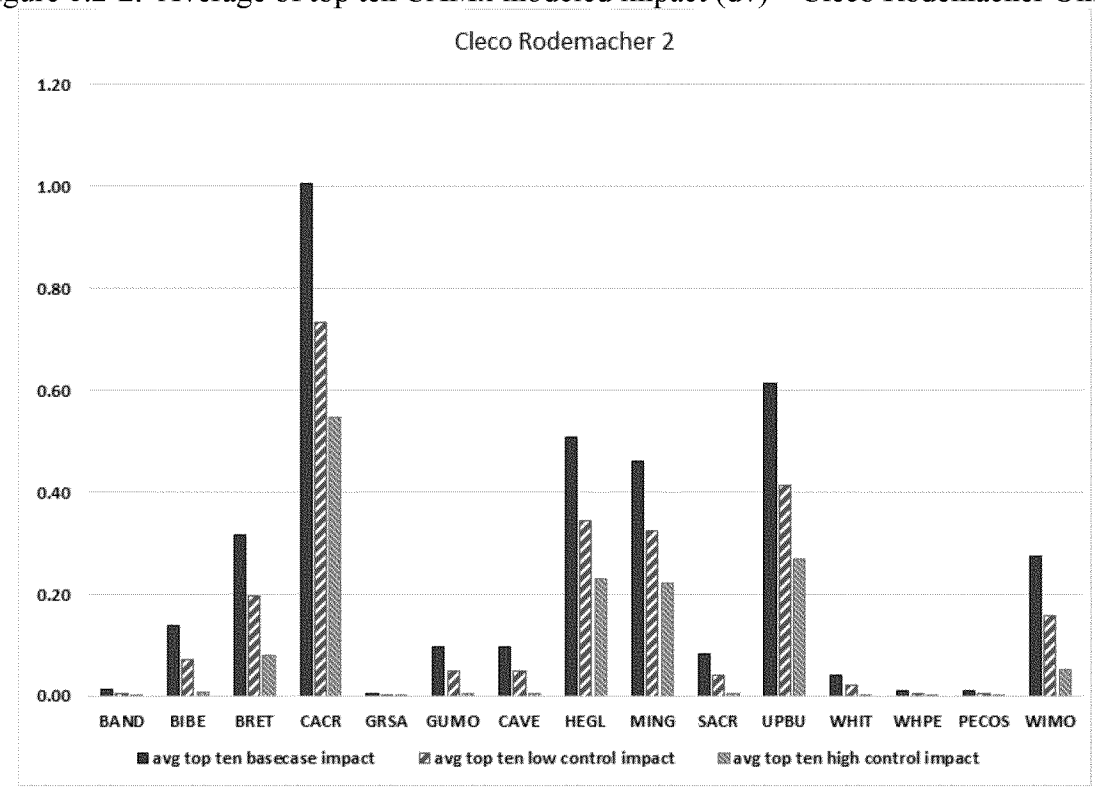
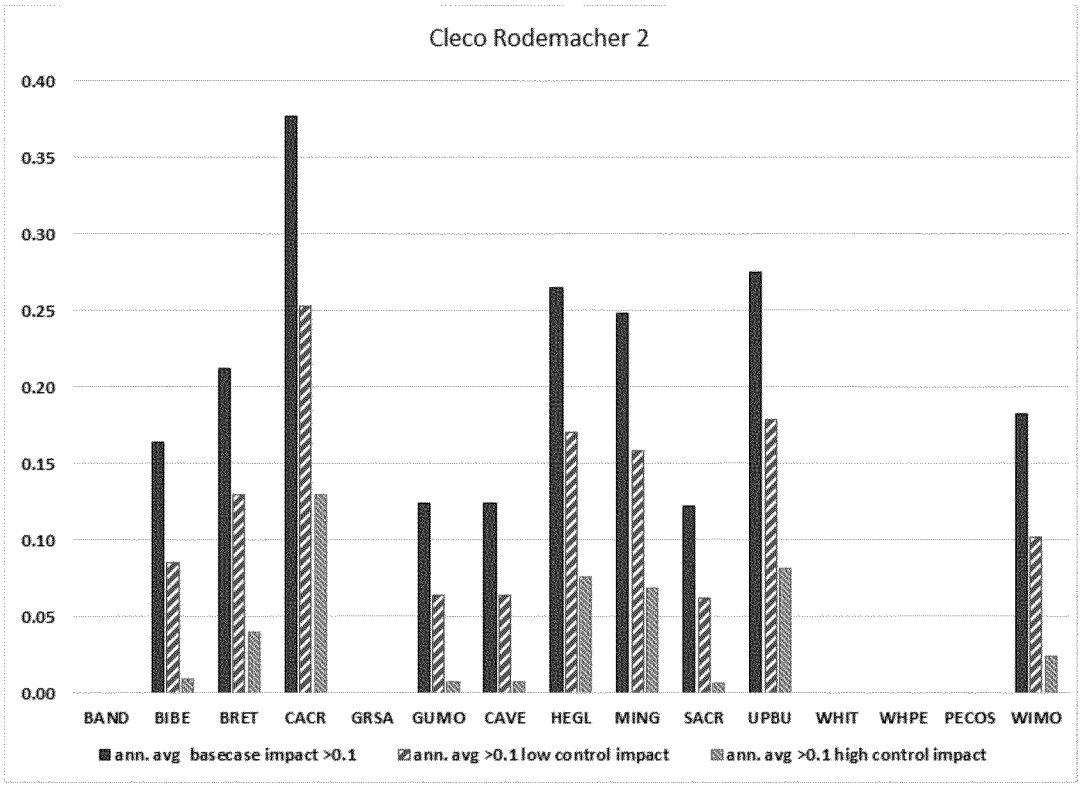


