Appendix H

Comments Received and Responses

Appendix H-1

U.S. Forest Service Comments on Draft Submittal

USDA United States Department of Agriculture | Forest Service | Southern Region | 1720 Peachtree Street, NW
Atlanta, GA 30309

File Code: 2580
Date: October 7, 2022

Leslie Poff
Environmental Scientist Consultant
Kentucky Division of Air Quality
300 Sower Blvd., 2nd Floor
Frankfort, KY 40601

Dear Leslie Poff,

On August 9, 2022, the State of Kentucky submitted a draft Regional Haze State Implementation Plan describing your proposal to continue improving air quality by reducing regional haze impacts at mandatory Class I areas across the region. We appreciate the opportunity to work closely with your State through the initial evaluation, development, and subsequent review of this plan. Cooperative efforts such as these ensure that, together, we will continue to make progress toward the Clean Air Act's goal of natural visibility conditions at our Class I areas.

This letter acknowledges that the U.S. Department of Agriculture, U.S. Forest Service, has received and conducted a substantive review of your proposed Regional Haze State Implementation Plan. This review satisfies your requirements under the federal regulations 40 C.F.R. § 51.308(i)(2). Please note, however, that only the U.S. Environmental Protection Agency (EPA) can make a final determination about the document's completeness, and therefore, only the EPA has the authority to approve the document.

We have enclosed comments to this letter based on our review. We look forward to your response required by 40 C.F.R. § 51.308(i)(3). For further information, please contact Jeremy Ash at jeremy.ash@usda.gov or 828-244-4751.

Again, we appreciate the opportunity to work closely with the State of Kentucky. The Forest Service compliments you on your hard work and dedication to significant improvement in our nation's air quality values and visibility.

Sincerely,

JAMES E. MELONAS
Forest Supervisor, National Forests in North Carolina

Enclosure

cc: Melanie Pitrolo

Kentucky Draft Regional Haze State Implementation Plan (RH SIP) - Specific Comments

The USDA Forest Service recognizes the significant emission reductions of nitrogen oxides (NO_x) and sulfur dioxide (SO_2) made in Kentucky in the last 15 years due to economic and regulatory drivers. These reductions directly led to measured visibility improvement and numerous other air quality related benefits at nearby USDA Forest Service Class I areas in the southeastern US over that time.

Overall, the USDA Forest Service finds that the draft RH SIP is well organized and comprehensive. The Long-Term Strategies for this planning period appear to indicate that Forest Service Class I Areas will continue to show visibility improvements better than the Uniform Rate of Progress (URP) through 2028, and we appreciate the commitment by Kentucky Energy and Environment Cabinet, Division of Air Quality, to evaluate progress in meeting the visibility goals during the 5-year progress reports. However, we offer these specific comments on the draft RH SIP review and consideration.

Screening of Sources for Reasonable Progress Evaluation / 4-Factor Analysis

Section 7.6 of KY's draft RH SIP discusses the methodology that was used to determine which sources to analyze for additional controls. Sources both within and out of KY were included in the screening (i.e., in the 'denominator' of the contribution evaluation), and a source was selected for reasonable progress evaluation / four-factor analysis if the facility was estimated to have a $\geq$ 1.00% sulfate or nitrate contribution to visibility impairment in 2028 at Mammoth Cave National Park and other Class I Areas in nearby states. This process resulted in two KY facilities being selected for further evaluation. USDA Forest Service understands and recognizes that EPA has afforded states the flexibility to screen facilities for additional analysis if that screening is based on reasonable methods. However, we request that KY consider only in-state facilities in the denominator of the contribution equation when screening for sulfate and nitrate visibility contributions at a Class I Area, as outlined in the July 2021 EPA Regional Haze Clarification Memorandum (https://www.epa.gov/visibility/clarifications-regarding-regional-haze-state-implementation-plans-second-implementation). This methodology would result in a more robust reasonable progress evaluation by focusing on sources permitted by KY.

Evaluation of Nitrogen Oxide Emission Sources for Additional Controls

The draft RH SIP only evaluates SO_2 emission sources for reasonable progress evaluations / four-factor analyses. USDA Forest Service appreciates the discussion within the draft RH SIP regarding nitrate formation in the VISTAS region. We understand that nitrate formation in the VISTAS region is limited by the availability of ammonia (which preferentially reacts with SO_2 and sulfates before reacting with NO_x) and by temperature, with particulate nitrate concentrations highest in the winter months. We also recognize that sulfates have been the main contributor to visibility impairment at Class I Areas within the southern US. The emissions data show that most NO_x emissions within KY are from the mobile sector, however Electrical Generating Units (EGUs) are the second highest sector. Additionally, the nitrate contribution to visibility impairment is increasing as sulfur dioxide emissions decrease, and there are still significant NO_x sources within the point sector in KY. IMPROVE monitoring data from Mammoth Cave National Park and nearby USFS Class I areas in NC (Shining Rock and Linville Gorge Wilderness Areas) show that some of the highest rates of light extinction from ammonium nitrate have occurred within the last several years (Figure 1). EPA's 2019 Regional Haze Guidance states that "because regional haze results from a multitude of sources over a broad geographic area, a measure may be necessary for reasonable progress even if that measure in isolation does not result in perceptible visibility improvement." Widespread emissions controls, particularly for SO_2 and NO_x, are essential for making reasonable progress at Class I areas both near to, and more distant from, emissions sources. Further, small visibility improvements, even those that may be imperceptible by themselves, are essential as we continue to make progress towards the national goal of restoring natural conditions at Class I areas by 2064. We request that KY consider evaluating NO_x sources, along with SO_2 sources, for reasonable progress during this planning period.

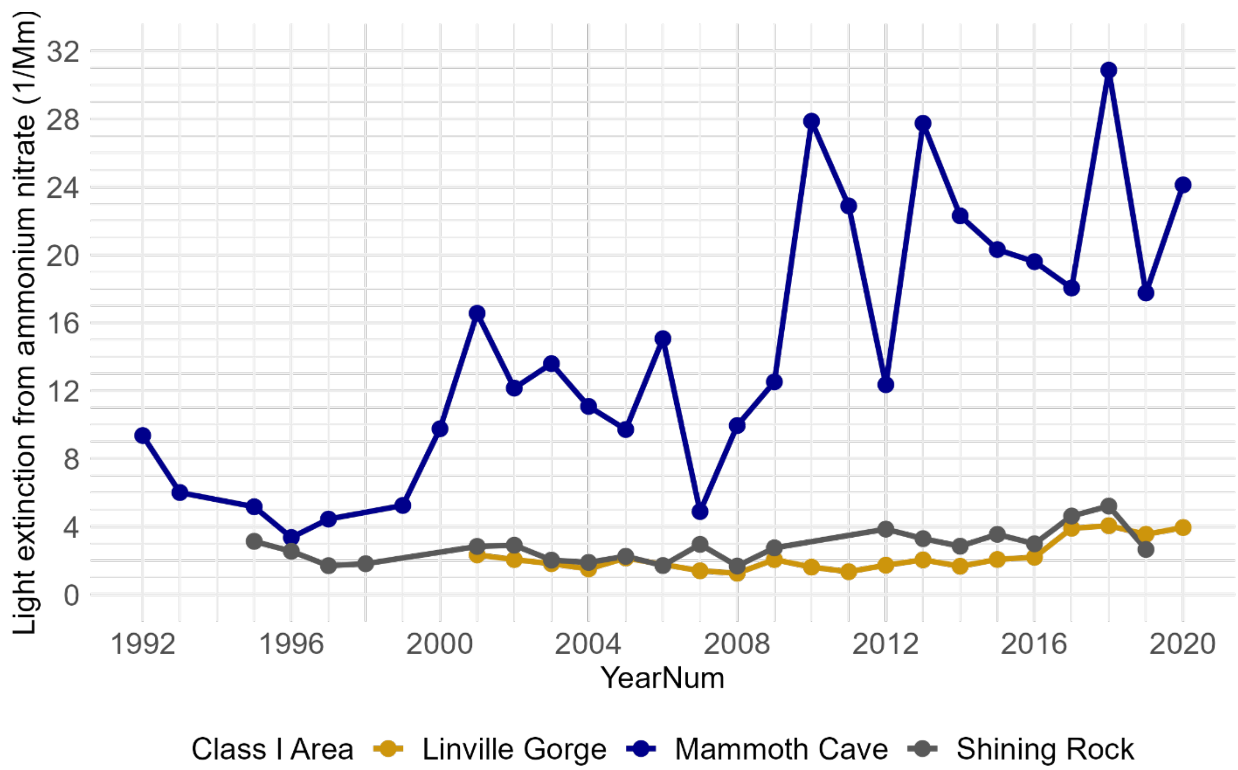

Figure 1. IMPROVE monitoring data from stations at Mammoth Cave National Park and nearby USFS Class I areas (Linville Gorge and Shining Rock Wilderness Areas) showing light extinction from ammonium nitrate (data retrieved from: https://views.cira.colostate.edu/fed/).

<u>Enforceability</u>

The draft KY RH SIP noted that SO_2 emissions reductions can be expected beginning in 2028 for the Tennessee Valley Authority – Shawnee Fossil Plant. This is an admirable first step, but we want to ensure that these agreements are enforceable. We also extend this concern to assumptions regarding:

- operating scenarios for emission units that represent a reduced capacity, for example a reduced number of operating hours per year,
- pollution control equipment efficiency used to designate a unit as "effectively controlled",
- any of the assumptions used in the four-factor analyses (e.g., the capacity factors).

<u>Prescribed Fire Emissions</u>

Fire plays an important role in shaping the vegetation and landscape in KY. Recurring fire has been a part of the landscape for thousands of years. Aggressive fire suppression, coupled with an array of other disturbances (e.g., logging and chestnut blight), has changed the historic composition and structure of the forests. Periodic prescribed burning and other vegetation management can recreate the ecological role of fire in a controlled manner. Fire and fuels management supports a variety of desired conditions and objectives across the Forests (e.g., community protection, hazardous fuels reduction, native ecosystems restoration, historic fire regimes restoration, wildlife openings, and open woodland creation, etc.). The 2017 Regional Haze Rule includes a provision to allow states to adjust the glidepath to account for prescribed fire. The draft KY RH SIP states that prescribed fire emissions were taken from the 2011 National Emissions Inventory (NEI) and were carried forward into the 2028 future year emissions without any changes. Recent data on prescribed fire activity, especially within the USDA Forest Service, show that the number of acres burned in prescribed fires during 2011 were lower than all other recent years. For example, within the southern region of the Forest Service a total of 749,080 acres were treated with prescribed fire in 2011, while the average number of acres treated annually from the years 2007-2019 was 980,422. The 2021 target for treatment by prescribed fire within the USDA Forest Service southern region is well over 1 million acres. Furthermore, the Land Management Plans for each of the southern Forests call for a cumulative total of up to 2.1 million acres per year to be treated with prescribed fire in the future. Therefore, keeping prescribed fire emissions steady from to 2028 undercounts emissions in the VISTAS states by up to fifty percent. At this point in the draft RH SIP review process, a quantitative analysis to adjust the glidepaths for actual prescribed fire projections is not practical. While prescribed fire is currently a minor contributor to visibility impairment on the 20% most impaired days, the USDA Forest Service would like assurances that KY will continue to recognize the important ecological role of prescribed fire and in the future adjust the glidepath to account for prescribed fire emissions accordingly.

Appendix H-2

National Park Service Comments on Draft Submittal

National Park Service (NPS) Regional Haze SIP feedback for the Kentucky Energy and Environment Cabinet, Division for Air Quality

October 11, 2022

Contents

1 Executive Summary

The National Park Service (NPS) appreciates the opportunity to review *Kentucky's State Implementation Plan (SIP) For Regional Haze (DRAFT)*. The Kentucky Energy and Environment Cabinet, Division for Air Quality (Kentucky EEC) developed a well-organized SIP and held a consultation meeting with the NPS on the proposed regional haze plan as required under §7491 (d) of the Clean Air Act.

The NPS consultation meeting, held on October 5, 2022, included staff from the NPS Air Resources Division (ARD), NPS Interior Regions 1 and 2, Mammoth Cave, Great Smoky Mountains and Shenandoah National Parks, as well as Kentucky EEC. In addition, staff from the U.S. Forest Service (USFS) and the Environmental Protection Agency Region 4 (EPA) attended. During this consultation meeting, the NPS provided conclusions regarding the current draft as well as recommendations to strengthen the Kentucky SIP which are discussed in detail in this document.

Kentucky is home to one Class I area, Mammoth Cave National Park which is administered by the National Park Service. In addition, emissions from Kentucky affect visibility at Great Smoky Mountains National Park, in North Carolina and Tennessee, and Shenandoah National Park in Virginia. NPS review and comment is focused on NPS-managed areas; this document does not represent the recommendations or conclusions of other Federal Land Management (FLM) agencies.

As noted in the draft SIP, significant reductions in SO_2 and NO_x emissions have occurred throughout Kentucky and the southeast region in the last decade. The NPS recognizes emission reductions in Kentucky that have contributed to visibility improvements in nearby Class I areas. However, additional progress is necessary before the ultimate visibility goal of no human caused impairment is realized for Class I areas affected by Kentucky emissions. This is particularly true for Mammoth Cave National Park, which is the second-most-impaired national park in the country based on the most recent five years of available visibility monitoring data relative to the end point visibility goal.[1]

Despite reductions, Kentucky emissions remain significant both regionally and nationally:

- Kentucky is currently ranked 11th highest nationally for point source $SO_2 + NO_x$ emissions reported in the 2017 National Emissions Inventory (NEI).[2]
- Kentucky is ranked 12th highest nationally for future point source $SO_2 + NO_x$ emissions included in the VISTAS 2028 Area of Influence (AoI) inventory.[3]

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[1] Impairment rankings calculated based on the mean deciview of the most recent 5-year period (2016-2020) for each NPS IMPROVE monitor minus the estimated endpoint goal for the NPS Class I area.
[2] Kentucky point source $SO_2 + NO_x$ emissions reported in the 2017 NEI totaled 146,474 tons.
[3] Kentucky point source $SO_2 + NO_x$ emission estimates included in the 2028 VISTAS AoI analysis totaled 135,432 tons.

Kentucky sources are also important in terms of their potential visibility impacts based on NPS analyses of surrogate visibility impacts:

- Kentucky is ranked the **#2** state nationally contributing to haze in *VISTAS region* NPS Class I areas based on cumulative AoI results.[4] (Indiana is the #1 ranked state.)
- Kentucky is ranked the **#2** state nationally contributing to haze in *all NPS Class I areas* based on the cumulative Q/d results.[5] (North Dakota is the #1 ranked state.)
- Kentucky is ranked the **#1** state in the *VISTAS region* contributing to haze in Mammoth Cave, Great Smoky Mountains, and Shenandoah National Parks based on the cumulative PSAT modeling contributions from Electricity Generating Units (EGU) plus non-EGU sources. Kentucky sources comprise 40% of the total VISTAS region states contributions to haze in these three parks.[6]

Given this information, the NPS has identified Kentucky as a priority state affecting haze in Mammoth Cave, Great Smoky Mountains, and Shenandoah NPs.

The Kentucky draft regional haze SIP focuses exclusively on SO_2 emissions, identifies two sources for analysis, does not contain any four factor analyses, and does not require any emission reductions for reasonable progress. As such, the draft SIP is missing significant opportunities to address haze-causing emissions from Kentucky that affect NPS Class I areas. NPS review finds that there may be additional reasonable opportunities to reduce emissions at Kentucky facilities and offer these recommendations to improve the SIP.

As described in Sections 2, the NPS recommends that Kentucky EEC:

- Clearly articulate impacts to Great Smoky Mountains and Shenandoah National Parks in the SIP.
- Evaluate and implement reasonable NO_x emission reduction opportunities in the round 2 regional haze SIP.
- Revise the source selection approach and address the additional 13 sources identified by the NPS.
- Establish a cost threshold similar to those established by other states in this round of regional haze planning to thoroughly document decisions. For example, Colorado, Nevada, and Oregon have established $10,000/ton cost thresholds.

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[4] Information Source: Statewide tallies of the 2028 AoI impact ((SO_4 EWRT*SO_2 Q/d)+ (NO_3 EWRT*NO_x Q/d)) for each facility in the state that falls on the 80% of the AoI impact for any NPS Class I area in the VISTAS region.
[5] Information Source: Statewide tallies of the current (2017 NEI or 2020 CAMD) emissions over distance (SO_2 Q/d + NO_x Q/d) for each facility in the state. Ranked against all other U.S. states.
[6] Tallies based on information provided in the "Region Sector to Area" tab of the VISTAS PSAT modeling results spreadsheet (See: *ATTACHMENT_A_PSAT_TAG_RESULTS_adjusted_09-02-2020 _SHEN_MACA_GRSM_tallies.xlsx*)

As described in Section 3, the NPS provides facility-specific recommendations, summarized here:

- Evaluate and implement cost-effective NO_x and SO_2 controls identified for specific units at:
  - D.B. Wilson
  - Shawnee
  - Mill Creek
  - Century Aluminum Sebree
  - Ghent Station
- Optimize/upgrade existing pollution control equipment for specific units at:
  - Shawnee
  - D.B. Wilson
  - Mill Creek
  - Ghent Station
  - Spurlock
  - Trimble Station
  - East Bend
- Evaluate through four-factor analysis and implement cost-effective NO_x and SO_2 controls for Carmeuse Lime, Pendleton Co
- Respond to information requests for the following facilities:
  - Century Aluminum, Hawesville
  - Brown Station
  - Kosmos Cement
  - Isp Chemicals
  - Cooper Station

As described in these comments, the Kentucky draft SIP outcome is partly due to Kentucky's analytical process for source selection and identification of pollutants to consider for control measures. The NPS raised concerns regarding Kentucky's source selection process and the exclusion of NO_x in communication to VISTAS states as early as May 17th, 2021. The Kentucky SIP does not substantively address this previous NPS feedback. It is with this in mind that the following recommendations are reiterated, and detailed feedback is given specific to Kentucky sources and the EEC SIP conclusions.

2 Overarching Feedback

2.1 Class I Areas Addressed in the SIP

The NPS recommends that Kentucky update the SIP and more clearly acknowledge that Great Smoky Mountains and Shenandoah National Parks are also affected by Kentucky emissions. Chapter seven of the SIP addresses Kentucky facility impacts to the in-state Class I areas and out-of-state Class I areas where the individual facility PSAT contribution exceeds 1% of the total EGU plus non-EGU impact. The NPS recommends that Kentucky expand the tables in this section to include the modeled impacts from Kentucky facilities on all VISTAS Class I areas. By omitting emissions below the 1% threshold, chapter seven does not fully disclose the impact of Kentucky emission sources in all Class I areas.

The VISTAS PSAT and AOI analyses indicate that, among VISTAS region states, Kentucky emissions and facilities affect Mammoth Cave, Great Smoky Mountains, and Shenandoah National Parks. The NPS has identified 15 Kentucky facilities as contributing to the top 80% of visibility impairment at these three parks based on the AOI analysis results.

2.2 FLM Consultation

The NPS appreciates that Kentucky provided the draft SIP materials to the FLMs at least 60 days in advance of their scheduled public comment period. Kentucky's FLM consultation period meets the prescribed timeframes outlined in 40 CFR 51.308(i)(2) of the implementing regulations.