Figure 6.2-3. Annual Average CAMx modeled impact (dv) excluding baseline days impacted less than 0.1 dv – Cleco Rodemacher Unit 2



6.3. Entergy R.S. Nelson

EPA's CAMx modeling analysis for Nelson Unit 6 evaluates the maximum baseline visibility impacts and potential benefits from DSI at 0.47 lb/MMBtu, to supplement the CALPUFF modeling. [76, 77] In addition to the DSI modeled benefits, visibility benefits for SDA (0.06lb/MMBtu) and low-sulfur coal (0.6 lb/MMBtu) for the average of the top ten impacted days were estimated based on linear extrapolation using the modeled baseline and DSI visibility impacts.[78] The results of this modeling for the maximum impacts and the average across the top ten most impacted baseline days are summarized in the table below.

[76] See spreadsheet: "LA_summary CAMx vis daily.xlsx" in the docket for this action for these and additional model results.

[77] See results: "camx_v630.EPA-R6-2016.TX-BART.CAMxRun3.final.xlsx" for base case model results, including species specifics extinction and total visibility impairment from each unit and subject-to-BART source. Similar data for the low control model results: "camx_v630.EPA-R6-2016.TX-BART.CAMxRun4.final.xlsx" are also available in the docket for this action.

[78] See "Nelson CAMx LSC.xlsx" and "Nelson CAMx DFGD WFGD.xlsx"

Table 6.3-1 EPA modeled anticipated visibility benefit due to controls on Nelson Unit 6 at most impacted Class I areas (CAMx)

Class I area	Baseline Impact (dv) (maximum)	Baseline Impact (dv) (average top ten impacted days)	Visibility benefit of controls over baseline (dv) maximum impact	Visibility benefit of controls over baseline (dv) average top ten impacted days		
			DSI[79]	Low-Sulfur Coal[80]	DSI[81]	SDA[82]
Breton	**0.599**	**0.314**	0.250	0.133	0.165	0.266
Caney Creek	**2.179**	**1.302**	1.187	0.411	0.511	0.831
Mingo	**1.468**	**0.785**	0.370	0.215	0.265	0.430
Upper Buffalo	**1.219**	**0.934**	0.374	0.330	0.408	0.663
Hercules-Glade	**1.287**	**0.777**	0.473	0.273	0.338	0.548
Wichita Mountains	**0.575**	**0.412**	0.287	0.180	0.223	0.360
Cumulative[83]	**8.939**	**5.444**	3.869	---	2.437	---

The CAMx-modeled visibility benefits of DSI yield a 1.187 dv visibility benefit at Caney Creek over the baseline for the most impacted day. Due to the additional emission reductions that would result from use of SDA, the visibility benefit for the most impacted day would be larger than that from DSI (greater than 1.2 dv) at Caney Creek. Examining the top ten impacted days during the baseline period, the average benefit over this set of days of DSI is 0.511 dv at Caney Creek and 0.408 dv at Upper Buffalo. The estimated benefit from SDA over this set of days is 0.831 dv at Caney Creek and 0.663 dv at Upper Buffalo. Low sulfur coal benefits are estimated to be 0.411 dv at Caney Creek and 0.330 dv at Upper Buffalo over this same set of top ten impacted days.

[79] DSI at 0.47 lb/MMBtu
[80] Low-Sulfur Coal benefit (at 0.6 lb/MMBtu) estimated based on linear extrapolation of baseline and DSI visibility impacts at each Class I area
[81] DSI at 0.47 lb/MMBtu
[82] SDA benefit estimated based on linear extrapolation of baseline and DSI visibility impacts at each Class I area
[83] Cumulative benefit is calculated as the difference in the maximum visibility impacts from the baseline and control scenario runs summed across 15 Class I areas included in the CAMx modeling.

The table below summarizes the number of days impacted over 0.5 dv and 1.0 dv for each modeled scenario. DSI level of control results in the elimination of all but one day where impacts are greater than 1 dv and decreases the number of days impacted over 0.5 dv from 69 to 23. Additional reduction in number of days impacted over 0.5 dv is anticipated with SDA level controls given the significant additional reduction in emissions and the estimated benefits discussed above.