The NPS intent in providing recommendations during the consultation process is so that Kentucky can use the information presented in these comments to "meaningfully inform" the long-term strategy and improve the Kentucky SIP by securing additional emission reductions in this round of regional haze planning. An approach that allows for *substantive* engagement from the FLMs is consistent with the intent of the consultation procedures outlined in §7491 of the Clean Air Act (CAA) and 40 CFR 51.308(i)(2) of the implementing regulations.

FLM consultation under the Regional Haze process is one of the most significant opportunities for the FLMs to carry out their congressionally-designated "affirmative responsibility" to protect air quality related values in the Class I areas they manage. The SIPs will influence visibility in Class I areas for the next decade. EPA underscored the value of FLM involvement in the SIP development process in the preamble to the Regional Haze rule[7]:

> *As discussed in the proposed rule,* ***state consultation with FLMs is a critical part of the development of quality SIPs.*** *. . . We proposed to add a requirement that such consultation on SIPs and progress reports* ***occur early enough to allow the state time for full consideration of FLM input,*** *but no fewer than 60 days prior to a public hearing or other public comment opportunity.* [Emphasis added.]

[7] Protection of Visibility: Amendments to Requirements for State Plans, Final Rule, 82 Fed. Reg. 3078 (January 10, 2017).

EPA further elaborated that FLM participation in the RPO is not sufficient to address the FLM consultation opportunity:

> *Finally, some multi-state organization commenters asked for confirmation that state and FLM participation in the RPO process would continue to meet the consultation requirement.* ***The EPA does not agree that such participation would suffice for consultation because being informed of the technical work performed by the multi-state organizations is not the same as the FLMs being substantively involved in regulatory decisions a state makes on what controls to require based on that work (i.e., the decisions on the long-term strategy on which public comment will be sought prior to submission to the EPA in the form of a SIP revision)****. Furthermore, the objective of these provisions is not to achieve FLM consultation with states on setting RPGs, since that process is largely mechanical in nature because RPGs are to be based on the long-term strategy and do not involve any additional policy decisions. We note that a standing invitation for FLM participation in the work performed by multi-state organizations may be part of the procedures that a SIP provides for continuing consultation between the state and the FLM, as required by 40 CFR 51.308(i)(4).* [Emphasis added.]

With this in mind, we appreciate Kentucky's efforts in consulting with the FLMs and look forward to substantive responses to NPS feedback in the final draft SIP.

2.3 Exclusion of NO_x from Four-Factor Analyses

2.3.1 Kentucky SIP Conclusions Regarding the Exclusion of NO_x from SIP RP determination:

Kentucky used modeling analysis results to conclude that evaluation of NO_x emission sources is not necessary in this round of regional haze planning. This conclusion was initially based on the VISTAS modeling, using a 2011 base year. In the draft SIP, Kentucky compared the 2011 VISTAS modeling with an EPA modeling study that used a 2016 base year to support the 2011 VISTAS modeling conclusions:

> *EPA's September 2019 modeling study, also shows that sulfates will continue to be the prevailing visibility impairing species in 2028 at VISTAS Class I areas and is consistent with a similar analysis of baseline conditions . . . These results corroborate the findings of the VISTAS study and indicate that focusing resources on the control of SO_2 is appropriate for this round of regional haze planning.*

Based on this conclusion, Kentucky EEC did not evaluate or consider NO_x control technologies in their four-factor analyses and reasonable progress determinations.

2.3.2 NPS Conclusions and Recommendations Regarding the Exclusion of NO_x from reasonable progress determinations:

The NPS recognizes that sulfate is the dominant anthropogenic visibility-impairing pollutant in Great Smoky Mountains and Shenandoah National Parks. However, the nitrate contribution to impairment is also important as supported by current monitoring information. For example, in Mammoth Cave National Park, the nitrate contribution to impairment is on par with the sulfate contribution in the most recent three-year period and exceeded the contribution of sulfate in 2018. As discussed in the NPS/Kentucky October 5, 2022 consultation meeting PowerPoint presentation and the NPS May 17, 2021 response to VISTAS's states regarding their source selection and technical analysis for regional haze SIP development, the nitrate contribution to visibility impairment on the 20% most-impaired days has been increasing over the last decade at Mammoth Cave, Great Smoky Mountains, and Shenandoah National Parks. The NPS recommends evaluating opportunities to reduce NO_x emissions from Kentucky stationary sources in this RH planning period. (NPS May 17, 2021 comments to the VISTAS region state are attached to these comments for additional details and reference.)

The NPS recommendation to consider NO_x emissions is supported by information in the EPA's July 8, 2021 Memorandum, "*Clarifications Regarding Regional Haze State Implementation Plans for the Second Implementation Period*" (EPA Clarification Memo), which states in Section 2.2:

> *Consistent with the first planning period, EPA generally expects that each state will analyze sulfur dioxide (SO_2) and nitrogen oxide (NO_x) in selecting sources and determining control measures. In nearly all Class I areas, the largest particulate matter (PM) components of anthropogenic visibility impairment are sulfate and nitrate, caused primarily by PM precursors SO_2 and NO_x, respectively. A state that chooses not to consider at least these two pollutants in the second planning period should show why such consideration would be unreasonable, especially if the state considered both these pollutants in the first planning period. Regional offices are encouraged to work closely with states to ensure the bases for their decisions are sufficiently developed to demonstrate a reasonable analysis.*

Currently, Kentucky's approach relies on 2028 modeling projections to determine that nitrate is not a significant contributor to impairment. Current IMPROVE monitoring information contradicts this conclusion (see slides 13-24 in the October 5, 2022 NPS consultation PowerPoint presentation, included with these written comments) as explained below.

As outlined in NPS May 17, 2021 communication with the VISTAS states, the VISTAS modeling used a 2011 base year which is not representative of current visibility monitoring trends for nitrate. The subset of 20% most-impaired days from the base year are carried forward into the 2028 future year analysis. This assumes that the 2011 distribution of most-impaired days is reflective of current trends. Monitoring data show that the distribution of most-impaired days has shifted to the cooler months and suggest the VISTAS 2028 results are biased toward summer months when sulfate concentrations are generally highest and nitrate concentrations are generally low. (Please reference the NPS May 17, 2021 comments for additional details).

To be clear, the NPS is not recommending that the modeling analysis should be redone or discarded. Rather, the NPS recommends that Kentucky supplement their approach and rely on a weight-of-evidence approach, including the visibility monitoring data, to draw conclusions regarding emission reduction measures to consider in the SIP.

The NPS appreciates Kentucky's efforts to compare the VISTAS modeling results with the more-recent EPA 2016 base year modeling study. While the EPA results predict that sulfate will continue to be the dominant visibility impairing pollutant in the VISTAS Class I areas, the results still appear to underpredict the nitrate contribution relative to current visibility monitoring information. Again, the NPS recommends that Kentucky rely on the weight-of-evidence and consider the monitoring information in addition to modeling results.

Finally, as noted above, the magnitude of NO_x emissions from Kentucky stationary sources is significant (based on both current and 2028 inventories) and is within the state's purview to control. Reducing NO_x emissions would have additional regional co-benefits for ozone and nitrogen deposition. Kentucky is one of the states identified under the EPA's recent good neighbor proposal, which may require the state to address ozone precursor emissions, including NO_x. Great Smoky Mountains National Park is currently part of two limited maintenance plans for ozone and has 12 acidified streams on the Clean Water Act 303(d) list for pH-impaired surface waters from excessive atmospheric nitrogen and sulfur deposition. A total maximum daily load of nitrogen and sulfur deposition was established to restore these streams which will require additional nitrogen and sulfur reductions to reach these protective critical loads. Shenandoah National Park also has acidified streams on the Clean Water Act 303(d) list for pH-impaired surface waters.

Given the current monitoring information, the NPS recommends that Kentucky consider NO_x emission reduction opportunities in this round of RH SIP development, as discussed in the facility-specific comments below.

2.4 Source Selection

The NPS ARD provided extensive comments on the VISTAS approach to source selection in our May 17, 2021 communication with the VISTAS's states. Please refer to those comments for a detailed discussion of NPS concerns related the VISTAS source selection methods. In summary, the individual facility percent-of-total-impact thresholds used by VISTAS states to screen sources in the source selection process were arbitrarily high and inherently less protective of the more-impacted Class I areas within the region, including Mammoth Cave National Park, Great Smoky Mountains National Park, and Shenandoah National Park. For example, the value of the VISTAS percent-based threshold to identify a source affecting Mammoth Cave National Park is 74 times higher than was needed to identify a source affecting Everglades National Park in Florida (the least-impacted area).

The source selection process resulted in the selection of two Kentucky sources, the D.B. Wilson Plant and the Tennessee Valley Authority (TVA) Shawnee Plant—neither of these sources underwent a four-factor analysis. The relatively small number of sources selected for four-factor analysis by VISTAS states represents a small fraction of the visibility-impairing emissions in the region. The two sources selected by Kentucky comprise approximately 26% of the total statewide point source SO_2 + NO_x emissions.

EPA has provided guidance for states to consider when determining what represents a reasonable number of sources. In their 2016 draft Regional Haze SIP development guidance, EPA initially proposed that capturing 80% of a state's contribution to visibility impairment[8] would constitute a "reasonable" number of sources for analysis. This this recommendation is not in the final 2019 guidance, however, Section 2.1 of the EPA 2021 Clarification Memo states:

> *What is reasonable will depend on the specific circumstances. We generally think that a threshold that captures* ***only a small portion*** *of a state's contribution to visibility impairment in Class I areas is more likely to be unreasonable. [Emphasis added.]*

Based on the VISTAS PSAT results, D.B. Wilson and TVA Shawnee account for **30%** of Kentucky's projected 2028 EGU plus non-EGU contribution to light extinction (Mm^{-1}) in Mammoth Cave National Park and **29%** of the Kentucky's projected 2028 EGU plus non-EGU contribution to light extinction (Mm^{-1}) across all three parks (Mammoth Cave, Great Smoky Mountains, and Shenandoah).[9] Again, Kentucky is ranked the #1 state in the VISTAS region contributing to haze in Mammoth Cave, Great Smoky Mountains, and Shenandoah National Parks based on the cumulative PSAT modeling contributions from VISTAS state EGU plus non-EGU sources. Kentucky sources comprise 40% of the total VISTAS region states contributions to haze in these three parks (Note: For this purpose, the NPS provides PSAT results as percentages rather than absolute value results because the model is more appropriately used in a relative rather than absolute sense to address model performance and uncertainties.)

In terms of emissions[10], D.B. Wilson and TVA Shawnee account for 38% of Kentucky's point source SO_2 emissions and 14% of Kentucky's point source NO_x emissions reported in the 2017 NEI. Relative to other states, Kentucky is in the top 20% of the highest SO_2 and NO_x emitting states in the country (ranked 11th) with 146,474 tons/year of NO_x + SO_2 emissions statewide. For comparison, the state of Idaho selected nine sources but is ranked among the states with the lowest SO_2 plus NO_x emissions. Idaho is ranked 45th with 10,579 tons/year of NO_x + SO_2 emissions.

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[8] This could be based on modeling results or surrogate for visibility impacts such as emissions over distance or an area of influence analysis, which is less resource intensive.

[9] Results are presented in terms of light extinction in inverse megameters (Mm-1). Data pulled from the information provided in the excel spreadsheet "VISTAS PSAT Source Apport Results April 2020.xlsm," available at: https://www.metro4-sesarm.org/content/task-7-source-apportionment-modelingtagging.

[10] The 2019 Regional Haze Guidance Document states: "*It may be helpful, however, for states* ***to provide an assessment of the portion of sources and/or emissions*** *selected in order to demonstrate that the source selection process employed has achieved a reasonable result*."

Kentucky's statewide emission burden is roughly *fourteen times* greater than Idaho's and the state selected less than one quarter of the number of sources for reasonable progress four-factor analysis. In terms of the Q/d values calculated by the NPS, Kentucky's cumulative Q/d contribution to NPS Class I areas is over *eight times* greater than Idaho's cumulative Q/d contribution.

When identifying source selection methods, the NPS agrees that an AOI approach is more sophisticated than a simple Q/d. As a result, we revised our original recommendations using the VISTAS AoI results and our proposed source screening thresholds. To address our concerns regarding source selection thresholds, the NPS re-sorted and ranked the VISTAS AoI results to develop source lists that capture 80% of the AOI impact[11] for each Class I area in the VISTAS region. This produced a list of all the facilities that contribute up to 80% of the AOI impact in each of the VISTAS Class I areas[12] and identified 16 Kentucky facilities that affect visibility in any VISTAS Class I area (see the AOI_&_Qd_lists.xlsx file; "KY-Source_All_C1A_AoI_impact" tab). There are 13 Kentucky sources on the 80% of the AOI impact list for NPS Class I areas in the VISTAS region.

The NPS then reviewed and revised this list considering information provided in the SIP and our original Q/d list to develop a final list of 15 sources recommended for analysis (Table 1). This list includes two large sources that were captured using our original Q/d method, but not the initial AoI rankings, Kosmos Cement and Carmeuse Lime Pendleton Co. For these two facilities, we note that the VISTAS 2028 inventory relied on to complete the AoI analyses assumes a 996 tons/year decrease in Q (SO_2+NO_x) emissions for the Kosmos Cement facility and a 1,227 tons/year decrease in Q (SO_2+NO_x) emissions for the Carmeuse Lime Pendleton County facility versus emission levels reported in the 2017 NEI. The NPS Class I area-specific EWRT*Q/d values for these two facilities were updated in the AoI spreadsheets using the emissions reported in the 2017 NEI. After reranking with the new facility and Class I area-specific EWRT*Q/d, the Kosmos facility is on Mammoth Cave National Park's 80% of the AoI impact list and Carmeuse Lime Pendleton Co. is on Great Smoky Mountain National Park's list. These are both large NO_x emission sources (among the largest industrial sources of NO_x in Kentucky) and there may be cost-effective NO_x control options for these source categories. (Note: Kosmos cement may already be effectively-controlled, see facility-specific comments below.)

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[11] The NPS defined AoI impact by first calculating the impact for each individual facility extinction-weighted residence time (EWRT) for sulfate times the SO_2 emissions over distance (Q/d) *plus* the EWRT for Nitrate times the Q/d NOx (EWRT SO_4* Q/d SO_2 + EWRT NO_3 * Q/d NO_x) for each VISTAS class I area. These values were then ranked by greatest AoI impact to least, and the list of sources comprising 80% of the AoI impact for each Class I area was culled. Lists were then compiled for a final list of 238 sources in the VISTAS states that fall on one or more VISTAS Class I area 80% list. Cumulative AoI impacts across all Class I areas for each individual facility were also calculated. Please see our May 2021 comments to the VISTAS states for additional details regarding NPS recommendations for source selection.

[12] There are 348 sources in total on the 80% lists *for all VISTAS Class I areas*, 238 of these include sources located in *VISTAS region states* (110 sources are located in states outside of the VISTAS region). There are 175 sources on the 80% of the AoI impact lists for the four VISTAS region NPS Class I areas—Mammoth Cave, Great Smoky Mountains, Shenandoah and Everglades National Parks—100 of these include sources located in *VISTAS region states* (75 sources are located in states outside of the VISTAS region).

The number of Kentucky sources on the NPS-recommended list (15) is in line with the number of sources selected for evaluation by other states in this round of Regional Haze planning. For instance, Minnesota selected 17, New Mexico selected 23, Oregon selected 12, and Texas selected 18 sources for evaluation in this round of regional haze planning.

Table 1. Final revised NPS list of Kentucky facilities recommended for four-factor analysis or consideration in the SIP, October 2022

	Facility Name	Cumulative AoI Impact Rank for NPS Class I Areas	No. NPS Class I Areas on 80% List	Impacted NPS Class I Areas (on 80% AoI List)	No. VISTAS Class I Areas Impacted (on 80% AoI List)
1	Big Rivers Electric Corp - Wilson Station	1	3	MACA, GRSM, SHEN	10
2	TVA Shawnee Fossil Plant	3	3	MACA, GRSM, EVER	13
3	Louisville Gas & Electric Co., Mill Creek Station	4	2	MACA, GRSM	9
4	Century Aluminum Sebree LLC	5	2	MACA, GRSM	7
5	KY Utilities Co - Ghent Station	6	3	MACA, GRSM, SHEN	10
6	East KY Power Coop - Spurlock Station	7	3	MACA, GRSM, SHEN	9
7	Louisville Gas & Electric Co - Trimble Co Generating Station	8	2	MACA, GRSM	8
8	Duke Energy KY East Bend	13	1	GRSM	4
10	Domtar Paper Co LLC - Hawesville Operations	11	1	MACA	1
11	*Carmeuse Lime Inc	14	1	GRSM	**NA**
12	Century Aluminum of KY LLC	2	2	MACA, GRSM	8
13	KY Utilities Co - Brown Station	9	1	GRSM	3
9	*Kosmos Cement Company	10	1	MACA	**NA**
14	Isp Chemicals Inc.	12	1	GRSM	3
15	East KY Power Coop - Cooper Station	15	1	GRSM	2

= NPS has specific control recommendations based on CAMD or PSD permit data.
= NPS requests 4FA (not enough info to provide detailed cost analyses/recommendations)
= NPS may request 4FA —seeking additional information on operating status/current emissions.
= Identified by Kentucky in their source selection process

Abbreviations: MACA, Mammoth Cave National Park; GRSM, Great Smoky Mountains National Park; SHEN, Shenandoah National Park; EVER, Everglades National Park; 4FA, four-factor analysis. *Two sources are included based on updated emissions and associated revised AoI rankings.

2.5 Requirement to Address In-state Contributions to Haze

Section 7.4 of the draft SIP, Relative Contributions to Visibility Impairment: Pollutants, Source Categories, and Geographic Areas, presents the modeling source apportionment results. This section concludes that *"emissions from other regional planning organizations (MANE-VU, LADCO, and CENRAP) generally have higher contributions to 2028 visibility impairment at mandatory federal Class I areas in VISTAS than the emissions from the home state."*

The NPS does not agree with this rationale for limiting source selection. Reasonable progress provisions direct each state to consider a reasonable subset of sources within its own boundaries and evaluate those sources in the context of the four statutory factors. Declining to select sources because there are larger contributions from out-of-state regions unnecessarily limits achievable progress. The cumulative benefit of multiple emission reductions will be needed to continue progress toward unimpaired visibility in Class I areas. EPA underscores the importance of focusing on in-state opportunities to reduce emissions in section 2.1 of the July 2021 Clarification Memo:

> *In applying a source selection methodology, states should focus on the in-state contribution to visibility impairment and not decline to select sources based on the fact that there are larger out-of-state contributors. What is reasonable will depend on the specific circumstances. We generally think that a threshold that captures only a small portion of a state's contribution to visibility impairment in Class I areas is more likely to be unreasonable. Similarly, a threshold that excludes a state's largest visibility impairing sources from selection is more likely to be unreasonable.*

Further, the Kentucky SIP conclusion referenced above compares the impact from a single state to the impact of regional planning organization (RPO) groupings of 6–12 states. The impact of combined emissions from an RPO may often exceed that of a single state. This does not diminish each states responsibility to address in-state emissions in the SIP. Furthermore, based on the VISTAS PSAT results, Kentucky's EGU + non-EGU impact in Mammoth Cave, Great Smoky Mountains and Shenandoah NPs is the most significant within the VISTAS region and is on par with the impact from the entire MANE-VU region (4.03 versus 4.07 Mm-1), which includes significant Pennsylvania point sources. This highlights that the 2028 emissions from Kentucky point sources will continue to be significant.