Table 6.3-2 EPA modeled anticipated visibility benefit due to controls on Nelson Unit 6 at most impacted Class I areas – number of days impacted over 0.5 and 1.0 dv (CAMx)

Class I area	Baseline - # of days impacted over		DSI - # of days impacted over	
	1 dv	0.5 dv	1 dv	0.5 dv
Breton	0	1	0	0
Caney Creek	6	30	0	11
Mingo	1	9	1	5
Upper Buffalo	4	18	0	5
Hercules-Glade	1	9	0	2
Wichita Mountains	0	2	0	0
Cumulative [84]	12	69	1	23

The figures below (Figures 6.3-1, 6.3-2, and 6.3-3) show the modeled impacts for each modeled scenario for the maximum impacts, average across the top ten impacted days, and the annual average impacts (excluding days impacted less than 0.1 dv). Figure 6.3-4 shows the contribution to extinction from the source for the base case scenario due to each visibility impairing species[85] in inverse megameters (Mm-1) on the ten highest impact days.

[84] Cumulative benefit is calculated as the difference in the maximum visibility impacts from the baseline and control scenario runs summed across 15 Class I areas included in the CAMx modeling.

[85] Ammonia nitrate (no3), ammonia sulfate (so4), elemental carbon (ec), organic carbon (oc), coarse mass (cm), soil, and nitrogen dioxide (no2)

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Figure 6.3-1. Maximum CAMx modeled impact (dv) – Entergy Nelson Unit 6

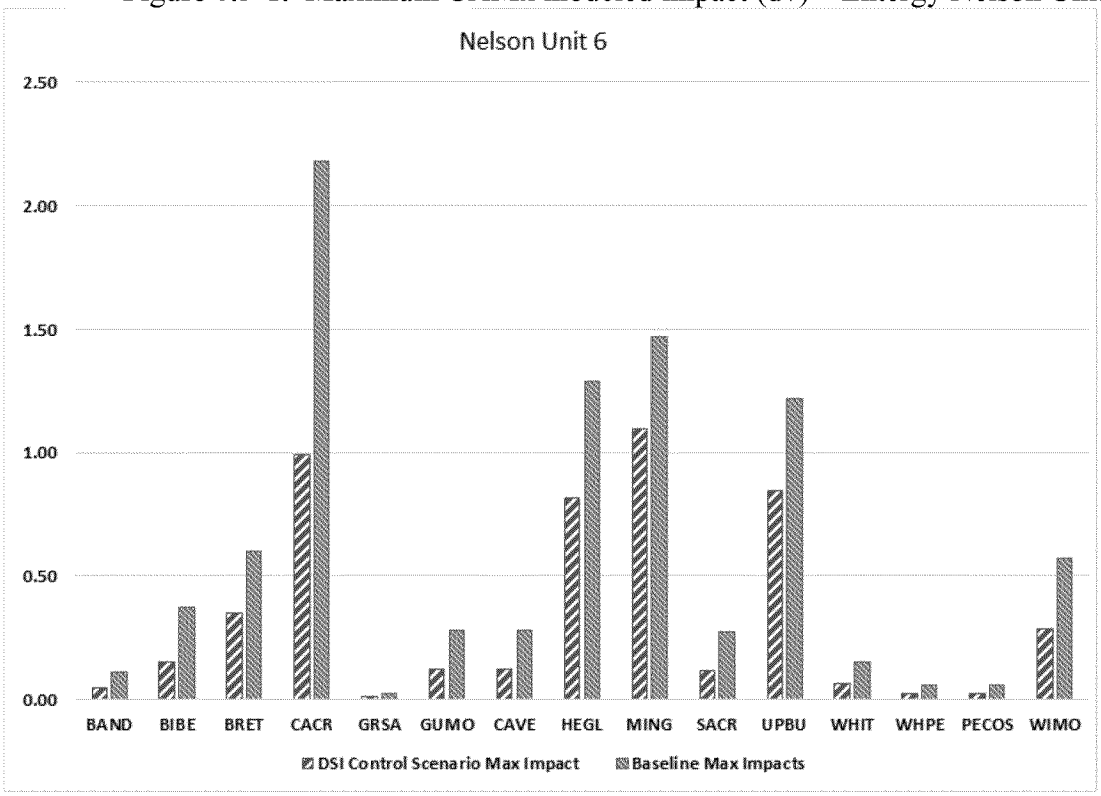


Figure 6.3-2. Average of top ten CAMx modeled impact (dv) – Entergy Nelson Unit 6