2.6 Decision-Making Criteria for Reasonable Progress Determinations

The NPS recommends that Kentucky conduct four-factor analyses in the draft SIP and establish cost thresholds to aid in documenting the rationale behind final determinations. The cost of control is likely the most important factor for many states when making reasonable progress determinations. The NPS recommends that states identify the criteria used when evaluating controls, including those for costs, as required under the regional haze (RH) regulations.[13] The rule requires the state to document *why* each of the four-factors, including the costs of controls, would or would not be considered reasonable for the source in question. In their 2019 regional haze guidance, EPA recommends that a useful metric in making such determinations is the estimated cost per ton of pollutant reduced.[14] EPA further elaborates in the 2019 Guidance that:

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[13] 40 CFR § 51.308 (f)(2)(i): The State *must include* in its implementation plan a description of *the criteria it used* to determine which sources or groups of sources it evaluated and *how* the four factors were taken into consideration in selecting the measures for inclusion in its long-term strategy. [Emphasis added]

[14] 2019 EPA Guidance on Regional Haze State Implementation Plans for the Second Implementation Period, Part II, Step 5—Decisions on what control measures are necessary to make reasonable progress.

> *When the cost/ton of a possible measure is within the range of the cost/ton values that have been incurred multiple times by sources of similar type to meet regional haze requirements or any other CAA requirement, this weighs in favor of concluding that the cost of compliance is not an obstacle to the measure being considered necessary to make reasonable progress. . . .Where the cost/ton of a possible measure exceeds the historical range of cost/ton values, we recommend that the state not automatically conclude that the cost of compliance by itself makes the measure not necessary to make reasonable progress.*

Many states have identified a cost-effectiveness threshold in their proposals in this round of regional haze planning. Some of the controls evaluated and recommended by the NPS for Kentucky sources are well within these cost-effectiveness ranges. For example, other states have proposed the following cost/ton thresholds:

- A range from $4,000 to $6,500/ton in Arizona
- $5,000/ton in Arkansas (EGUs) and Texas
- $6,100/ton in Idaho
- $10,000/ton in Colorado, Nevada, and Oregon

The NPS recommends that Kentucky complete four-factor analyses, establish a cost threshold to support the reasonable progress determinations and require all technically-feasible, cost-effective controls identified through four-factor analyses in this planning period.

3 Facility-Specific Recommendations for Kentucky

3.1 Overarching Themes for NPS Facility-Specific Feedback

3.1.1 Identifying "Effectively Controlled" EGUs

EPA guidance addressed the analytical expectations for "effectively controlled" determinations in the July 2021 EPA Clarification Memorandum. Section 2.3 of the clarification memo states:

> *The underlying rationale for the "effective controls" flexibility is that if a source's emissions are already well controlled, it is unlikely that further cost-effective reductions are available.* ***A state relying on an "effective control" to avoid performing a four-factor analysis for a source should demonstrate why, for that source specifically, a four-factor analysis would not result in new controls and would, therefore, be a futile exercise.*** *States should first assess whether the source in question already operates an "effective control" as described in the August 2019 Guidance.* ***They should further consider information specific to the source, including recent actual and projected emission rates, to determine if the source could reasonably attain a lower rate****.* ***It may be difficult for a state to demonstrate that a four-factor analysis is futile for a source just because it has an "effective control" if it has recently operated at a significantly lower emission rate****. In that case, a four-factor analysis may identify a lower emission rate (e.g., associated with more efficient use of the "effective existing controls") that may be reasonable and thus necessary for reasonable progress. If a source can achieve, or is achieving, a lower emission rate using its existing measures than the rate assumed for the "effective control," a state should further analyze the lower emission rate(s) as a potential control option. [Emphasis added.]*

Section 3.2 of the clarification memo:

> *"Similarly, in some cases, states may be able to achieve greater control efficiencies, and, therefore, lower emission rates, using their existing measures. Considering efficiency improvements for an existing control (e.g., using additional reagent to increase the efficiency of an existing scrubber) as a potential measure is generally reasonable since in many cases such improvements may only involve additional operation and maintenance costs.* ***States should generally include efficiency improvements for sources' existing measures as control options in their four-factor analyses in addition to other types of emission reduction measures****." [Emphasis added.]*

Based on this guidance, the NPS used Clean Air Markets Division (CAMD) EGU data to evaluate emission rate trends for individual EGUs. Emission rates reported in the NPS analyses represent annual average unit-specific emissions (in pounds) per annual heat input (MMBtu). In many cases, the Kentucky EGUs have previously operated at lower emission rates than are currently being achieved and show an upward trend in emission rates or control deterioration over time. In these cases, the NPS recommends that Kentucky evaluate optimization of existing control equipment and implement requisite permit limits to ensure that control equipment is maintained.

In cases where it was necessary to estimate the control efficiency of existing equipment, the NPS analyses relied on fuels data provided by the Energy Information Administration (EIA) and AP-42 emission factors to estimate uncontrolled SO_2 emissions. The EIA fuels data (EIA form EIA-923[15]) provides detailed, facility-specific monthly fuels data, including fuel sulfur content.

As discussed during the Kentucky/NPS October 2022 consultation call and presentation, the NPS has reviewed several examples of cost analyses for scrubber upgrades in this round of haze planning. In many cases these improvements are very cost-effective.

3.1.2 Benchmark Emission Rates for Identifying Effective NO_x Controls

On April 6, 2022, EPA proposed to update its "good neighbor" policy to reduce NO_x emissions across 26 states, including Kentucky. In that proposal[16], EPA stated that:

> *Therefore, consistent with the Revised CSAPR Update, where EPA identified 0.08 lb/mmBtu as a reasonable level of performance for units with optimized SCR, the EPA proposes a rate of 0.08 lb/mmBtu as the optimized rate for this rule. The EPA notes that half of the SCR-controlled EGUs achieved a NO_x emissions rate of 0.064 lbs/MMBtu or less over their third-best entire ozone season. Moreover, for the SCR-controlled coal units that the EPA identified as having a 2021 emissions rate greater than 0.08 lb/mmBtu, the EPA verified that in prior years, the majority (more than 90 percent) of these same units had demonstrated and achieved a NO_x emissions rate of 0.08 lb/mmBtu or less on a seasonal or monthly basis. This further supports EPA's determination that 0.08 lb/mmBtu reflects a reasonable emissions rate for representing SCR optimization at coal steam units…*

Therefore, in addition to historic operating levels, the NPS also used the 0.08 lb/MMBtu as a benchmark for SCR Optimization on coal-fired units.

3.1.3 EPA Guidance on Anticipated Shutdowns

Section 4.3 of EPA's Clarification Memo provides guidance on how "On-the-Way" Measures and Shutdowns should be addressed. This section states:

> *Therefore, on-the-way measures, including anticipated shutdowns that are relied on to forgo a four-factor analysis or to shorten the remaining useful life of a source, are necessary to make reasonable progress and must be included in a SIP.*

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[15] Available at: https://www.eia.gov/electricity/data/eia923/

[16] Federal Implementation Plan Addressing Regional Ozone Transport for the 2015 Ozone National Ambient Air Quality Standard, 87 Fed. Reg. 20036 (April 6, 2022).

In cases where a shutdown or emission reduction is not federally enforceable, the NPS recommends completing a four-factor analysis.

3.1.4 NPS Requests for Source Analyses

The NPS provided Kentucky with lists of sources recommended for analysis in May of 2019 and again in May of 2021. Each of the sources addressed in detail in these consultation comments were on one or both of those lists.[17] The final revised AoI list (as described in section 2.4) includes 15 sources recommended for consideration. The EPA addressed expectations for consultation and response in Section 2.1 of their 2021 Clarification Memo, which states:

> *Finally, given the interstate nature of regional haze, other states that also contribute at a given Class I area and FLMs play important roles in addressing visibility impairment. Pursuant to the RHR, states must, therefore, consider selecting sources identified by other states or by FLMs.* ***A state receiving a request to select a particular source(s) should either perform a four-factor analysis on the source(s) or provide a well-reasoned explanation as to why it is choosing not to do so****.* [Emphasis added.]

Many of the sources on the NPS lists were not addressed or discussed in the SIP. The NPS recommends that the draft SIP be updated to address NPS input.

3.2 Big Rivers Electric Corporation (BREC) D.B. Wilson Station

3.2.1 Summary of NPS Recommendations for BREC D.B. Wilson Station:

SO_2 Recommendations

- The NPS agrees that the existing SO_2 scrubber system should be replaced.
- A new FGD system should be capable of achieving up to 99% SO_2 control efficiency rather than the proposed 97%.
- The NPS evaluated the incremental cost of going from 97% to 99% control efficiency and found that it would result in an incremental cost-effectiveness of $248/ton and remove an additional 1,138 tons/year SO_2.
- The NPS recommends that Kentucky require increased scrubber efficiency as part of the Regional Haze SIP.

[17] The 2019 NPS recommendations were based on a Q/d analysis. The 2021 NPS recommendations were based on the NPS revised AoI analyses. Our final list of recommendations includes 15 sources. Ten of these sources were on both the 2019 Q/d and 2021 AoI lists. Three of these sources were on just the 2021 revised AoI list. Two sources on our final list, Kosmos Cement and Carmuese Lime Pendleton, County, were on the 2019 Q/d list, but not the 2021 Aol list. As noted in these comments, the 2028 emissions for these two facilities were revised in the AoI analyses using recent emissions reported in the 2017 NEI. The AoI results were then re-sorted and ranked with the revised emissions for Mammoth Cave, Great Smoky Mountains and Shenandoah NPs. These two sources ended up on the revised AoI analyses.

NO_x Recommendations

- Unit 1 has operated at much lower NO_x rates in the past (below 0.08 lb/MMBtu) and NO_x emission rates have been steadily increasing above 0.08 lb/MMBtu since 2017.
- The NPS recommends that Kentucky require DB Wilson Station to achieve a NO_x emission rate equivalent to the 0.07 lb/MMBtu rate previously achieved (2012–2016).

3.2.2 BREC D.B. Wilson Station Facility Background:

D.B. Wilson Station (Wilson) is a fossil fuel-fired electric power generating facility located near Centertown, Kentucky. Wilson is owned and operated by Big Rivers Electric Corporation (BREC) and consists of one (1) pulverized coal-fired boiler. The boiler, Unit 1 (W1), was constructed in 1984 and has an input capacity of 4,585 MMBtu/hr with a rated capacity of 509 MW. The unit is wall-fired, equipped with an electrostatic precipitator (ESP), wet flue gas desulfurization (WFGD), selective catalytic reduction (SCR), hydrated lime injection, and low nitrogen oxide burners. D.B. Wilson is one of the two facilities selected by Kentucky for four-factor analysis.

D.B. Wilson is ranked number one among the Kentucky facilities for haze contributions in NPS Class I areas in the VISTAS region based on the AOI source screening results. Based on the PSAT source apportionment results, it is the number one Kentucky facility contributing to light extinction in Mammoth Cave NP and ranked number three overall for Mammoth Cave. Using the NPS recommended screening threshold to capture 80% of the total Class I area AOI impact, this source:

- Is on the 80% of total AOI impact list for **10 VISTAS Class I areas**, including Mammoth Cave, Great Smoky Mountains and Shenandoah National Parks.
- Is ranked number 10 out of 238 VISTAS state sources that fall on any VISTAS region Class I area's 80% of total AOI impact list when ranking based on the cumulative AOI impact.

Of 1,382 power plants in EPA's Clean Air Markets Database (CAMD) in 2021, Wilson Station ranked #37 for SO_2 emissions (7,157 tons) and #131 for NO_x emissions (1,762 tons).

In their 2020 Integrated Resource Plan, BREC determined that the continued operation of the D.B. Wilson coal unit represents the "least cost option" for the company. However, BREC notes that the current FGD system is "unable to meet the facility's SO_2 allocation under the Cross State Air Pollution Rule, and therefore, continued operation will require a FGD upgrade." The BREC proposal to upgrade the Wilson FGD system involves "recycling the Coleman Station FGD/absorber system."

3.2.3 BREC D.B. Wilson Station SIP Conclusions:

Kentucky did not complete a four-factor analysis for D.B Wilson and concluded the following:

> *BREC is in the process of installing an advanced wet flue gas desulfurization (WFGD) control device on Wilson Station Unit 1 that will increase the SO_2*

> *emissions removal efficiency to 97%. The WFGD will be operational by June 2022. Considering existing installed controls, and BREC's recent investment in the WFGD, Unit 1 is effectively controlled and a four-factor analysis is not necessary for the Wilson facility.*

Kentucky did not evaluate or consider whether the new scrubber system could achieve greater than 97% control.

3.2.4 NPS Review of BREC D.B. Wilson Station:

SO_2 Review

The NPS agrees that the existing scrubber system should be replaced and recommends evaluating higher control efficiencies. The revised SO_2 and Acid Gas Controls Chapter of the CCM notes that *"[n]ew wet FGD systems can achieve SO2 removal of 99% and HCl removal of over 95%."*

To verify that the emission rates associated with the potential control efficiencies are within the range of rates demonstrated in practice, the NPS compared the anticipated emission rates to values for similar coal-fired units in CAMD. Uncontrolled emissions were calculated using EIA fuels data and AP-42 emission factors for uncontrolled SO_2 emissions from bituminous coal-fired PC dry bottom wall-fired units. Based on this information, the NPS estimates that the existing scrubber system is only achieving 90% control.[18] The NPS anticipates that a new wet scrubbing system on the D.B. Wilson facility would achieve the following SO_2 emission rates at 97%, 98% and 99% control efficiency:

- 97% Control: 0.114 lb/MMBtu (proposed emission rate)
- 98% Control: 0.076 lb/MMBtu
- 99% Control: 0.038 lb/MMBtu (NPS recommended emission rate)

When ranking all coal-fired units in the2021 CAMD database from the tightest controlled to the least controlled on a lb/MMBtu basis, achieving 0.038 lb/mmBtu (99% SO_2 control efficiency) would rank D.B. Wilson #63. This is well within the range of achievable emission rates demonstrated in practice. The proposed 97% level of control (0.114 lb/mmBtu) would rank the EGU as 219[th] out 460 total coal-fired units and does not represent a high-performing level of control, particularly for a new control system. (See attached spreadsheet CAMD_2021_coal_units_top_performers.xlsx.)

Finally, to demonstrate the cost-effectiveness of this option, the NPS used the most recent CCM workbook for wet FGDs to estimate the costs of the new scrubbing system at 97%, 98% and 99% control efficiencies. This analysis demonstrates that for a negligible increase in annual operating

[18] To estimate uncontrolled emissions, the NPS used five years (2017-2021) of EIA reported fuel sales data for the D.B. Wilson facility and the AP-42 emission factor (38S) for a PC, dry bottom, wall-fired, bituminous coal unit (38S). This calculated control efficiency is corroborated by control rates reported in BREC's IRP.

costs (direct annual costs), an additional 1,138 tons/year of SO_2 could be removed (at an incremental cost-effectiveness of $248/ton).

Table 2. NPS estimate of the new scrubbing system costs at 97%, 98% and 99% control efficiencies for DB Wilson Unit 1

Cost Estimation Method	Updated CCM for Wet Scrubbers for D.B. Wilson Boiler W1		
Control Efficiency	97%	98%	99%
Unit Size (Gross MW)	509	509	509
Inlet SO_2 Emissions	3.79	3.79	3.79
Outlet SO_2 Emissions	0.114	0.076	0.038
Retrofit Factor	1	1	1
CEPCI for 2021	708	708	708
Annual Interest Rate (i) (%)	5.5	5.5	5.5
Equipment Life (years)	30	30	30
Total Capital Investment	$345,561,698	$345,561,698	$345,561,698
Capital Recovery Cost	$23,774,645	$23,774,645	$23,774,645
Indirect Annual Cost	$23,881,774	$23,881,774	$23,881,774
Direct Annual Cost	$18,457,070	$18,597,518	$18,739,094
Total Annual Cost	$42,338,844	$42,479,292	$42,620,868
Uncontrolled SO_2	56,885	56,885	56,885
SO_2 Removed	55,178	55,747	56,316
Direct Cost-Effectiveness	$767	$762	$757
Incremental Total Annual Cost	-	$140,448	$282,023
Incremental SO_2 Removed	-	569	1,138
Incremental Cost-Effectiveness	-	$247	$248

Improving the control efficiency requirement of the new scrubber system is very cost effective. The NPS recommends that Kentucky require a 99% control efficiency for the D.B. Wilson wet FGD in the RH SIP, along with a requisite emission rate limit, ensuring that performance of the new scrubbing system is in line with other systems currently in operation.

NO_x Review

Based on CAMD data, the SCR unit on the D.B. Wilson boiler has been achieving a 0.086 lb/MMBtu NO_x emission rate (most recent 5-year average). However, the unit has operated at much lower NO_x rates in the past (below 0.08 lb/MMBtu). NO_x emissions rates have been steadily increasing above 0.08 lb/MMBtu since 2016 (see Figure 1).

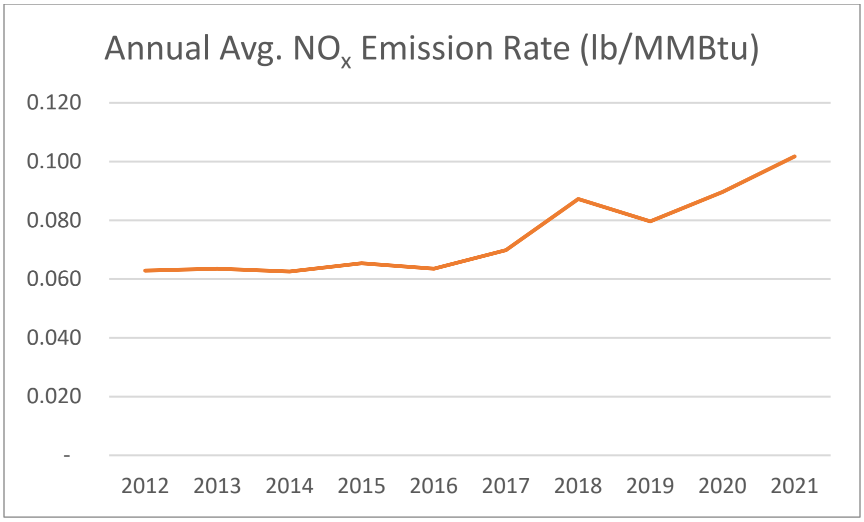

Figure 1: Ten-year trends in NO_x emission rates (lb/MMBtu, annual average) for the D.B. Wilson unit.

The NPS recommends that the Kentucky address SCR optimization under the SIP to ensure the D.B. Wilson unit consistently achieves emission rates achieved between 2012 and 2016. (Requisite limits should be incorporated into the permit to ensure the SCR system achieves optimal NO_x emission rates.) This recommendation is consistent with the EPA clarification memo which states, it *"may be difficult for a state to demonstrate that a four-factor analysis is futile for a source just because it has an "effective control" if it has recently operated at a significantly lower emission rate."* Finally, the NPS notes that upgrades may be necessary under the benchmark NO_x emission limits proposed in the "Good Neighbor" rule.

3.3 Tennessee Valley Authority (TVA) - Shawnee Fossil Plant

3.3.1 Summary of NPS Recommendations for TVA Shawnee Fossil Plant:

SO_2 Recommendations

- Units 2–3 and 5–9
  - The NPS recommends evaluating and requiring Dry Sorbent Injection (DSI) with trona.
  - DSI is very cost-effective and could reduce SO_2 emissions by 79%–85% (over 10,000 tons/year).
- Units 1 & 4
  - The NPS recommends evaluating and requiring cost-effective scrubber upgrades.
  - The existing dry lime scrubbers do not appear to be effectively controlling SO_2 with 29% control efficiency on Unit 1 and 28% control efficiency on Unit 2.
  - Dry scrubbers are typically capable of reducing SO_2 by at least 95%.
  - Upgrading or optimizing the scrubbers on these units to 95% control efficiency could result about 3,000 tons of additional SO_2 emission reductions per year.

NO_x Recommendations

- Units 2–3 and 5–9
  - The NPS recommends evaluating and requiring Selective Catalytic Reduction (SCR).
  - SCR is a cost-effective way to reduce NO_x emissions by over 80% from these units (over 5,000 tons/year) and is within the range of cost-effectiveness thresholds selected by other states.
  - Selective Non-Catalytic Reduction (SNCR) is also very cost-effective but results in far fewer NO_x reductions relative to SCR (approx. 1,300 tons/year) and would meet NO_x limits under EPA's "good neighbor" proposal.
- Units 1 & 4
  - The NPS recommends evaluating and requiring optimization of the existing SCR systems.
  - The existing SCR systems do not appear to be effectively controlling for NO_x with approximately 45% control efficiency on both units 1 and 4.
  - SCR units are typically capable of reducing SO_2 by at least 80-90%.
  - The NPS recommends that TVA improve the effectiveness of these controls to match levels achieved by typical modern controls.
  - Optimizing the SCRs on these units to 80% control efficiency could result in about 800 tons of additional NO_x emission reductions per year.

3.3.2 Facility Background – TVA Shawnee Fossil Plant:

The Shawnee Fossil Plant (Shawnee) is a coal-fired power station owned and operated by the Tennessee Valley Authority (TVA) and is located 245 km west of Mammoth Cave National Park. The nine identical 175 MW dry-bottom, wall-fired, sub-critical boilers are fired on subbituminous Powder River Basin (PRB) coals. In-service dates for the boilers range from 1953 to1955. All Shawnee units are equipped with Low-NO_x Burners (LNB) with Separated Overfire Air (SOFA) for NO_x control and baghouse fabric filters to control particulate. Shawnee units 1 & 4 are the only units with post combustion controls and are equipped with dry lime scrubbers for SO_2 control and Selective Catalytic Reduction (SCR) for NO_x control. The other seven Shawnee EGUs lack post-combustion SO_2 and NO_x controls.

The Shawnee Fossil Plant is ranked #3 among the Kentucky facilities for haze contributions in NPS Class I areas in the VISTAS region based on AOI source screening results. It is ranked the #1 Kentucky facility impacting Mammoth Cave, Great Smoky Mountains, and Shenandoah National Parks based on the cumulative PSAT source apportionment results. Using the NPS-recommended screening threshold to capture 80% of the total Class I area AOI impact, this source:

- Is on the 80% of total AOI impact list for **13** VISTAS Class I areas.
- Ranks #19 of 238 VISTAS state sources for cumulative impacts to all VISTAS Class I areas.

Of 1,382 power plant facilities in EPA's Clean Air Markets Database (CAMD) in 2021, Shawnee ranked #13 for SO_2 emissions (14,696 tons) and #16 for NO_x emissions (6,986 tons). Plant-wide SO_2 emissions for the most recent five years are shown in Table 3 below. Shawnee's carbon dioxide emissions of 7,498,469 tons ranked the facility #51 among U.S. EGUs. Shawnee also ranked #115 for EGU mercury emissions with 32 lb in 2017. The Table 4 provides a breakdown of 2021 SO_2 and NO_x emissions for each individual unit and the unit-specific rankings versus the 4,175 *EGUs* in CAMD.

Table 3: Shawnee Plantwide Annual SO_2 Emissions (2017–2021)

Year	SO_2 Mass (short tons)	SO_2 Rate (lbs/mmBtu)	Heat Input (mmBtu)
2017	20,494	0.547	74,961,683
2018	15,149	0.398	76,218,017
2019	16,346	0.448	72,978,788
2020	9,024	0.402	44,866,117
2021	14,696	0.411	71,495,764

Table 4: TVA Shawnee Unit-specific 2021 SO_2 and NO_x Emissions and Rankings as Reported in CAMD.

Unit ID	SO_2 (tons)	SO_2 Rank	Avg. SO_2 Rate (lb/MMBtu)	Avg. SO_2 Rate (Rank)	NO_x (tons)	NO_x Rank	Avg. NO_x Rate (lb/MMBtu)	Avg. NO_x Rate (Rank)
1	1,439	169	0.329	131	704	318	0.163	340
2	1,367	175	0.334	129	667	331	0.165	331
3	1,099	224	0.339	124	538	366	0.167	323
4	1,139	217	0.326	132	557	355	0.161	341
5	1,489	164	0.334	128	734	304	0.166	328
6	1,841	143	0.509	54	876	275	0.240	152
7	1,970	134	0.511	53	901	270	0.233	177
8	2,152	121	0.506	58	997	235	0.234	173
9	2,200	116	0.505	59	1,014	229	0.232	179

3.3.3 SIP Conclusions – TVA Shawnee Fossil Plant:

Kentucky did not complete a four-factor analysis for TVA Shawnee and concluded the following:

> *TVA chose to forego performing a four-factor analysis for the Shawnee facility by taking emission limits that would be implemented in two phases: Phase 1 will begin on December 1, 2028. SO_2 emissions from Emission Units 1-9 will not exceed a source-wide limit of 0.7 lb./MMBtu based on a 24-hour rolling average at each stack; Phase 2 will begin on December 31, 2034. TVA will either ensure that SO_2 emissions from Shawnee do not exceed 8,208 tons per year based on a 12-month rolling average or cease firing coal in Emission Units 2-3 and 5-9.*

As noted in the SIP, the phased-in emission limits proposed by TVA for Shawnee lack board approval, a detailed schedule, and are not currently federally enforceable through the SIP.

3.3.4 NPS Review of TVA Shawnee Fossil Plant:

Phase 1 of TVA's proposed SO_2 emission reduction will not begin until the very end of the planning period (December 1, 2028) and will only result in a 41.7 % reduction in allowable SO_2 emissions. Phase 2 will be implemented seven years into the ***third planning period*** (December 31, 2034). If TVA elects to continue operating beyond 2035, Shawnee will still be permitted to emit up to 8,208 tons per year of SO_2.

Kentucky has not demonstrated why it is reasonable to take credit for emission reductions that are (1) anticipated to occur after the planning period ends, and (2) are not federally enforceable through the SIP or other regulatory mechanisms. [19] Furthermore, the SIP lacks discussion of how the four-factors were considered when making the reasonable progress determinations for the nine Shawnee units. For instance, the SIP does not contain discussion of whether Units 1 and 4 are "effectively controlled," nor does it address whether post-combustion controls would be reasonable for the remaining seven units (2–3 and 5–9) based on the four statutory factors. Finally, the Phased-in emissions reduction plan does not address NO_x emissions.

The NPS recommends that the SIP evaluate the addition of post-combustion SO_2 and NO_x controls for units 2–3 and 5–9 and consider upgrades/optimization of existing post-combustion SO_2 and NO_x control equipment on Units 1 and 4.

SO_2 Review

SHAWNEE UNITS 1 & 4

Following is a unit-specific description of SO_2 controls for Shawnee units 1 and 4, including charts showing emission rate trends.

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[19] This is addressed in Section 4.3 of EPA's Clarification Memo: "*Therefore, on-the-way measures, including anticipated shutdowns that **are relied on to forgo a four-factor analysis** or to shorten the remaining useful life of a source, are necessary to make reasonable progress **and must be included in a SIP**.*"

Shawnee Units 1 and 4 are equipped with a Dry Lime FGDs which began operating in November and October of 2017, respectively. Current control efficiencies were calculated using estimates of current uncontrolled emissions. Uncontrolled emissions were calculated based on EIA fuels data and AP-42 emission factors for uncontrolled SO_2 emissions from PRB coals and dry-bottom wall-fired units. Based on these estimates, the scrubbers on Units 1 and 4 have been achieving approximately 28%-29%[20] control efficiency over the past four years since the scrubbers were installed, which is very poor performance for relatively new scrubbers.

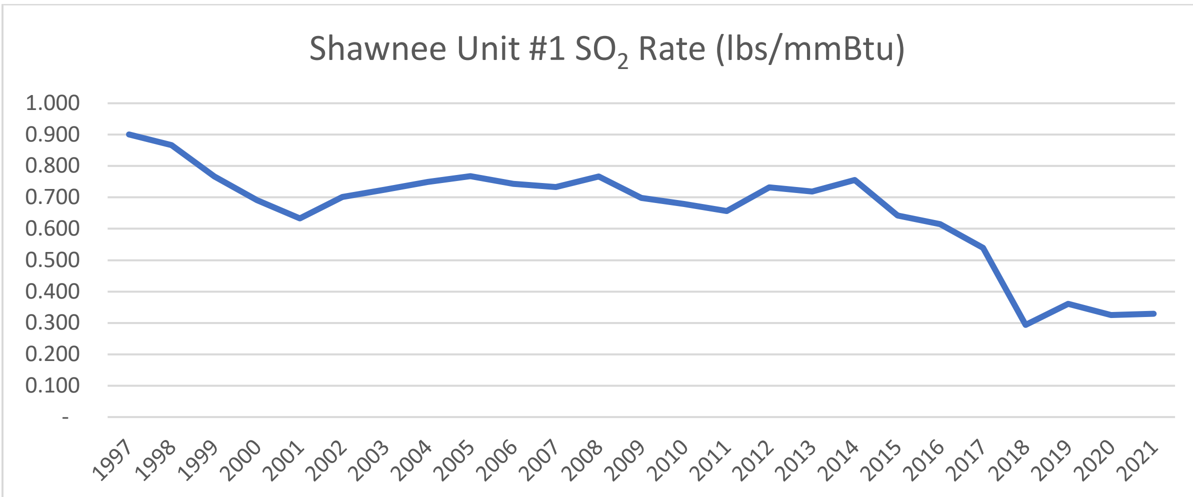

Figure 2: Shawnee Unit 1 SO_2 Emission Rate Trends (1997-2021)

[20] The NPS notes that calculating the control efficiency based on the 5-year period prior to scrubber installation (2012-2016) versus the four-year period post scrubber installation (2018-2021) would result in approximately 53% reduction. However, based on EIA fuels data, it appears that Shawnee also switched to firing mostly lower sulfur coals in this time frame (previously, the facility fired blends with higher sulfur coals). Due to this, it was determined that the EIA fuels data was more accurate for estimating uncontrolled emissions and thus the control efficiency of the existing dry scrubbers.

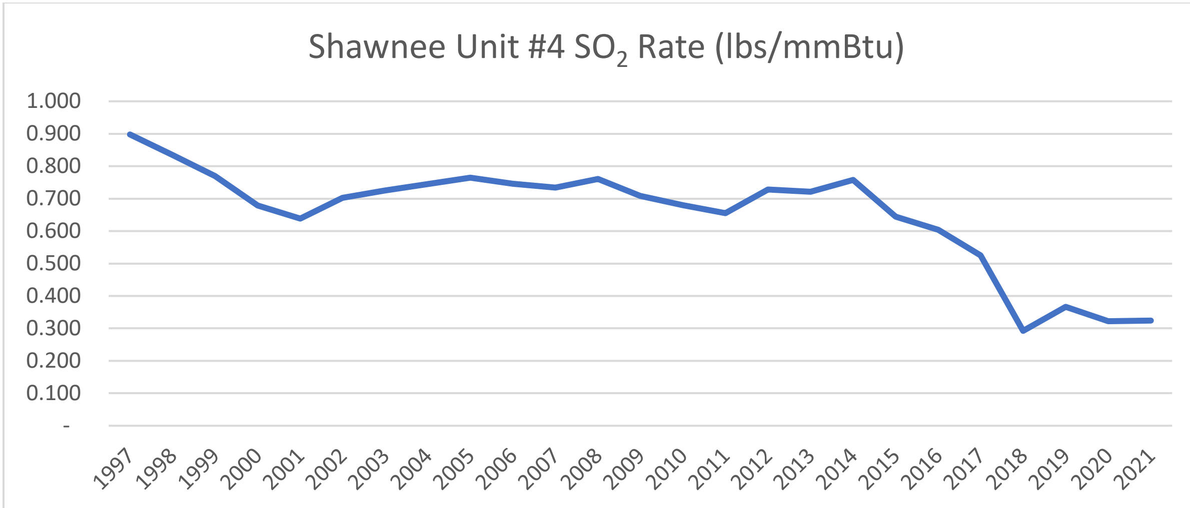

Figure 3: Shawnee Unit 4 SO_2 Emission Rate Trends (1997-2021)

The NPS anticipates that a dry scrubbing system achieving 95% control efficiency would result in a 0.0227 lb/MMBtu emission rate based on the current calculated uncontrolled rates. When ranking all coal-fired units in the 2021 CAMD database from the tightest controlled to the least controlled on a lb/MMBtu basis, achieving an emission rate in this range would rank these Shawnee units #46. This is well within the range of achievable emission rates demonstrated in practice. The NPS recommends that Kentucky require evaluation and implementation of scrubber upgrades for Shawnee units 1 and 4.

TVA Shawnee Units 2-3 & 5-9

The NPS conducted a cost analysis of adding controls to Shawnee units 2–3 and 5–9.

NPS analyses evaluated the addition of Dry Sorbent Injection (with trona) to these units by applying the cost methodology developed by Sargent & Lundy for EPA's Integrated planning Model (IPM). Even though DSI with trona and a baghouse can achieve up to 90% SO_2 control, based upon review of CAMD data, the NPS assumed that DSI would not reduce emissions below 0.08 lb/mmBtu. NPS model inputs and results are shown in the table below, calculation workbooks are attached.

Table 5: NPS Cost Calculation Results Summary for DSI on Shawnee Units 2-3 and 5-9

Cost Estimation Method	IPM DSI with Trona						
Shawnee EGU	Unit #2	Unit #3	Unit #5	Unit #6	Unit #7	Unit #8	Unit #9
Unit Size (Gross MW)	175	175	175	175	175	175	175
Inlet SO_2 Emissions	0.390	0.392	0.389	0.523	0.523	0.525	0.519
Outlet SO_2 Emissions	0.080	0.080	0.080	0.080	0.080	0.080	0.080
SO_2 Removal Efficiency (%)	80	80	79	85	85	85	85
Retrofit Factor	1	1	1	1	1	1	1
CEPCI for 2021	708	708	708	708	708	708	708
Annual Interest Rate (i) (%)	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Equipment Life (years)	30	30	30	30	30	30	30
Total Capital Investment	$15,272,452	$15,310,087	$15,261,565	$17,208,784	$17,206,419	$17,249,513	$17,154,668
Capital Recovery Cost	$1,050,827	$1,053,417	$1,050,078	$1,184,057	$1,183,894	$1,186,859	$1,180,334
Fixed O&M	$355,633	$355,876	$355,563	$368,127	$368,112	$368,390	$367,778
Variable O&M	$2,928,798	$3,031,644	$3,241,847	$3,992,831	$3,898,214	$4,109,865	$4,223,891
Total Annual Cost	$4,335,257	$4,440,936	$4,647,488	$5,545,015	$5,450,220	$5,665,114	$5,772,002
Uncontrolled SO_2	1,444	1,495	1,599	1,953	1,907	2,010	2,067
SO_2 Removed	1,148	1,190	1,270	1,654	1,615	1,704	1,748
Cost-Effectiveness	$3,775	$3,731	$3,660	$3,352	$3,375	$3,325	$3,302

Based upon a 30-year remaining useful life, over 10,000 tons/year of SO_2 could be reduced at an annual cost of about $36 million for an average cost-effectiveness of less than $3,500/ton. Because the Shawnee units are not subject to a federally enforceable shutdown, the NPS analyses reported above used a 30-year equipment life. ***However, DSI remains very cost-effective even if the remaining useful life is reduced to five or ten years.*** This cost-effectiveness value is lower than thresholds used by Arizona ($4,000-$6,500/ton), Idaho ($6,100/ton), and Colorado, Nevada and Oregon ($10,000/ton) in this round of regional haze planning.

NO_x Review

NO_X Controls for Shawnee Units 1 & 4

Following is a unit-specific description of NO_2 controls for Shawnee Units 1 and 4, including charts showing emission rate trends.

Shawnee Units 1 and 4 are equipped with LNB Technology (Dry Bottom only) and SCR. The SCRs began operating in November and October of 2017, respectively. Based on information provided in the CAMD database, the NPS estimates that the SCRs on these units have been achieving 45% control over the past four years which is poor performance for newer SCR units. The NPS recommends that Kentucky evaluate optimization of the SCR systems on Shawnee Units 1 and 4.

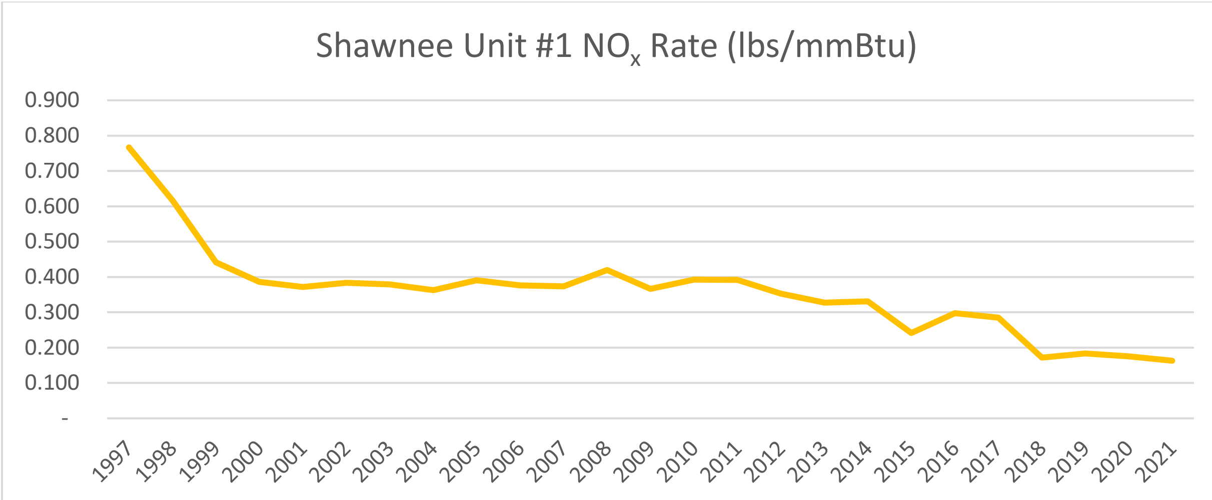

Figure 4: Shawnee Unit 1 NO_x Emission Rate Trends (1997-2021)

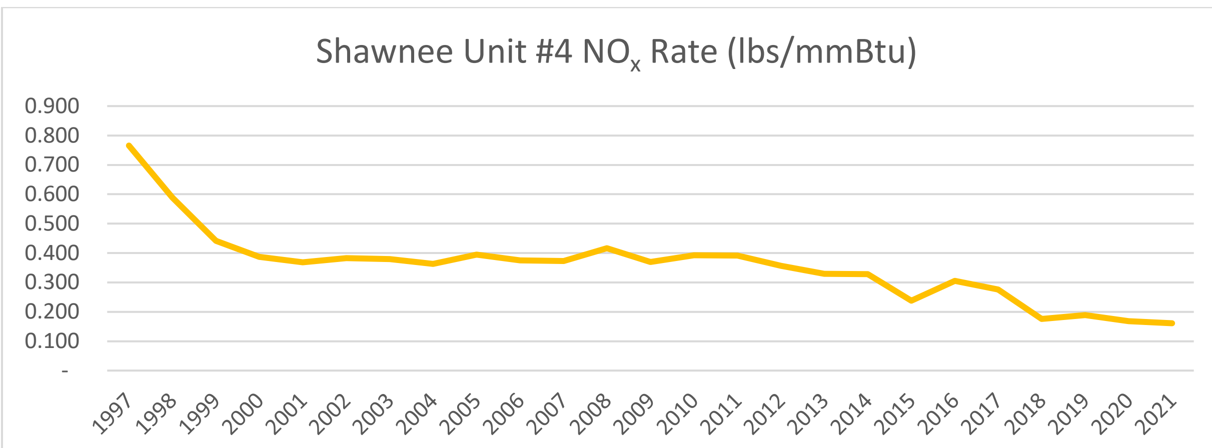

Figure 5: Shawnee Unit 4 NO_x Emission Rate Trends (1997-2021)

NO_X Controls for Shawnee Units 2-3 & 5-9

Similar to the SO_2 analyses, the NPS evaluated the addition of Selective Non-Catalytic Reduction (SNCR) and Selective Catalytic Reduction (SCR) for the Shawnee units lacking post-combustion controls. For the SNCR cost analyses, the NPS applied the cost methodology in EPA's Control Cost Manual (CCM). NPS CCM workbook inputs and results are shown in Table 6 below and calculation workbooks are attached.