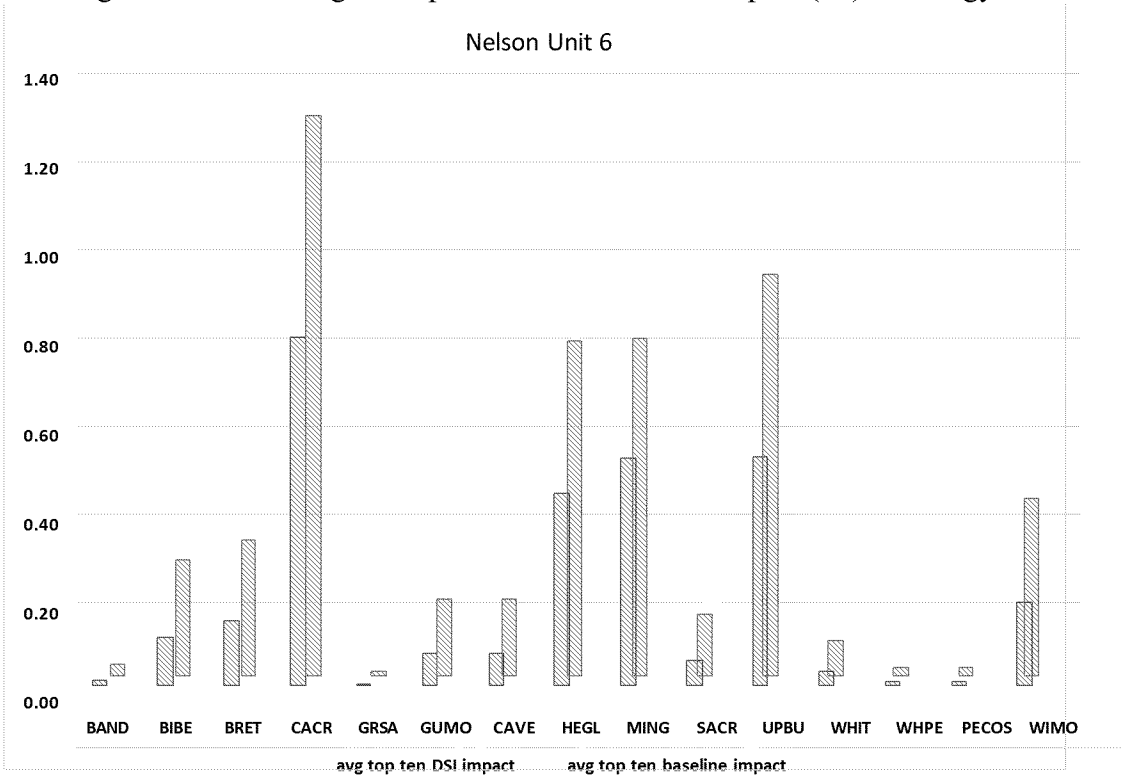


Figure 6.3-3. Annual Average CAMx modeled impact (dv) excluding baseline days impacted less than 0.1 dv – Entergy Nelson Unit 6