Table 6: NPS Cost Calculation Results Summary for SNCR on Shawnee Units 2-3 and 5-9

Cost Estimation Method	**CCM for SNCR**						
Shawnee EGU	**Unit #2**	**Unit #3**	**Unit #5**	**Unit #6**	**Unit #7**	**Unit #8**	**Unit #9**
Unit Size (Gross MW)	175	175	175	175	175	175	175
Inlet NO_x Emissions	0.201	0.206	0.207	0.254	0.249	0.249	0.248
Outlet NO_x Emissions	0.159	0.163	0.163	0.198	0.195	0.195	0.194
NO_x Removal Efficiency (%)	21%	21%	21%	22%	22%	22%	22%
Retrofit Factor	1	1	1	1	1	1	1
CEPCI for 2021	708	708	708	708	708	708	708
Annual Interest Rate (i) (%)	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Equipment Life (years)	20	20	20	20	20	20	20
Total Capital Investment	$ 8,636,100	$ 8,655,324	$ 8,665,088	$ 8,780,584	$ 8,765,033	$ 8,767,493	$ 8,760,326
Capital Recovery Cost	$ 722,842	$ 724,451	$ 725,268	$ 734,935	$ 737,578	$ 733,839	$ 733,239
Indirect Annual Cost	$ 726,728	$ 728,346	$ 729,167	$ 738,886	$ 737,578	$ 737,785	$ 737,181
Direct Annual Cost	$ 292,687	$ 302,041	$ 316,583	$ 340,376	$ 331,523	$ 341,088	$ 348,579
Total Annual Cost	$ 1,019,415	$ 1,030,386	$ 1,045,750	$ 1,079,262	$ 1,069,100	$ 1,078,873	$ 1,085,760
Uncontrolled NO_x	742	783	849	949	910	953	988
NO_x Removed	154	164	177	209	199	208	216
Cost-Effectiveness	$ 6,612	$ 6,297	$ 5,892	$ 5,175	$ 5,372	$ 5,176	$ 5,033

Based upon a 20-year remaining useful life, over 1,300 tons/year of NO_x could be reduced at an annual cost of about $7.4 million for an average cost-effectiveness of less than $5,600/ton. This cost-effectiveness value is lower than thresholds used by AZ ($4,000-$6,500/ton), ID ($6,100/ton), and CO, NV and OR ($10,000/ton). While the NPS cost analyses reported above reflect a 20-year equipment life, ***this control is still cost effective with a ten-year useful life, with cost-effectiveness values between $7,000 - $10,000/ton***.

For the SCR cost analyses, the NPS applied the cost methodologies recently developed by Sargent & Lundy in support of EPA's April 6, 2022 "good neighbor" proposal. While similar to the CCM, Sargent & Lundy updated its 2017 SCR cost model[21] to reflect more-recent information (2021) on SCR capital and catalyst costs.[22] NPS application of the updated model resulted in costs as shown in the "Updated CCM for SCR" columns in the table below and attached calculation workbooks. The NPS SCR workbook inputs and results are shown in Table 7 below.

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[21] The S&L model provided the basis for EPA's current SCR cost methodology and can be found at SCR Cost Development Methodology (epa.gov)

[22] The updated SCR cost model can be found in the "good neighbor" proposal docket.

Table 7: NPS Cost Calculation Results Summary for SCR on Shawnee Units 2–3 and 5–9

Cost Estimation Method	Updated CCM for SCR						
Shawnee EGU	Unit #2	Unit #3	Unit #5	Unit #6	Unit #7	Unit #8	Unit #9
Unit Size (Gross MW)	175	175	175	175	175	175	175
Inlet NO_x Emissions	0.201	0.206	0.207	0.254	0.249	0.249	0.248
Outlet NO_x Emissions	0.040	0.040	0.040	0.040	0.040	0.040	0.040
NO_x Removal Efficiency (%)	80%	81%	81%	84%	84%	84%	84%
Retrofit Factor	1	1	1	1	1	1	1
CEPCI for 2021	708	708	708	708	708	708	708
Annual Interest Rate (i) (%)	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Equipment Life (years)	20	20	20	20	20	20	20
Total Capital Investment	$ 74,911,965	$ 75,040,931	$ 75,256,866	$ 74,775,079	$ 74,674,115	$ 74,765,958	$ 74,648,525
Capital Recovery Cost	$ 5,153,943	$ 5,162,816	$ 5,177,672	$ 5,144,525	$ 5,137,579	$ 5,143,898	$ 5,135,819
Indirect Annual Cost	$ 5,160,548	$ 5,169,443	$ 5,184,427	$ 5,151,071	$ 5,144,032	$ 5,150,544	$ 5,142,630
Direct Annual Cost	$ 814,379	$ 827,878	$ 851,959	$ 865,080	$ 803,871	$ 867,950	$ 878,914
Total Annual Cost	$ 5,974,927	$ 5,997,321	$ 6,036,386	$ 6,016,151	$ 5,947,903	$ 6,018,494	$ 6,021,545
Uncontrolled NO_x	742	783	849	949	910	953	988
NO_x Removed	594	631	684	799	764	800	828
Cost-Effectiveness	$ 10,056	$ 9,504	$ 8,819	$ 7,525	$ 7,787	$ 7,523	$ 7,270
Incremental Total Annual Cost	$ 4,955,512	$ 4,966,934	$ 4,990,636	$ 4,936,889	$ 4,878,803	$ 4,939,621	$ 4,935,784
Incremental SO_2 Removed	440	467	507	591	565	592	613
Incremental Cost-Effectiveness	$ 11,263	$ 10,627	$ 9,844	$ 8,355	$ 8,638	$ 8,349	$ 8,057

Based on a 30-year remaining useful life, over 8,200 tons/year of NO_x could be reduced at an annual cost of about $40 million for an average cost-effectiveness of less than $8,300/ton. This cost-effectiveness value is lower than the threshold used by CO, NV, and OR ($10,000/ton) in this round of regional haze planning. Further, SCR could remove almost 3,800 tons of NO_x annually when compared to SNCR at an additional annual cost $34.6 million; the NPS recommends that this incremental annual cost is reasonable. In addition, an SCR-level of control may be necessary for units 2–3 and 5–9 under EPA's "good neighbor" proposal. The NPS recommends that Kentucky evaluate and implement SCR under the Regional Haze SIP for units 2–3 and 5–9.

3.4 Louisville Gas & Electric Company Mill Creek Station

3.4.1 Summary of NPS Recommendations for Mill Creek Station:

SO_2 Recommendations

- The performance of the wet limestone scrubbers on units 1, 2, and 3 has been deteriorating over the past five years (on a lb/MMBtu basis).

- The NPS recommends that scrubber optimization on units 1-3 is evaluated and implemented to ensure effective controls are maintained.
- The NPS recommends incorporating requisite SO_2 emission rates into the permit to ensure scrubber efficiency is maintained as a requirement of the SIP.
- Unit 4 appears to be operating efficiently.

NO_x Recommendations

- Units 1 and 2 lack post-combustion NO_x controls. SCR is estimated to be cost-effective for Mill Creek Station units 1 and 2 and the NPS recommends evaluating and implementing this option under the regional haze SIP.
- CAMD data indicates that the SCR systems on Units 3 and 4 are operating effectively relative to the benchmark NO_x emission rate proposed under EPA's "good neighbor" rule.

3.4.2 Facility Background – Mill Creek Station:

Mill Creek Station (MCS) is a bituminous coal-fired power station owned by Louisville Gas and Electric Company (parent company is PPL) and located 88 km north of Mammoth Cave National Park and near Louisville, Kentucky. MCS has a nameplate capacity of 1,717 MW. Units and in-service dates are as follows:

- Unit 1: tangentially-fired 356 MW (1972)
- Unit 2: tangentially-fired 356 MW (1974)
- Unit 3: dry-bottom, wall-fired 463 MW (1978)
- Unit 4: dry-bottom, wall-fired 544 MW (1982)

MCS units 1 and 2 are identical boilers with wet limestone scrubbers for SO_2 control and Low-NO_x Burners (LNB) with Separated Overfire Air (SOFA) for NO_x control and baghouse fabric filters to control particulate. (According to online reports, Unit 1 is expected to retire in 2024 and unit 2 by 2028.) MCS units 3 and 4 are equipped with wet limestone scrubbers for SO_2 control and LNB with Selective Catalytic Reduction (SCR) for NO_x control and baghouse fabric filters to control particulate.

Mill Creek Station is ranked #4 among the Kentucky facilities for haze contributions in NPS Class I areas in the VISTAS region based on AOI source screening results. Using the NPS-recommended screening threshold to capture 80% of the total Class I area AOI impact, this source:

- Is on the 80% of total AOI impact list for 9 VISTAS Class I areas.
- Ranks #25 of 238 VISTAS state sources for cumulative impact to VISTAS Class I areas

Of 1,382 power plants in EPA's Clean Air Markets Database (CAMD) in 2021, Mill Creek ranked #75 for SO_2 emissions (3,205 tons) and #47 for NO_x emissions (4,861 tons). Mill Creek Station's carbon dioxide emissions of 7,866,168 tons ranked #42 among all power plants. Mill Creek Station also ranked #145 for EGU mercury emissions with 8 lb in 2017. Table 8 below provides unit-specific 2021 SO_2 and NO_x emissions and rankings versus the 3,219 EGUs in CAMD.

Table 8: Mill Creek Station Unit-specific 2021 SO_2 and NO_x Emissions and Rankings as Reported in CAMD.

Unit ID	SO_2 (tons)	SO_2 Rank	Calculated Avg. SO_2 Rate (lb/MMBtu)	Calculated Avg. SO_2 Rate (Rank)	NO_x (tons)	NO_x Rank	Calculated Avg. NO_x Rate (lb/MMBtu)	Calculated Avg. NO_x Rate (Rank)
1	619	301	0.093	315	1,749	123	0.264	119
2	552	317	0.100	299	1,465	143	0.267	116
3	767	276	0.068	388	717	310	0.063	1,231
4	1,268	193	0.085	339	930	258	0.062	1,243

3.4.3 NPS Review of Mill Creek Station:

SO_2 Review

MILL CREEK UNITS 1–3

The following figures provide SO_2 emission rates for Mill Creek Station units 1-4. Even though the scrubbers on these units have averaged 98% to 99% control over the past five years, the charts indicate that scrubber performance on Units 1, 2 and 3 has deteriorated during this period and scrubber performance should be addressed. These recommendations are consistent with Section 2.3 of the July 2021 EPA Clarification Memorandum, which addressed the analytical expectations for "effectively controlled" determinations.

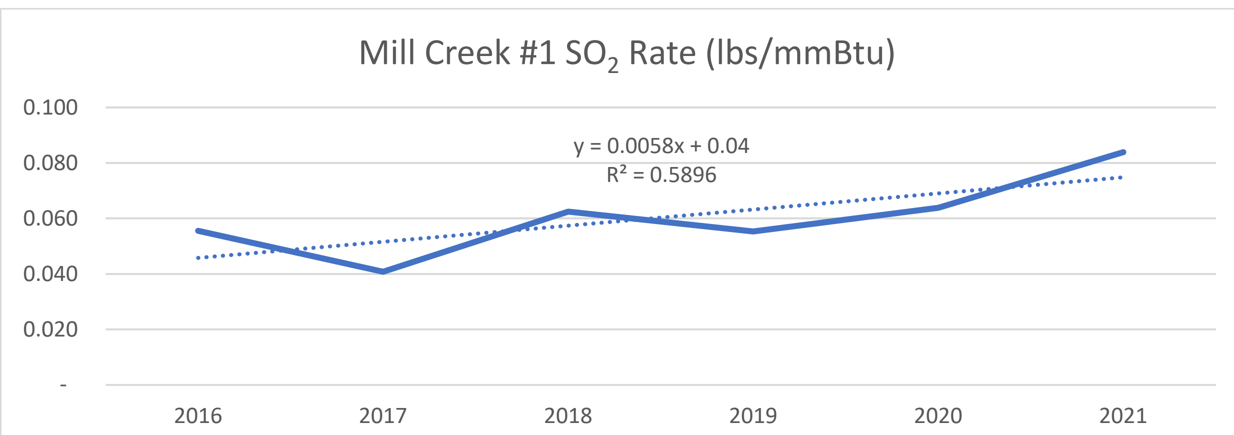

Figure 6: Mill Creek Unit 1 SO_2 Emission Rate Trends (2016-2021)

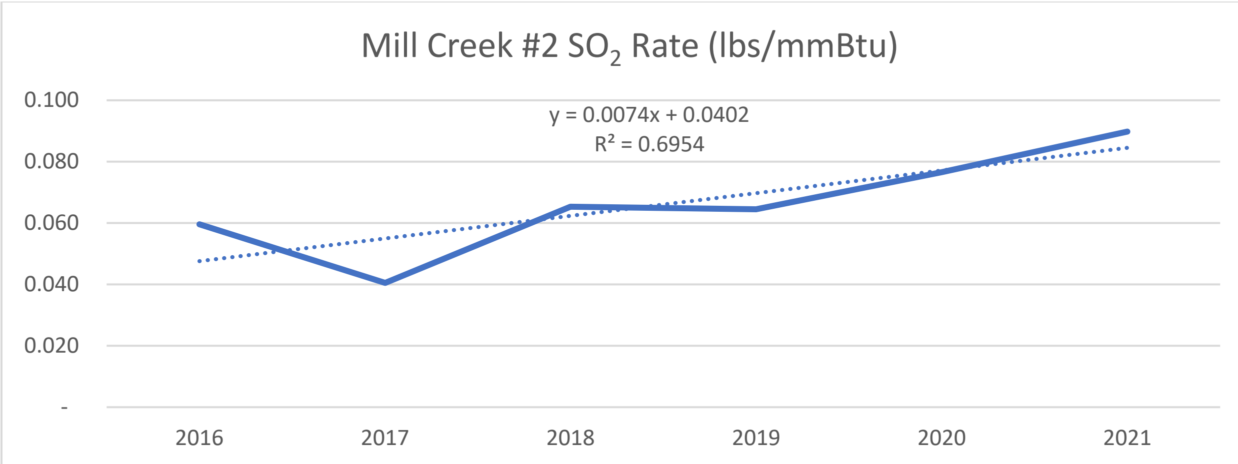

Figure 7: Mill Creek Unit 2 SO_2 Emission Rate Trends (2016-2021)

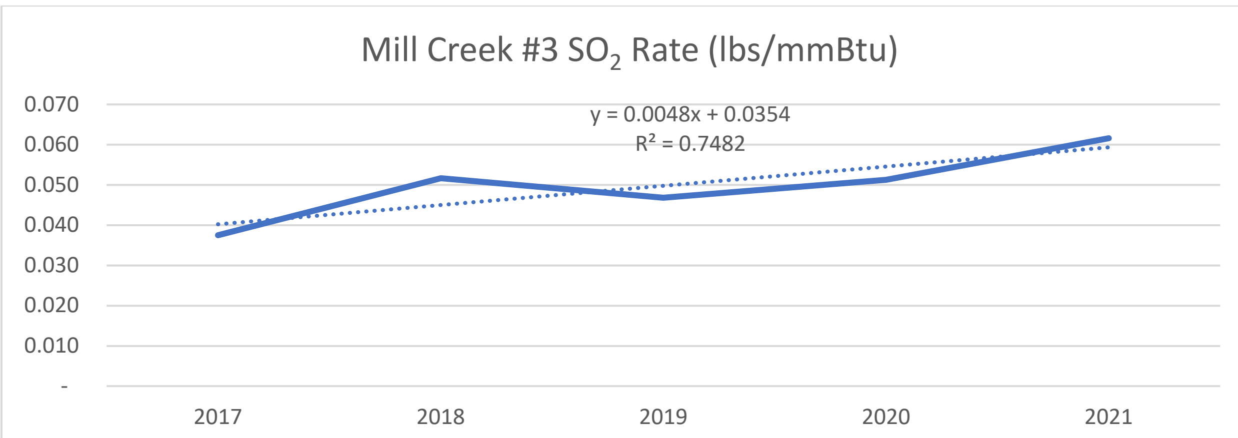

Figure 8: Mill Creek Unit 3 SO_2 Emission Rate Trends (2016-2021)

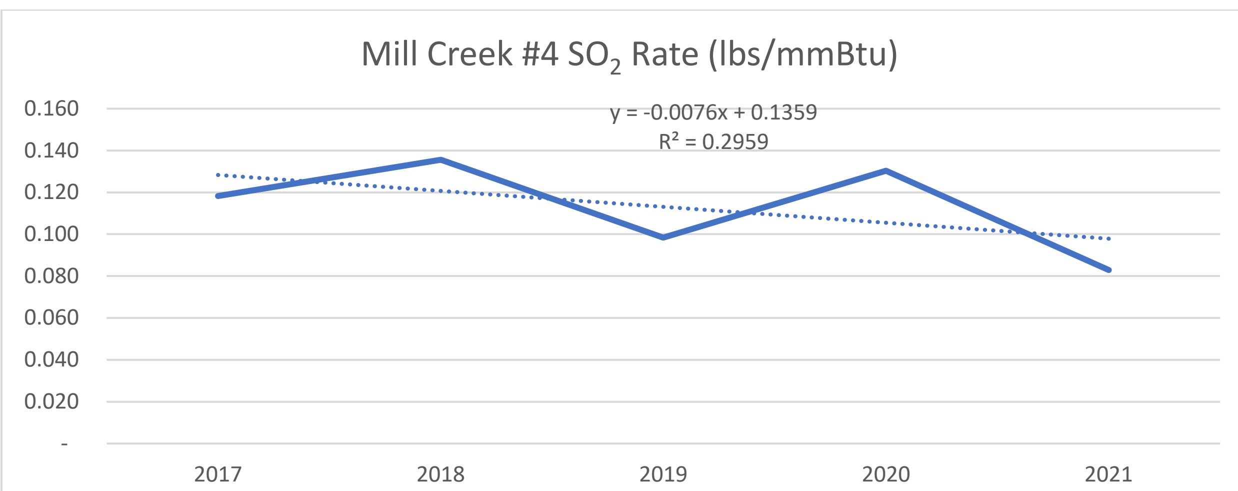

Figure 9: Mill Creek Unit 4 SO_2 Emission Rate Trends (2016-2021)

NO_x Review

Mill Creek Station units 1 and 2 lack post-combustion NO_x controls. The NPS evaluated the addition of Selective Non-Catalytic Reduction (SNCR) and Selective Catalytic Reduction (SCR) for these Mill Creek Station units. For the SNCR cost analyses, the NPS applied the cost methodology in EPA's Control Cost Manual (CCM). Our CCM workbook inputs and results are shown in Table 9 below and our cost calculation workbooks are included in the attachments.

For the SCR cost analyses, the NPS applied the cost methodologies recently developed by Sargent & Lundy in support of EPA's April 6, 2022 "good neighbor" proposal. While similar to the CCM, Sargent & Lundy updated its 2017 SCR cost model[23] to reflect more-recent information (2021) on SCR capital and catalyst costs. [24] Our application of the updated model resulted in costs as shown in the "Updated CCM for SCR" columns in the table below and our workbooks are included. Our SCR workbook inputs and results are also shown in Table 9 below and our workbooks are included in the attachment.

Table 9: NPS Cost Calculation Results Summary for SNCR and SCR on Mill Creek Station Units 1 and 2.

Cost Estimation Method	SNCR		SCR (Updated)	
MCS Unit	**Unit #1**	**Unit #2**	**Unit #1**	**Unit #2**
MW rating at full load capacity (Bmw) =	356	356	356	356
Inlet NO_x Emissions (NO_xin) to SCR (lb/mmBtu) =	0.288	0.291	0.288	0.291
Outlet NO_x Emissions (NO_xout) from SCR (lb/mmBtu) =	0.222192475	0.224505663	0.05	0.05
NO_x Removal Efficiency (EF) (%) =	23	23	82.61326816	82.80884542
CEPCI for 2021 =	708	708	708	708
Total Capital Investment (TCI) =	$21,934,174	$22,021,968	$119,713,654	$120,481,123
Estimated equipment life (years) =	20	20	30	30
Annual Interest Rate (i) (%) =	5.5	5.5	5.5	5.5
Annual Capital Recovery Costs (CR)=	$1,835,890	$1,843,239	$8,236,299	$8,289,101
Indirect Annual Cost (IDAC) =	$1,845,761	$1,853,149	$8,242,152	$8,294,674
Reagent (Costreag) ($/gal) =	0.56	0.56	0.56	0.56
Catalyst cost (CC replace) ($/ft3) =			255	255
Direct Annual Cost =	$857,959	$798,352	$1,431,272	$1,241,526
Total Annual Cost (TAC) =	$2,703,719	$2,651,500	$9,673,423	$9,536,200
Uncontrolled NO_x (tons/year) =	2,358	2,086	2,358	2,086
NO_x Removed (tons/year) =	536	476	1,948	1,728
Cost Effectiveness ($/ton) =	$5,044	$5,572	$4,967	$5,520
Incremental Total Annual Cost (TAC) =			$6,969,704	$6,884,700
Incremental NO_x Removed (tons/year) =			1,412	1,252
Incremental Cost Effectiveness ($/ton) =			$ 4,937	$ 5,500

[23] The S&L model provided the basis for EPA's current SCR cost methodology and can be found at SCR Cost Development Methodology (epa.gov)

[24] The updated SCR cost model can be found in the "good neighbor" proposal docket.

The updated cost model indicates that addition of SCR to coal-fired MCS Units #1 & #2 could reduce annual NO_x emissions by almost 3,700 tons from these two boilers at a total annual cost of $19 million; this yields a cost-effectiveness of $5,000 - $5,500/ton.

The addition of Selective Non-Catalytic Reduction (SNCR) to Mill Creek Station Units 1 and 2 could reduce annual NO_x emissions by about 500 tons each at a total annual cost of $2.7 million each; this yields an average cost-effectiveness of $5,000 - $5,600/ton.

The incremental cost-effectiveness of SCR versus SNCR is under $6,000/ton. Because incremental cost-effectiveness is typically much greater than average cost-effectiveness, the NPS recommends that $6,000/ton is very reasonable. All these cost-effectiveness estimates are below the thresholds set by other states in this round of regional haze planning.

In its April 6, 2022 "good neighbor" proposal, EPA stated:

> *Based on the characteristics of coal units of 100 MW or greater capacity that do not have post-combustion NO_x control technology, the EPA estimated a weighted-average representative SCR cost of* ***$11,000/ton****.*
>
> *This cost estimate is representative of coal units lacking any post-combustion control. A subset of units within the universe of coal sources with SCR retrofit potential, but that have an existing SNCR technology in place would have a weighted average cost that falls above this level, but still cost effective.*

Unless the remaining useful life of Units 1 and 2 is limited by federally enforceable shutdown dates (noted above), these costs are considered reasonable, and the NPS recommends that Kentucky require SCR for Mill Creek Units 1 and 2 under the regional haze SIP.

3.5 Century Aluminum Sebree, LLC

3.5.1 Summary of NPS Recommendations for Century Aluminum Sebree

- The NPS recommends evaluating and requiring sodium-based scrubbing to control SO_2 emissions.
- The installation of sodium-based scrubbing technology at Sebree could reduce annual SO_2 emissions by over 3,700 tons/year with a cost-effectiveness of $5,700/ton.
- The NPS recommends implementing this cost-effective SO_2 control in the RH SIP.

3.5.2 Facility Background – Century Aluminum Sebree

Sebree is a primary aluminum smelter located near Robards, Kentucky,118 km from Mammoth Cave National Park. The plant consists of three potlines (128 cells each) plus an anode processing operation (with anode bake furnace) and associated operations. Century Aluminum Company acquired the Sebree facility from Rio Tinto Alcan (RTA) in 2013.

Potlines are vented to Alcoa A-398 alumina fluidized bed scrubbers to remove fluorides and PM10. Fugitive emissions exhaust through uncontrolled roof monitors. Green anodes are formed from petroleum coke, recycled spent anode material, and coal tar pitch. Emissions from anode paste mixing and forming vent to a Procedair dry coke scrubber. Anode bake furnace emission exhaust to an Alcoa A-446 alumina fluidized bed scrubber.

The Century Aluminum Sebree Plant is ranked number five among the Kentucky facilities for haze contributions in NPS Class I areas in the VISTAS region based on AOI source screening results. Using the NPS recommended screening threshold to capture 80% of the total Class I area AOI impact, this source:

- Is on the 80% of total AOI impact list for 7 VISTAS Class I areas, including Mammoth Cave and Great Smoky Mountains NPs.
- Ranks #32 of 238 VISTAS state sources for cumulative impact to VISTAS Class I areas.

An October 4, 2010, Prevention of Significant Deterioration (PSD) permit revision allowed RTA to modify the existing potlines to increase production from 219,999 tons/year to 253,531 tons/year. RTA identified Limestone Slurry Forced Oxidation (LSFO) and sodium-based wet scrubbing, as well as management of sulfur input, as technically feasible options to control SO_2. In the permit, RTA concluded that a sodium-based scrubber could remove 5,042 tons/year SO_2 at $5,067/ton (2008$). The cost-effectiveness of the limestone- and lime-based scrubbers was approximately $9,700/ton. At the time, Kentucky concluded that none of the scrubbers would be cost-effective. BACT for SO_2 was established as a plant-wide cap of 5,853 tons/year based upon a sulfur limit of 3% in the anode raw materials:

> *Sulfur dioxide (SO_2) emissions shall not exceed 5,853 total tons in any 12-month consecutive period, from the production of primary aluminum by electrolysis (potline operations) and anode bake furnace operations (401 KAR 51:017; BACT Limit).*

At the time, the NPS notified Kentucky of several concerns with the RTA cost analyses (these issues were addressed in the NPS cost assessment, as described below).

Recent and projected SO_2 emissions are shown in Table 10 below and were extracted from Kentucky's Table 7-31 in the Draft SIP.

Table 10: SO_2 Emissions Comparison Between 2017, 2018, 2019, and 2028

EIS Facility ID	Facility	SO_2 2017 (tpy)	SO_2 2018 (tpy)	SO_2 2019 (tpy)	SO_2 2028 Remodel (tpy)
7352311	Century Aluminum Sebree LLC	4,629	4,239	4,314	4,193

3.5.3 NPS Review of Century Aluminum Sebree:

The Sebree plant was BART-eligible but was exempted from further BART analysis in 2009 through unit-specific exemption modeling.[25] The NPS requested that Kentucky evaluate the Century Aluminum Sebree facility in May of 2019 and again in May of 2021.

The NPS evaluated sodium-based scrubbing, limestone-based (LSFO) scrubbing, and lime-based scrubbing based on information submitted by RTA in September 2009[26] and by applying the current section of EPA's Control Cost Manual (CCM).[27]

The NPS analyses make several revisions to the RTA BACT analysis. For example, in the September 2009 submittal, RTA assumed 95% SO_2 control efficiency for all three technologies and applied that reduction to potential SO_2 emissions of 5,308 tons/year from the potlines.[28] The NPS notes that these scrubber systems should be capable of 98% control. According to the CCM:

> *Several vendors supply scrubbers of various sizes that are designed for specific industrial applications, such as sulfur recovery units (SRUs), fluidized catalytic cracking units (FCCUs), sulfuric acid production plants,* ***aluminum production****, and other non-ferrous metal smelters.* ***These systems typically achieve control efficiencies greater than 98%****; however, the removal efficiency achieved can be lower for systems where the waste gas characteristics are variable (e.g., varying acid gas concentrations, flow rates, or temperature).*

The NPS reevaluated the three scrubbing technologies by assuming 98% control and applied that level of control to projected annual SO_2 potline emissions of 3,803 tons/year.[29] A summary of NPS results is shown in the table below (calculation spreadsheets are included in the attachments).

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[25] The source was exempted based on a modeled impact of 0.467 dv at Mammoth Cave NP; Kentucky exempted sources with less than 0.5 dv impact from further BART review.
[26] EPA's Control Cost Manual recommends against using cost information that is more than five years old.
[27] OAQPS Control Cost Manual 7th edition, Section 5 (SO_2 and Acid Gas Controls), Chapter 1 (Wet and Dry Scrubbers for Acid Gas Control)
[28] The 5,853 tpy PSD permit limit applies to the entire facility and includes SO_2 emissions from the anode baking operation as well as potline fugitive emissions.
[29] RTA estimated that potline emissions would be 91% (5,308/5,832) of total plantwide emissions. KYDAQ projected that 2028 plantwide SO_2 emissions would be 4,193.37 tons/year.

Table 11: NPS Cost Calculation Results for SO_2 Scrubber Systems for Century Aluminum Sebree.

SO_2 Scrubber Technology	Sodium	Limestone	Lime
Uncontrolled emissions (tons/year)	3,803	3,803	3,803
Control efficiency (%)	98%	98%	98%
Emission reduction (tons/year)	3,727	3,727	3,727
Total Capital Investment	$ 174,587,846	$ 371,463,502	$ 371,463,502
Indirect Annual Cost	$ 19,037,490	$ 40,458,622	$ 40,458,622
Direct Annual Cost	$ 2,212,994	$ 3,773,396	$ 3,999,989
Total annualized cost ($/yr)	$ 21,250,483	$ 44,232,018	$ 44,458,611
Cost/ton removed ($/T)	$ 5,702	$ 11,868	$ 11,929

The application of sodium-based scrubbing technology at Sebree could reduce annual SO_2 emissions by over 3,700 tons/year at a cost-effectiveness level of $5,700/ton. These costs are well below cost-effectiveness thresholds acceptable to at least six states in this round of regional haze planning. The NPS recommends evaluating and implementing sodium-based scrubbing for the Century Aluminum Sebree facility in the regional haze SIP.

3.6 Kentucky Utilities Company Ghent Station

3.6.1 Summary of NPS Recommendations for Ghent Station

SO_2 Recommendations

- The performance of the wet limestone scrubbers on units 1, 2, and 3 has been deteriorating over the past five years (on a lb/MMBtu basis).
- The NPS recommends evaluating and implementing scrubber optimization on Units 1-3 to ensure effective SO_2 controls are maintained.
- The NPS recommends incorporating requisite SO_2 emission rates into the permit to ensure scrubber efficiency is maintained and required under the RH SIP.
- Unit 4 appears to be operating efficiently.

NO_x Recommendations

- Unit 2 lacks post combustion NO_x controls.
  - The NPS recommends that SCR is cost-effective for Ghent Station Unit 2 and that SCR be evaluated and implemented under the regional haze SIP.
  - The NPS evaluated the addition of Selective Non-Catalytic Reduction (SNCR) and Selective Catalytic Reduction (SCR) for unit 2. Based on the NPS Analyses;
    - SNCR could reduce NO_x by over 500 tons/year of for an average cost-effectiveness of $6,300/ton.
    - SCR could reduce approximately 1,900 tons/year of NO_x for an average cost-effectiveness $7,500 and an incremental cost-effectiveness of $7,900/ton.

- Units 1 and 4: The SCR systems on Units 1 and 4 are operating effectively relative to the 0.08 lb/MMBtu benchmark NO_x emission rate proposed under EPA's "good neighbor" rule, but performance appears to be deteriorating. The NPS recommends addressing this to ensure NO_x rates are maintained.

- Unit 3: CAMD data indicates that the SCR on Unit 3 has been achieving 48% control @ 0.17 lb/MMBtu the last 5 years. This is relatively poor performance. The NPS Recommends evaluating SCR optimization for Unit 3.

3.6.2 Facility Background – Ghent Station

Ghent Generating Station (Ghent) is a 2,226 MW coal-fired[30] power station located near Ghent, Kentucky 186 km north-northeast of Mammoth Cave National Park. Ghent is owned by Kentucky Utilities Company. Unit types along with in-service dates are as follows:

- Unit 1: tangentially-fired, 557 MW (1974)
- Unit 2: tangentially-fired, 556 MW (1977)
- Unit 3: dry-bottom, wall-fired, 557 MW (1981)
- Unit 4: dry-bottom, wall-fired, 556 MW (1984)

All four EGUs are equipped with wet limestone scrubbers for SO_2 control. Units 1, 3 & 4 are equipped with Low-NO_x Burner (LNB) Technology w/Separated Over-fire Air (SOFA) and Selective Catalytic Reduction (SCR). Unit 2 is equipped with LNB Technology w/Closed-coupled SOFA. All units are equipped with baghouse fabric filters to control particulate.

Ghent Station is ranked #6 among the Kentucky facilities for haze contributions in NPS Class I areas in the VISTAS region based on AOI source screening results. Using the NPS-recommended screening threshold to capture 80% of the total Class I area AOI impact, this source:

- Is on the 80% of total AOI impact list for 10 VISTAS Class I areas, including Mammoth Cave, Great Smoky Mountains, and Shenandoah National Parks.
- Ranks #22 of 238 VISTAS state sources for cumulative impact to VISTAS Class I areas.

Of 1,382 power plants in EPA's Clean Air Markets Database (CAMD) in 2021, Ghent ranked #18 for SO_2 emissions (11,060 tons) and #21 for NO_x emissions (6,584 tons). Ghent's carbon dioxide emissions of 11,356,336 tons ranked #14 among U.S. facilities. Ghent also ranked #67 for EGU mercury emissions with 51 lb in 2017. The table below provides a unit-specific 2021 SO_2 and NO_x emissions and their associated rankings versus the 3,219 EGUs in CAMD.

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[30] Ghent burns bituminous coals from the CUMBERLAND MINE (PA), MACH #1 MINE (IL), MC#1 Mine (IL), MCELROY MINE (WV), NORTH KNOTTSVILLE MINE (KY), PRAIRIE EAGLE – UNDERGROUND (IL), PRIDE (KY), RIVER VIEW MINE (KY), SHOEMAKER MINE (WV), and TUNNEL RIDGE MINE (WV).

Table 12: Ghent Station Unit-specific 2021 SO_2 and NO_x Emissions and Rankings as Reported in CAMD.

Unit ID	SO_2 (tons)	SO_2 Rank	Avg. SO_2 Rate (lb/MMBtu)	Avg. SO_2 Rate (Rank)	NO_x (tons)	NO_x Rank	Avg. NO_x Rate (lb/MMBtu)	Avg. NO_x Rate (Rank)
1	1,400	172	0.100	300	978	243	0.070	1,162
2	4,551	51	0.348	120	2,437	82	0.186	272
3	4,296	56	0.292	137	2,299	88	0.156	354
4	813	269	0.060	405	870	277	0.064	1,218

3.6.3 NPS Review of Ghent Station:

SO_2 Review

The following figures provide SO_2 emission rate trends Ghent Units 1-4.