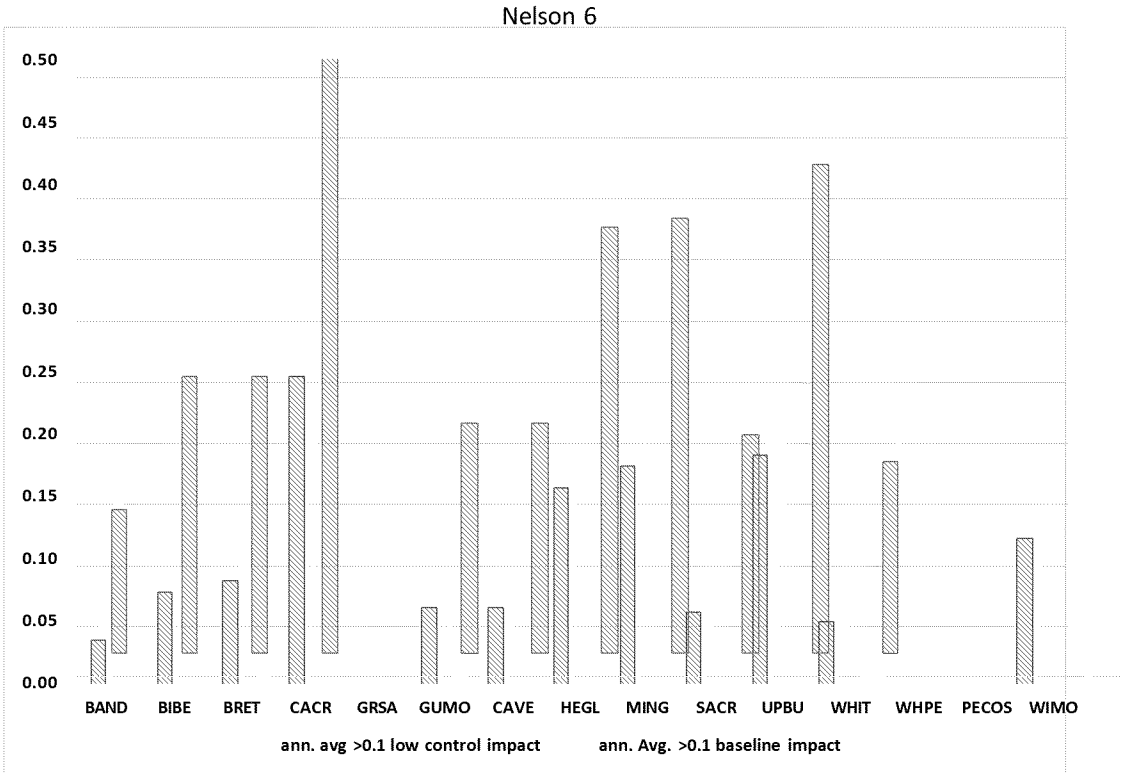
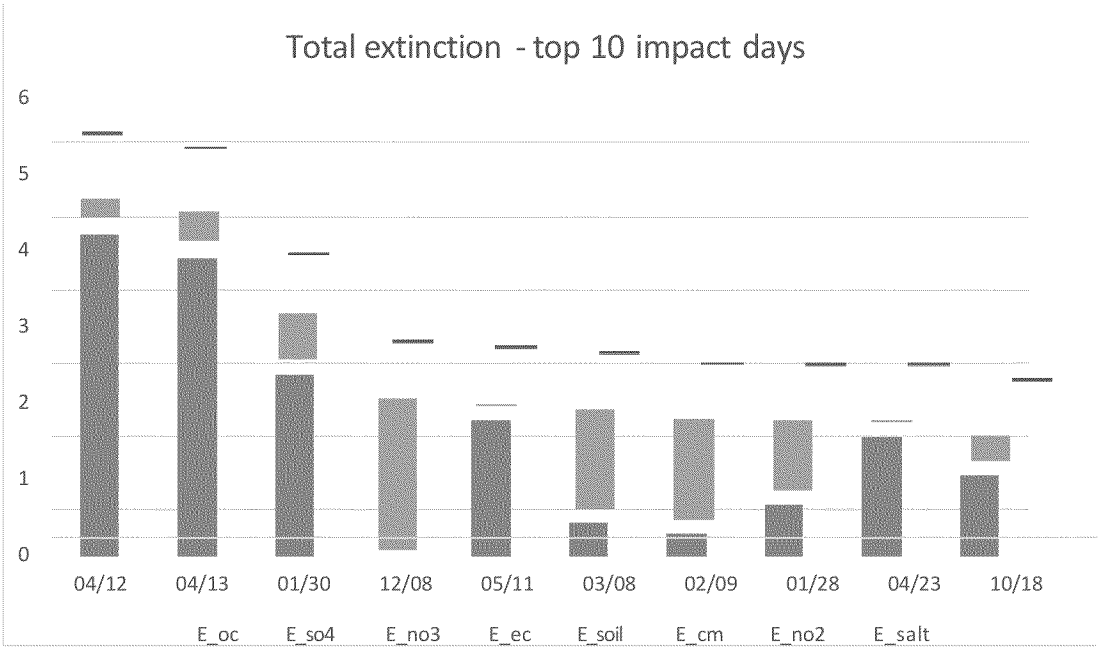


Figure 6.3-4. Species Contribution (Mm-1) on ten highest impact days (base case) at Caney Creek Class I area – Nelson Unit 6


Total extinction - top 10 impact days
6
5
4
3
2
1
0
04/12
04/13
01/30
12/08
05/11
03/08
02/09
01/28
04/23
10/18
E_oc
E_so4
E_no3
E_ec
E_soil
E_cm
E_no2
E_salt

Note: Modeling files (CALPUFF and CAMx) are large and due to size and/or file type cannot be added to the electronic docket available at www.regulations.gov. Electronic files are available upon request. Contact Erik Snyder (Snyder.erik@epa.gov 214-665-7305) or Michael Feldman (Feldman.Michael@epa.gov 214-665-9793).

Appendix A. Modeled parameters: Stack and emissions for CAMx modeled sources

Table A-1. Base Case (Run 1)

PLANT NAME	BOILER ID	Height (ft)	Diameter (ft)	Exit Temp (F)	Flow Rate (ft3/sec)	Exit Velocity (ft/s)	SO_2 Max Day (tpy)	NOx Max Day (tpy)	PM10 Max Day (tpy)	PM 2.5 Max Day
ENTERGY R.S. NELSON	6	500	23	277	4111.124	9.9	89.32	69.92	4.146	3.127
ENTERGY R.S. NELSON	4	400	19	300	2550.465	9	0.033	9.561	0.310	0.310
ENTERGY R.S. NELSON	0	196	10	301	392.5	5	1.28	0.68	0.101	0.101
NRG BIG CAJUN II	2B1	600	26.5	325	30666.67	53.53	78.974	32.512	8.721	5.214
NRG BIG CAJUN II	2B2	600	26.5	325	30666.67	53.53	73.118	33.632	7.638	4.567
CLECO Brame Nesbit	1	195	16.9	287	21613.82	74.61	40.26	15.86	0.334	0.334
CLECO Brame Rodemacher	2	266	18	307	36000	118	64.98	39.58	1.756	0.529

Table A-2. Low Control Scenario (Run 4)