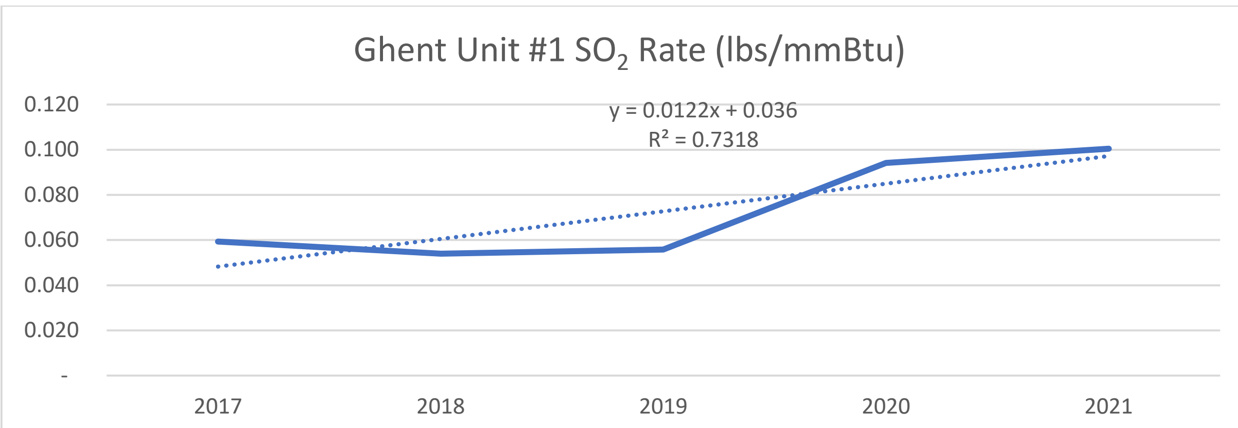

Figure 10: Ghent Station Unit 1 SO_2 Emission Rate Trends (2017-2021)

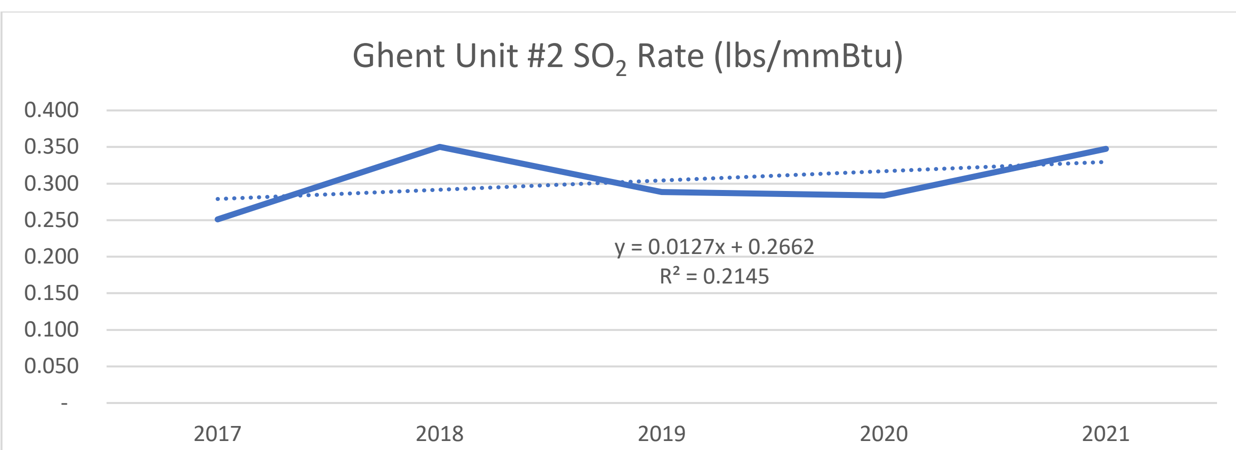

Figure 11: Ghent Station Unit 2 SO_2 Emission Rate Trends (2017-2021)

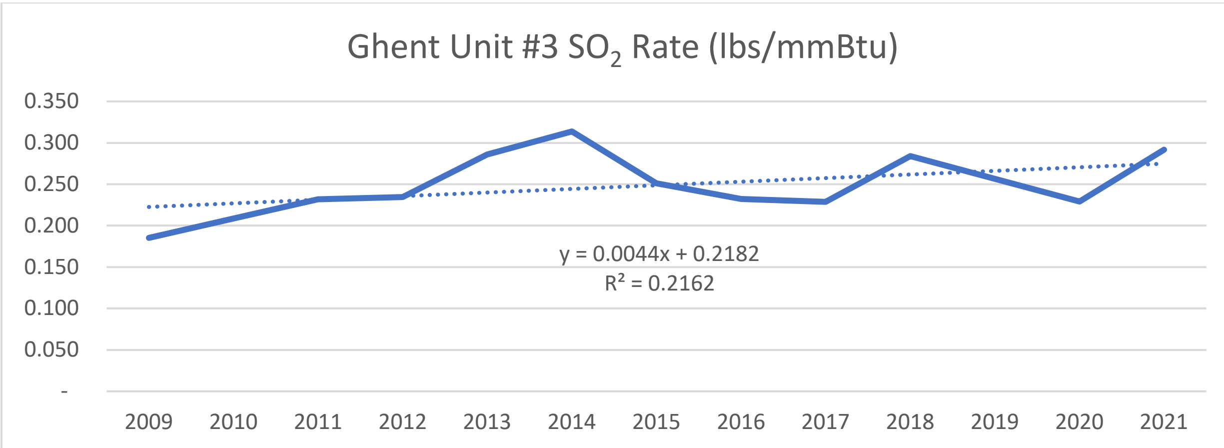

Figure 12: Ghent Station Unit 3 SO_2 Emission Rate Trends (2009-2021)

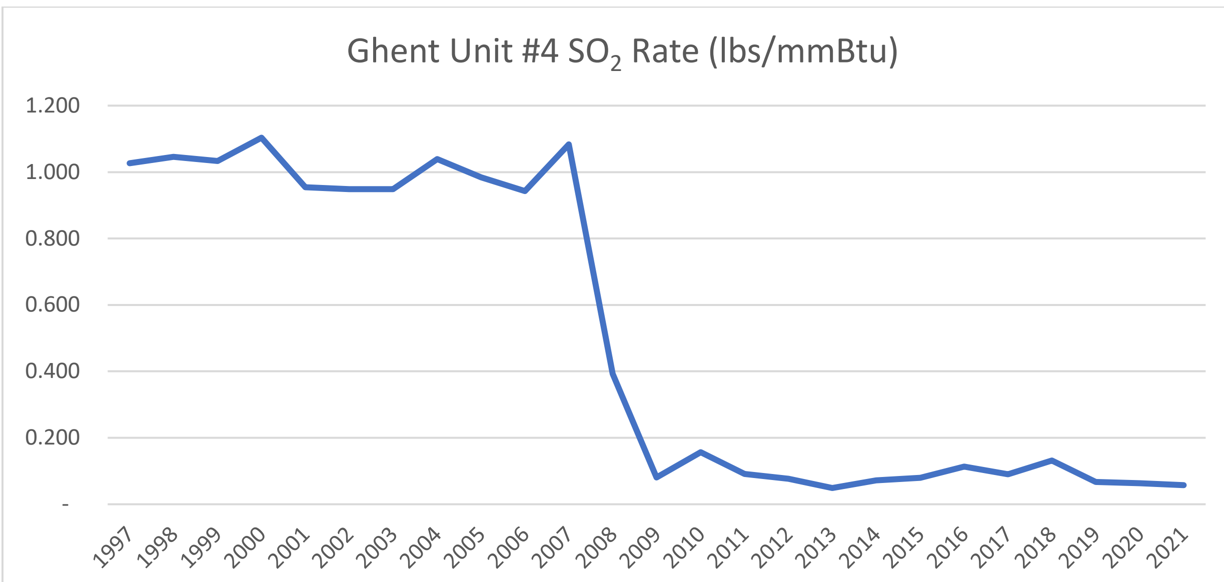

Figure 13: Ghent Station Unit 4 SO_2 Emission Rate Trends (1997-2021)

Based on the unit-specific emission trends, the NPS recommends the following for the wet limestone scrubbers:

- Unit 1: Even though the scrubber has been achieving 98.5% control over the past five years, its effectiveness appears to have been deteriorating and should be addressed.
- Unit 2: The scrubber has been achieving only 93.5% control over the past five years and performance appears to be deteriorating; scrubber upgrades should be evaluated.
- Unit 3: The scrubber has been achieving only 94.5% control over the past five years and its performance appears to be deteriorating; scrubber upgrades should be evaluated.
- Unit 4: The scrubber has been achieving 98.4% control and continues to operate effectively.

NO_x Review

The following figures provide NO_x emission rate trends for SCR systems on Ghent Units 1, 3 and 4.

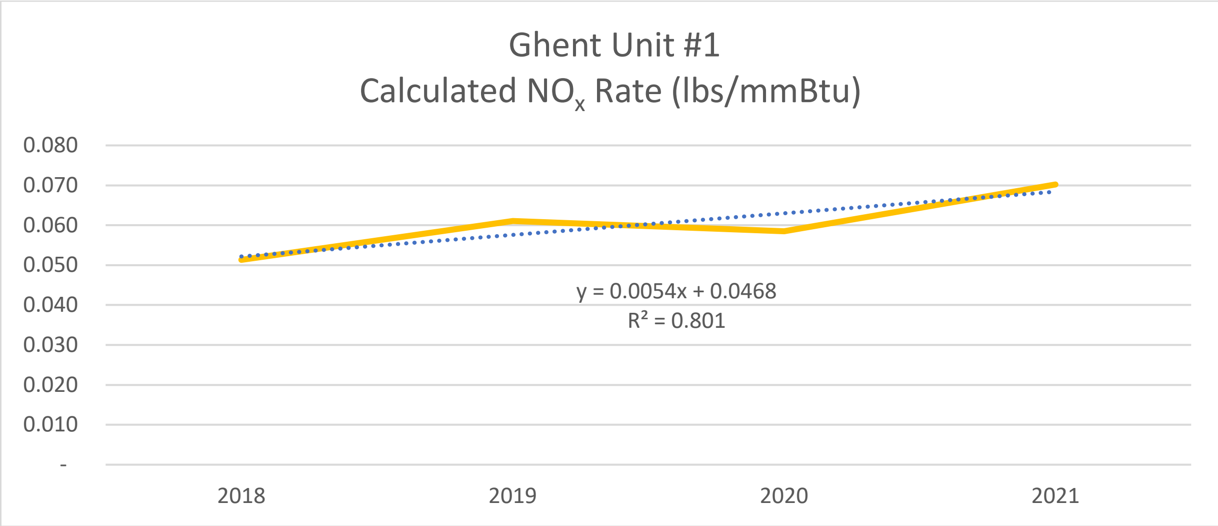

Figure 14: Ghent Station Unit 1 NO_x Emission Rate Trends (2018-2021)

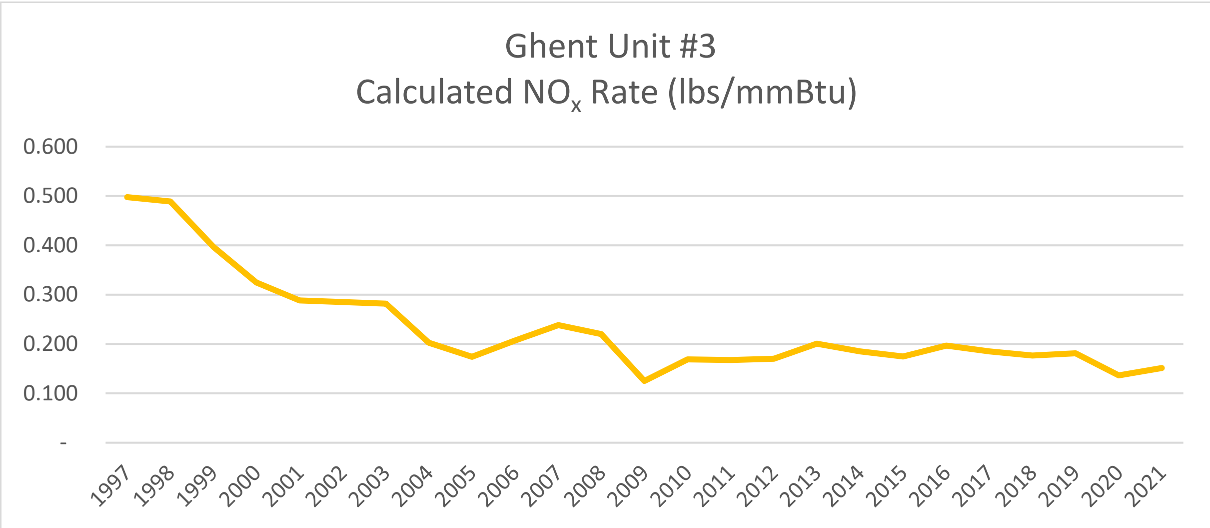

Figure 15: Ghent Station Unit 3 NO_x Emission Rate Trends (1997-2021)

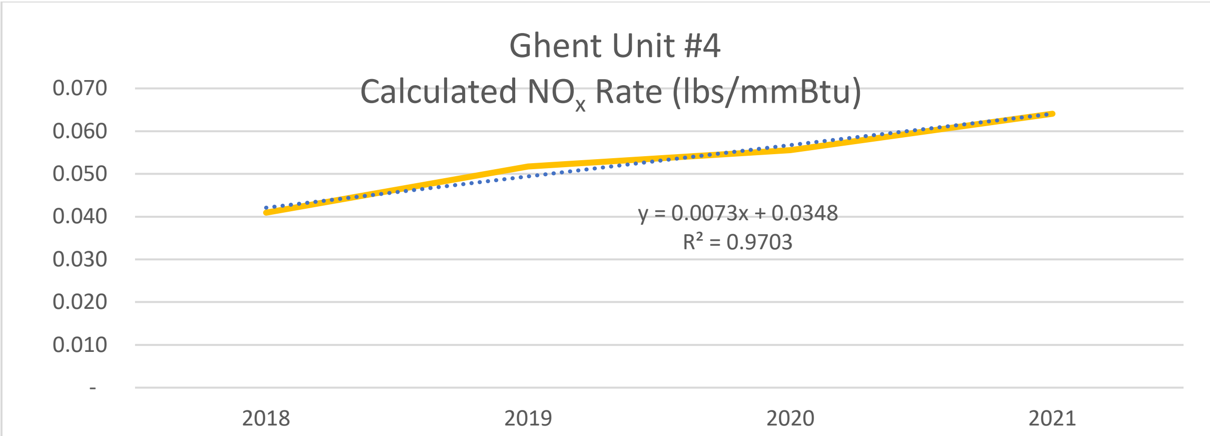

Figure 16: Ghent Station Unit 4 NO_x Emission Rate Trends (2018-2021)

Based on the unit-specific emission trends, the NPS recommends the following for the SCR systems on units 1, 3 and 4:

- Unit 1: LNB Technology w/ SOFA and SCR (Began Apr 01, 2004) has been achieving 85% control @ 0.06 lb/mmBtu over the last four years, but performance appears to be deteriorating and should be addressed.
- Unit 3: LNB Technology w/ OFA and SCR (Began Feb 24, 2004) has been achieving 48% control @ 0.17 lb/mmBtu over the last five years; SCR optimization should be evaluated.
- Unit 4: LNB Technology w/ OFA (Began Jan 05, 1999) and SCR (Began Mar 11, 2004) and has been achieving 81% control @ 0.06 lb/mmBtu over the last four years but performance appears to be deteriorating and should be addressed.

Ghent Unit 2 lacks post-combustion NO_x controls. The NPS evaluated the costs of post-combustion NO_x controls including SNCR and SCR.

For the SNCR cost analyses, the NPS applied the cost methodology in EPA's Control Cost Manual (CCM). Our CCM workbook inputs and results are shown in Table 9 below and our workbooks are included.

For the SCR cost analyses, the NPS applied the cost methodologies recently developed by Sargent & Lundy in support of EPA's April 6, 2022 "good neighbor" proposal. The revised estimate methods are similar to the CCM, however, Sargent & Lundy updated its 2017 SCR cost model[31] to reflect more-recent information (2021) on SCR capital and catalyst costs.[32] Our application of the updated model resulted in costs as shown in the "SCR" column in the table

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[31] The S&L model provided the basis for EPA's current SCR cost methodology and can be found at SCR Cost Development Methodology (epa.gov)
[32] The updated SCR cost model can be found in the "good neighbor" proposal docket.

below and our workbooks are included. Our SCR workbook inputs and results are also shown in Table 13 below and our workbooks are included in the attachment.

Table 13: NPS Cost Calculation Results Summary for SNCR and SCR on Ghent Station Unit 2.

Cost Estimation Method	SNCR	SCR
MW rating at full load capacity (Bmw) =	556	576
Inlet NO_x Emissions (NO_xin) to SCR (lb/mmBtu) =	0.193	0.193
Outlet NO_x Emissions (NO_xout) from SCR (lb/mmBtu) =	0.153	0.05
NO_x Removal Efficiency (EF) (%) =	21	74.0389836
CEPCI for 2021 =	708	708
Total Capital Investment (TCI) =	$28,220,002	$174,253,190
Estimated SCR equipment life (years) =	20	30
Annual Interest Rate (i) (%) =	5.5	5.5
Annual Capital Recovery Costs (CR)=	$2,362,014	$11,988,620
Indirect Annual Cost (IDAC) =	$2,374,713	$12,001,393
Reagent (Costreag) ($/gal) =	0.56	0.56
Catalyst cost (CC replace) ($/ft3) =		255
Direct Annual Cost =	$1,005,216	$2,400,109
Total Annual Cost (TAC) =	$3,379,929	$14,401,502
Uncontrolled NO_x (tons/year) =	2,596	2,596
NO_x Removed (tons/year) =	535	1,922
Cost Effectiveness ($/ton) =	$6,321	$7,491
Incremental Total Annual Cost (TAC) =		$11,021,574
Incremental NO_x Removed (tons/year) =		1,388
Incremental Cost Effectiveness ($/ton) =		$ 7,942

The incremental cost-effectiveness of SCR versus SNCR is under $8,000/ton. Because incremental cost-effectiveness is typically much greater than average cost-effectiveness, $8,000/ton is very reasonable. All these cost-effectiveness estimates are below the $10,000/ton thresholds set by Colorado, Nevada, and Oregon in this round of regional haze planning.

Additionally, these costs are well within the range of acceptable costs established by EPA in the April 6, 2022 "good neighbor" proposal:

> *Based on the characteristics of coal units of 100 MW or greater capacity that do not have post-combustion NO_x control technology, the EPA estimated a weighted-average representative SCR cost of $11,000 per ton. (Statement includes footnote 156).*
>
> *Footnote 156: This cost estimate is representative of coal units lacking any post-combustion control. A subset of units within the universe of coal sources with SCR retrofit potential, but that have an existing SNCR technology in place would have a weighted average cost that falls above this level, but still cost effective.*

Addition of SCR to Ghent Unit 2 could reduce annual NO_x emissions by over 1,900 tons from this boiler at a total annual cost of $14.4 million; this yields an average cost-effectiveness of under $7,500/ton. The incremental cost-effectiveness of SCR versus SNCR is under $8,000/ton and is very reasonable. The NPS recommends evaluating and implementing SCR for Ghent Unit 2 under the regional haze SIP.

3.7 East Kentucky Power Coop Spurlock Station

3.7.1 Summary of NPS Recommendations for Spurlock Station

SO_2 Recommendations

- Units 1 & 2:
  - The wet limestone scrubbers with DSI are achieving > 98% control and reducing SO_2 emissions to < 0.09 lb/mmBtu;
  - The NPS finds that Units 1 & 2 are effectively controlled.
- Units 3 & 4:
  - The CFBs with a Dry Lime Scrubbers and DSI added in 2014 are achieving 97.4% SO_2 control at 0.136 lb/MMBtu on unit 3 and 98.0% SO_2 control at 0.102 lb/MMBtu on unit 4.
  - The NPS recommends evaluating Unit #3 SO_2 controls to determine if they can achieve an SO_2 emission rate similar to Unit #4 (or better).

NO_x Recommendations

- Units 1 & 2:
  - The LNBs with SCR are achieving about 75% - 80% control.
  - NPS Recommendation: While performance has been maintained in the last 5 years, units 1 & 2 may require SCR optimization under EPA's good neighbor proposal.
- Units 3 & 4:
  - Units 3 & 4 are achieving ozone season average NO_x emissions < 0.07 lb/MMBtu and represent effective levels of control.

3.7.2 Facility Background for Spurlock Station

Spurlock Power Station (Spurlock) is a coal-fired power station owned and operated by East Kentucky Power Cooperative and located 250 km northeast of Mammoth Cave National Park near Maysville, Kentucky. Spurlock has a nameplate capacity of 1,371 MW. A description of the Spurlock units, in-service dates and existing control equipment follows:

- Unit 1: Dry bottom wall-fired 325 MW (1977)
  - SO_2: Wet Limestone Scrubber; installed under a 2007 consent decree
  - NO_x: Low-NO_x Burners (LNB) with Selective Catalytic Reduction (SCR) ; installed under a 2007 consent decree

- Unit 2: Tangentially-fired 510 MW (1981)
    - SO_2: Wet Limestone Scrubber; installed under a 2007 consent decree
    - NO_x: Low-NO_x Burners (LNB) with w/ Closed-coupled OFA and Selective Catalytic Reduction (SCR) ; installed under a 2007 consent decree
- Unit 3: Circulating fluidized bed boiler 268 MW (2005)
    - SO_2: CFB with Dry Lime Scrubber & Dry Sorbent Injection (DSI) added in 2014
    - NO_x: Selective Non-catalytic Reduction (SNCR)
- Unit 4: Circulating fluidized bed boiler 268 MW (2009)
    - SO_2: CFB with Dry Lime Scrubber & Dry Sorbent Injection (DSI) added in 2014
    - NO_x: Selective Non-catalytic Reduction (SNCR)

Spurlock Station is ranked #7 among the Kentucky facilities for haze contributions in NPS Class I areas in the VISTAS region based on AOI source screening results. Using the NPS recommended screening threshold to capture 80% of the total Class I area AOI impact, this source:

- Is on the 80% of total AOI impact list for 9 VISTAS Class I areas.
- Ranks #46 of 238 VISTAS state sources for cumulative impact to VISTAS Class I areas.