PLANT NAME	BOILER ID	Height (ft)	Diameter (ft)	Exit Temp (F)	Flow Rate (ft3/sec)	Exit Velocity (ft/s)	SO_2 Max Day (tpy)	NOx Max Day (tpy)	PM10 Max Day (tpy)	PM 2.5 Max Day
ENTERGY R.S. NELSON	6	500	23	277	41132.1	99	36.44	69.92	4.146	3.127
ENTERGY R.S. NELSON	4	400	19	300	25517.6	90	0.033	9.561	0.310	0.310
ENTERGY R.S. NELSON	0	196	10	301	3926.99	50	1.28	0.68	0.101	0.101
NRG BIG CAJUN II	2B1	600	26.5	316.2	36407.5	66.01	29.28	32.512	8.721	5.214
NRG BIG CAJUN II	2B2	600	26.5	304.97	33114.8	60.04	0.13	11.56	0	0.143

CLECO Brame Nesbit	1	195	16.9	287	21613.82	74.61	0.036	15.86	0.334	0.334
CLECO Brame Rodemacher	2	266	18	307	36000	118	32.64	39.58	1.756	0.529

Table A-3. High Control Scenario Run 3

PLANT NAME	BOILER ID	Height (ft)	Diameter (ft)	Exit Temp (F)	Flow Rate (ft3/sec)	Exit Velocity (ft/s)	SO_2 Max Day (tpy)	NOx Max Day (tpy)	PM10 Max Day (tpy)	PM 2.5 Max Day
ENTERGY R.S. NELSON	6	500	23	277	41132.1	99	89.32	69.92	4.146	3.127
ENTERGY R.S. NELSON	4	400	19	300	25517.6	90	0.033	9.561	0.310	0.310
ENTERGY R.S. NELSON	0	196	10	301	3926.99	50	1.28	0.68	0.101	0.101
NRG BIG CAJUN II	2B1	600	26.5	125	25316	45.9	3.08	32.512	4.36	2.607
NRG BIG CAJUN II	2B2	600	26.5	304.97	33114.8	60.04	0.13	11.56	0	0.143
CLECO Brame Nesbit	1	195	16.9	287	21613.82	74.61	0.036	15.86	0.334	0.334
CLECO Brame Rodemacher	2	266	18	307	36000	118	3.18	39.58	0.878	0.264

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Appendix B. CAMx Maximum Impact at each Class I Area

Table B-1. Base Case (Run 1) Maximum Impact*

Class I Area	Big Cajun II 1	Big Cajun II 2	Cleco Nesbitt 1	Cleco Rodemacher 2
BAND	0.038	0.035	0.022	0.038
BIBE	0.167	0.154	0.129	0.224
BRET	0.885	0.818	0.398	0.713
CACR	0.851	0.815	0.935	2.051
CAVE	0.148	0.137	0.107	0.181
GRSA	0.011	0.010	0.005	0.009
GUMO	0.148	0.137	0.107	0.181
HEGL	0.708	0.657	0.419	0.687
MING	0.649	0.615	0.420	0.711
PECO	0.037	0.035	0.012	0.020
SACR	0.103	0.096	0.085	0.135
UPBU	0.751	0.700	0.524	1.102
WHIT	0.062	0.057	0.049	0.082
WHPE	0.037	0.035	0.012	0.020
WIMO	0.393	0.366	0.322	0.578
Cumulative	4.991	4.668	3.545	6.733

* Entergy Nelson modeled impacts not shown for Run 1. Run 1 included incorrect stack parameters for these units

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Table B-2. High Control (Run 3) Maximum Impact

Class I Area	Big Cajun II 1	Big Cajun II 2	Cleco Nesbitt 1	Cleco Rodemacher 2	Nelson Aux. Boiler*	Nelson Unit 4*	Nelson Unit 6*
BAND	0.001	0.000	0.000	0.002	0.001	0.001	0.111
BIBE	0.008	0.001	0.002	0.015	0.005	0.002	0.373
BRET	0.289	0.095	0.122	0.314	0.007	0.028	0.599
CACR	0.530	0.189	0.765	1.813	0.034	0.125	2.179
CAVE	0.008	0.001	0.002	0.011	0.003	0.002	0.279
GRSA	0.000	0.000	0.000	0.001	0.000	0.000	0.024
GUMO	0.008	0.001	0.002	0.011	0.003	0.002	0.279
HEGL	0.238	0.111	0.231	0.587	0.018	0.100	1.287
MING	0.417	0.136	0.170	0.391	0.018	0.147	1.468
PECO	0.001	0.000	0.000	0.001	0.001	0.000	0.060
SACR	0.005	0.000	0.001	0.008	0.004	0.001	0.276
UPBU	0.242	0.070	0.377	0.947	0.019	0.107	1.219
WHIT	0.002	0.000	0.000	0.004	0.002	0.001	0.152
WHPE	0.001	0.000	0.000	0.001	0.001	0.000	0.060
WIMO	0.038	0.010	0.043	0.139	0.008	0.017	0.575
Cumulative	1.790	0.615	1.716	4.245	0.124	0.533	8.939

* Entergy Nelson modeled impacts for Run 3 are the corrected base case impacts, not high control scenario impacts

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Table B-3. Low Control (Run 4) Maximum Impact

Class I Area	Big Cajun II 1	Big Cajun II 2	Cleco Nesbitt 1	Cleco Rodemacher 2	Nelson Aux. Boiler	Nelson Unit 4	Nelson Unit 6
BAND	0.014	0.000	0.000	0.020	0.001	0.001	0.049
BIBE	0.063	0.001	0.002	0.121	0.005	0.002	0.151
BRET	0.469	0.092	0.115	0.527	0.007	0.027	0.349
CACR	0.596	0.188	0.765	1.933	0.034	0.123	0.992
CAVE	0.057	0.001	0.002	0.093	0.003	0.002	0.121
GRSA	0.004	0.000	0.000	0.005	0.000	0.000	0.010
GUMO	0.057	0.001	0.002	0.093	0.003	0.002	0.121
HEGL	0.493	0.117	0.230	0.635	0.018	0.100	0.814
MING	0.452	0.136	0.167	0.573	0.018	0.145	1.099
PECO	0.014	0.000	0.000	0.011	0.001	0.000	0.026
SACR	0.039	0.000	0.001	0.070	0.004	0.001	0.114
UPBU	0.373	0.070	0.377	1.022	0.019	0.107	0.845
WHIT	0.024	0.000	0.001	0.042	0.002	0.001	0.066
WHPE	0.014	0.000	0.000	0.011	0.001	0.000	0.026
WIMO	0.160	0.010	0.040	0.372	0.008	0.016	0.288
Cumulative	2.829	0.616	1.702	5.525	0.123	0.525	5.070

ED_001812_00003267-00059

Appendix C. CAMx Modeled Number of Days impacted

Table C-1. Base Case (Run 1) Number of days impacted over 0.5 dv*

Class I Area	Big Cajun II (Units 1 & 2)	Big Cajun II 1	Big Cajun II 2	Cleco Brame (Nesbitt & Rodemacher)	Cleco Nesbitt 1	Cleco Rodemacher 2
BAND	0	0	0	0	0	0
BIBE	0	0	0	0	0	0
BRET	16	4	2	2	0	2
CACR	17	6	6	30	6	15
CAVE	0	0	0	0	0	0
GRSA	0	0	0	0	0	0
GUMO	0	0	0	0	0	0
HEGL	9	3	2	14	0	5
MING	22	7	7	15	0	2
PECO	0	0	0	0	0	0
SACR	0	0	0	0	0	0
UPBU	11	2	2	14	1	7
WHIT	0	0	0	0	0	0
WHPE	0	0	0	0	0	0
WIMO	4	0	0	4	0	1
Cumulative	79	22	19	79	7	32

* Entergy Nelson modeled impacts not shown for Run 1. Run 1 included incorrect stack parameters for these units

ED_001812_00003267-00060

Table C-2. Base Case (Run 1) Number of days impacted over 1 dv*

Class I Area	Big Cajun II (Units 1 & 2)	Big Cajun II 1	Big Cajun II 2	Cleco Brame (Nesbitt & Rodemacher)	Cleco Nesbitt 1	Cleco Rodemacher 2
BAND	0	0	0	0	0	0
BIBE	0	0	0	0	0	0
BRET	2	0	0	1	0	0
CACR	6	0	0	10	0	3
CAVE	0	0	0	0	0	0
GRSA	0	0	0	0	0	0
GUMO	0	0	0	0	0	0
HEGL	2	0	0	1	0	0
MING	7	0	0	1	0	0
PECO	0	0	0	0	0	0
SACR	0	0	0	0	0	0
UPBU	2	0	0	3	0	1
WHIT	0	0	0	0	0	0
WHPE	0	0	0	0	0	0
WIMO	0	0	0	0	0	0
Cumulative	19	0	0	16	0	4

* Entergy Nelson modeled impacts not shown for Run 1. Run 1 included incorrect stack parameters for these units

ED_001812_00003267-00061

Table C-3. High Control (Run 3) Number of days impacted over 0.5 dv*

Class I Area	Big Cajun II (Units 1 & 2)	Big Cajun II 1	Big Cajun II 2	Cleco Brame (Nesbitt & Rodemacher)	Cleco Nesbitt 1	Cleco Rodemacher 2	Entergy Nelson (Aux. Boiler, Units 4 & 6)	Nelson Aux. Boiler	Nelson Unit 4	Nelson Unit 6
BAND	0	0	0	0	0	0	0	0	0	0
BIBE	0	0	0	0	0	0	0	0	0	0
BRET	0	0	0	0	0	0	1	0	0	1
CACR	1	1	0	4	1	2	31	0	0	30
CAVE	0	0	0	0	0	0	0	0	0	0
GRSA	0	0	0	0	0	0	0	0	0	0
GUMO	0	0	0	0	0	0	0	0	0	0
HEGL	0	0	0	1	0	1	11	0	0	9
MING	1	0	0	1	0	0	11	0	0	9
PECO	0	0	0	0	0	0	0	0	0	0
SACR	0	0	0	0	0	0	0	0	0	0
UPBU	0	0	0	1	0	1	20	0	0	18
WHIT	0	0	0	0	0	0	0	0	0	0
WHPE	0	0	0	0	0	0	0	0	0	0
WIMO	0	0	0	0	0	0	2	0	0	2
Cumulative	2	1	0	7	1	4	76	0	0	69

* Entergy Nelson modeled impacts for Run 3 are the corrected base case impacts, not high control scenario impacts

ED_001812_00003267-00062

Table C-4. High Control (Run 3) Number of days impacted over 1 dv*

Class I Area	Big Cajun II (Units 1 & 2)	Big Cajun II 1	Big Cajun II 2	Cleco Brame (Nesbitt & Rodemacher)	Cleco Nesbitt 1	Cleco Rodemacher 2	Entergy Nelson (Aux. Boiler, Units 4 & 6)	Nelson Aux. Boiler	Nelson Unit 4	Nelson Unit 6
BAND	0	0	0	0	0	0	0	0	0	0
BIBE	0	0	0	0	0	0	0	0	0	0
BRET	0	0	0	0	0	0	0	0	0	0
CACR	0	0	0	2	0	2	9	0	0	6
CAVE	0	0	0	0	0	0	0	0	0	0
GRSA	0	0	0	0	0	0	0	0	0	0
GUMO	0	0	0	0	0	0	0	0	0	0
HEGL	0	0	0	0	0	0	2	0	0	1
MING	0	0	0	0	0	0	1	0	0	1
PECO	0	0	0	0	0	0	0	0	0	0
SACR	0	0	0	0	0	0	0	0	0	0
UPBU	0	0	0	1	0	0	5	0	0	4
WHIT	0	0	0	0	0	0	0	0	0	0
WHPE	0	0	0	0	0	0	0	0	0	0
WIMO	0	0	0	0	0	0	0	0	0	0
Cumulative	0	0	0	3	0	2	17	0	0	12

* Entergy Nelson modeled impacts for Run 3 are the corrected base case impacts, not high control scenario impacts

ED_001812_00003267-00063

Table C-5. Low Control (Run 4) Number of days impacted over 0.5 dv

Class I Area	Big Cajun II (Units 1 & 2)	Big Cajun II 1	Big Cajun II 2	Cleco Brame (Nesbitt & Rodemacher)	Cleco Nesbitt 1	Cleco Rodemacher 2	Entergy Nelson (Aux. Boiler, Units 4 & 6)	Nelson Aux. Boiler	Nelson Unit 4	Nelson Unit 6
BAND	0	0	0	0	0	0	0	0	0	0
BIBE	0	0	0	0	0	0	0	0	0	0
BRET	1	0	0	1	0	1	0	0	0	0
CACR	2	1	0	10	1	7	16	0	0	11
CAVE	0	0	0	0	0	0	0	0	0	0
GRSA	0	0	0	0	0	0	0	0	0	0
GUMO	0	0	0	0	0	0	0	0	0	0
HEGL	1	0	0	2	0	1	4	0	0	2
MING	1	0	0	2	0	1	6	0	0	5
PECO	0	0	0	0	0	0	0	0	0	0
SACR	0	0	0	0	0	0	0	0	0	0
UPBU	0	0	0	2	0	1	6	0	0	5
WHIT	0	0	0	0	0	0	0	0	0	0
WHPE	0	0	0	0	0	0	0	0	0	0
WIMO	0	0	0	0	0	0	0	0	0	0
Cumulative	5	1	0	17	1	11	32	0	0	23

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Table C-6. Low Control (Run 4) Number of days impacted over 1 dv

Class I Area	Big Cajun II (Units 1 & 2)	Big Cajun II 1	Big Cajun II 2	Cleco Brame (Nesbitt & Rodemacher)	Cleco Nesbitt 1	Cleco Rodemacher 2	Entergy Nelson (Aux. Boiler, Units 4 & 6)	Nelson Aux. Boiler	Nelson Unit 4	Nelson Unit 6
BAND	0	0	0	0	0	0	0	0	0	0
BIBE	0	0	0	0	0	0	0	0	0	0
BRET	0	0	0	0	0	0	0	0	0	0
CACR	0	0	0	2	0	2	3	0	0	0
CAVE	0	0	0	0	0	0	0	0	0	0
GRSA	0	0	0	0	0	0	0	0	0	0
GUMO	0	0	0	0	0	0	0	0	0	0
HEGL	0	0	0	0	0	0	0	0	0	0
MING	0	0	0	0	0	0	1	0	0	1
PECO	0	0	0	0	0	0	0	0	0	0
SACR	0	0	0	0	0	0	0	0	0	0
UPBU	0	0	0	1	0	1	0	0	0	0
WHIT	0	0	0	0	0	0	0	0	0	0
WHPE	0	0	0	0	0	0	0	0	0	0
WIMO	0	0	0	0	0	0	0	0	0	0
Cumulative	0	0	0	3	0	3	4	0	0	1

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