Of 1,382 power plants in EPA's Clean Air Markets Database (CAMD) in 2021, Spurlock ranked #62 for SO_2 emissions (3,968 tons) and #78 for NO_x emissions (3,240 tons). Spurlock's carbon dioxide emissions of 8,723,951 tons ranked it number 14 among U.S. powerplants. Spurlock also ranked number 168 for EGU mercury emissions with 18 lb in 2017. Table 14 below provides a unit-specific 2021 SO_2 and NO_x emissions and rankings versus the 4,175 EGUs in CAMD.

Table 14: Spurlock Station Unit-specific 2021 SO_2 and NO_x Emissions and Rankings as Reported in CAMD.

Unit ID	SO_2 (tons)	SO_2 Rank	Calculated Avg. SO_2 Rate (lb/MMBtu)	Calculated Avg. SO_2 Rate (Rank)	NO_x (tons)	NO_x Rank	Avg. NO_x Rate (lb/MMBtu)	Calculated Avg. NO_x Rate (lb/MMBtu)	Calculated Avg. NO_x Rate (Rank)
1	830	267	0.082	354	905	269	0.089	0.089	875
2	962	239	0.070	383	1,219	186	0.090	0.089	873
3	1,295	188	0.137	219	562	354	0.062	0.060	1,289
4	881	253	0.095	310	555	357	0.062	0.060	1,287

3.7.3 NPS Review of Spurlock Station:

SO_2 Review

The following figures provide SO_2 emission rate trends for Spurlock Station Units 1-4.

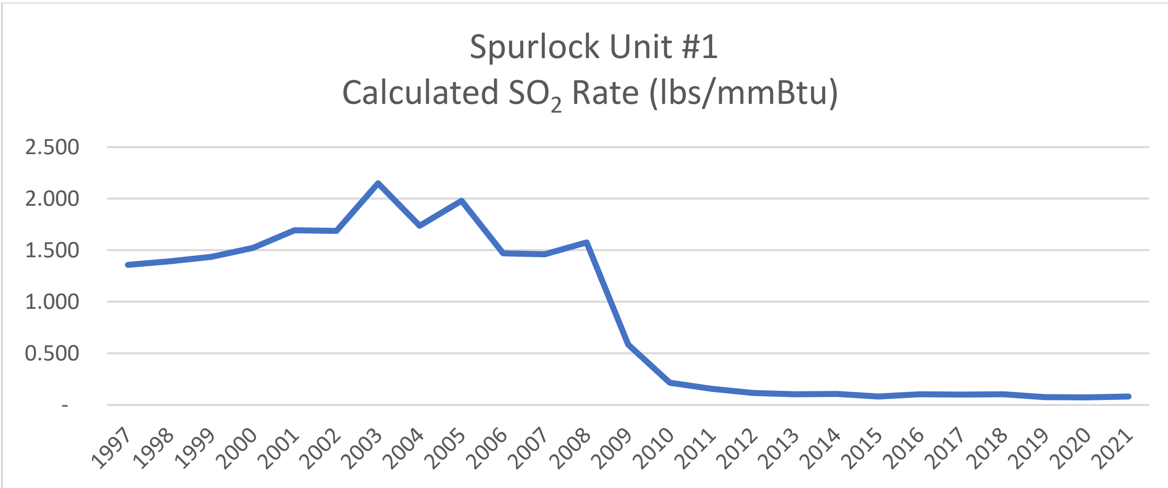

Figure 17: Spurlock Station Unit 1 SO_2 Emission Rate Trends (1997-2021)

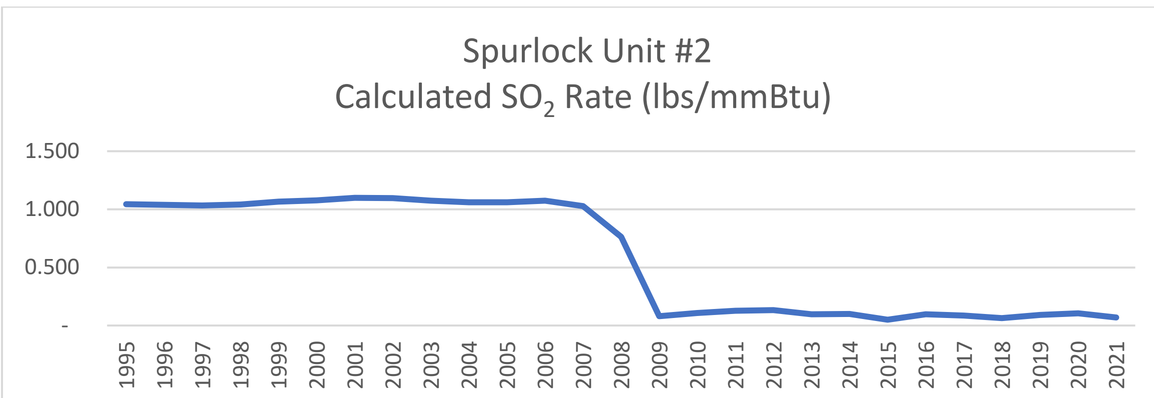

Figure 18: Spurlock Station Unit 2 SO_2 Emission Rate Trends (1995-2021)

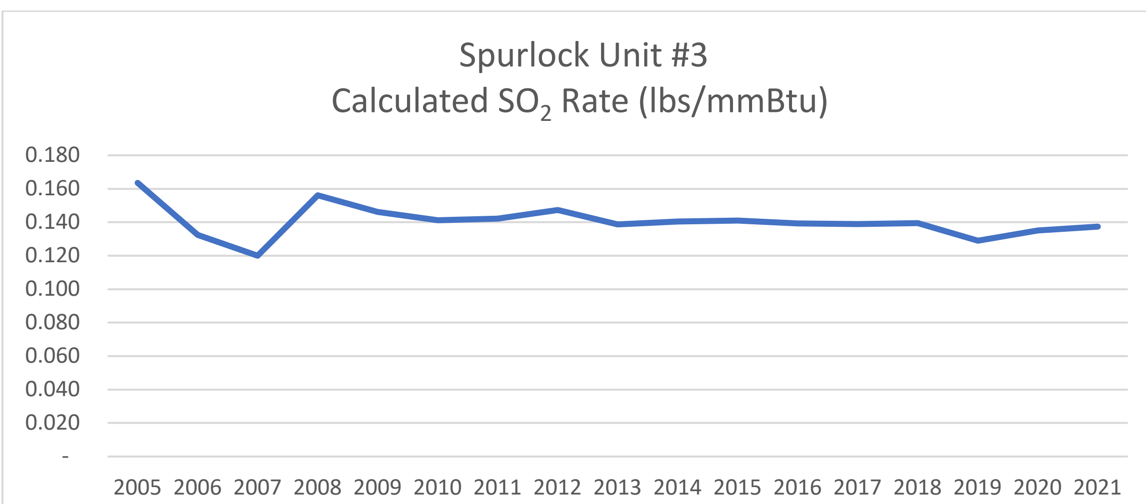

Figure 19: Spurlock Station Unit 3 SO_2 Emission Rate Trends (2005-2021)

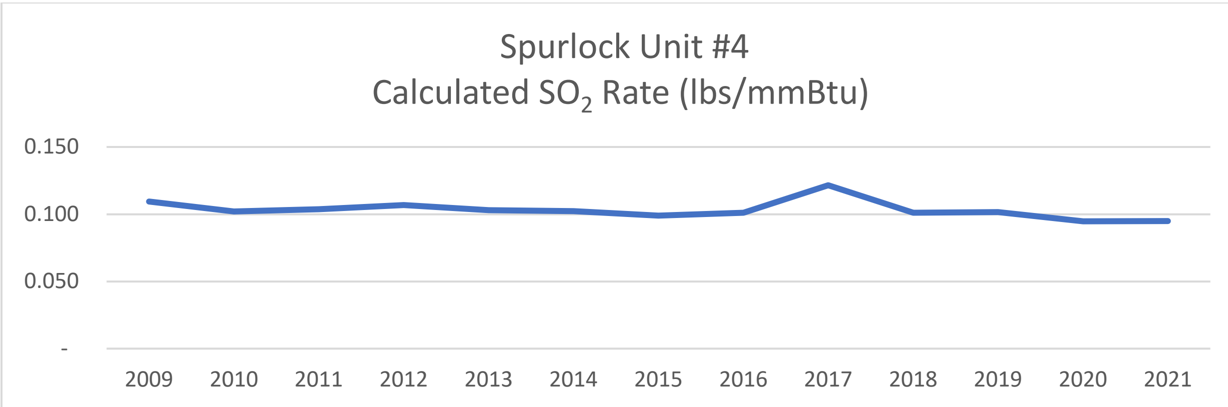

Figure 20: Spurlock Station Unit 4 SO_2 Emission Rate Trends (2009-2021)

Based on the unit-specific emission trends, the NPS recommends the following for the wet limestone scrubbers:

- Units 1 and 2: The wet limestone scrubbers (with DSI) on units 1 and 2 are achieving greater than 98% control and reducing SO_2 emissions to less than 0.09 lb/mmBtu; these units are effectively controlled.
- Unit 3: The fluidized bed limestone injection with DSI added in 2014 is achieving 97.4% SO_2 control with an associated emission rate of 0.136 lb/mmBtu. Unit 3 SO_2 controls should be evaluated to determine if they can achieve an SO_2 emission rate like those achieved by Unit 4 (or better).
- Unit 4: The fluidized bed limestone injection with DSI added in 2014 is achieving 98.0% SO_2 control with an associated emission rate of 0.102 lb/mmBtu. This unit is effectively controlled.

NO_x Review

The following figures provide NO_x emission rate trends for SCR systems on Spurlock Units 1-4.

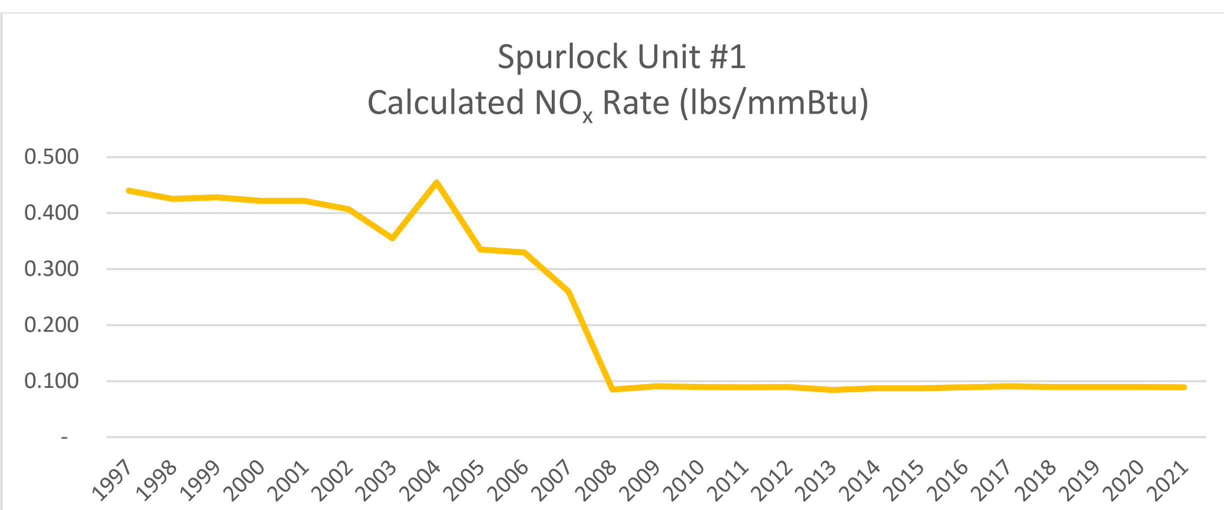

Figure 21: Spurlock Station Unit 1 NO_x Emission Rate Trends (1997-2021)

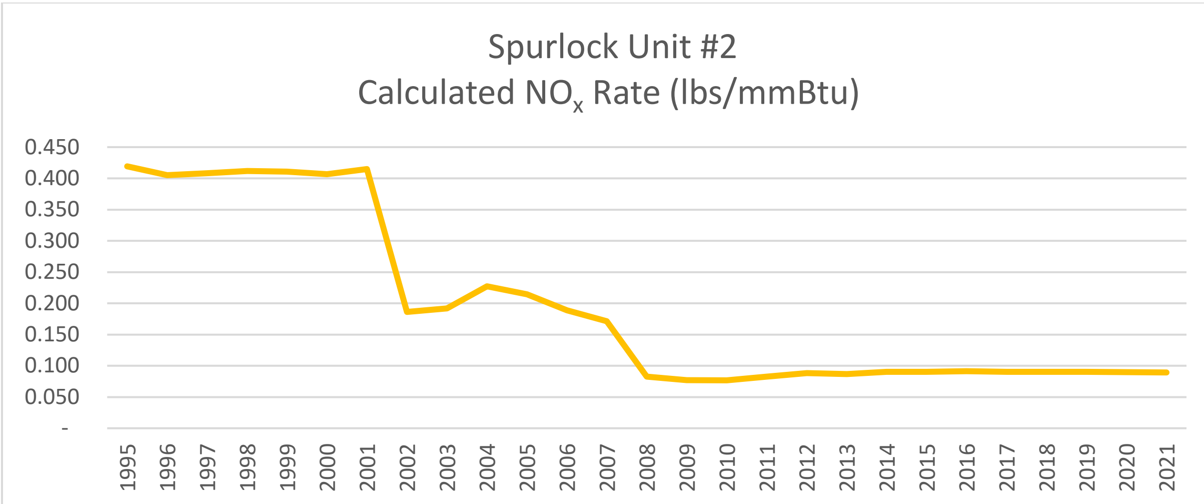

Figure 22: Spurlock Station Unit 2 NO_x Emission Rate Trends (1995-2021)

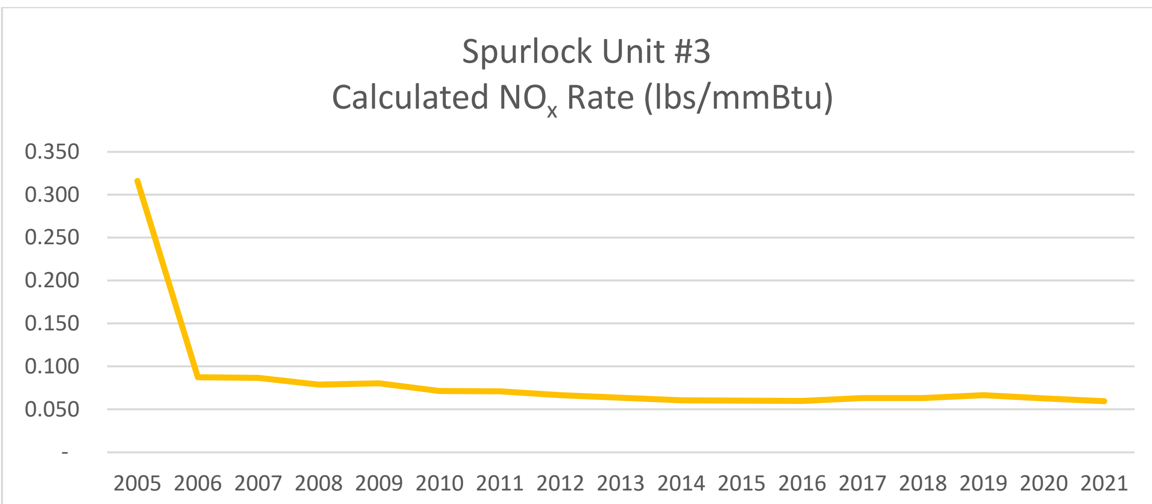

Figure 23: Spurlock Station Unit 3 NO_x Emission Rate Trends (2005-2021)

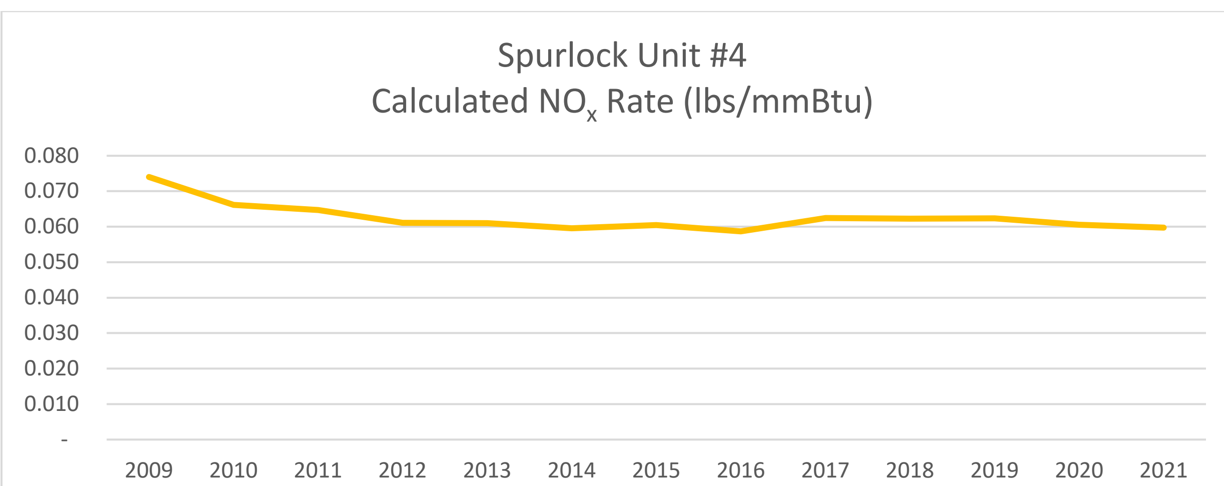

Figure 24: Spurlock Station Unit 4 NO_x Emission Rate Trends (2009-2021)

Based on the unit-specific emission trends, the NPS recommends the following for the SCR systems on Spurlock units 1, 3 and 4:

- Units 1 & 2: The LNBs with SCRs are achieving about 75% - 80% control. Based upon EPA's April 6, 2022 "good neighbor" proposal, these EGUs could be subject to a requirement to optimize SCR performance because ozone season average NO_x emissions exceed 0.08 lb/mmBtu every year 2017 - 2021.[33] The NPS recommends SCR optimization be evaluated for units 1 and 2.
- Unit 3 and 4: The SCR systems on these units are achieving ozone season average NO_x emissions of < 0.07 lb/mmBtu and are effectively controlled.

3.8 Louisville Gas & Electric Company Trimble County Generating Station

3.8.1 Summary of NPS Recommendations for Trimble Generating Station

SO_2 Recommendations

- Units 1 & 2:
    - SO_2 emission rates have shown a long-term upward trend at both Units 1 and 2. (SO_2 emission rates decreased again in 2020 and 2021):
    - The NPS recommends that LG&E optimize scrubber performance and reduce SO_2 emissions back to 2006 levels.

NO_x Recommendations

- Unit 1:
    - The addition of SCR in 2002 decreased NO_x emissions significantly, but since this time, emissions have fluctuated by almost a factor of 3 and have consistently exceeded 0.08 lb/mmBtu (annual average)
    - The NPS recommends evaluating and optimizing SCR performance.
- Unit 2: The SCR on Unit 2 is preforming well.

3.8.2 Facility Background

Trimble County Generating Station is a coal and natural gas-fired power station operated by Louisville Gas and Electric Company (LG&E) 156 km north-northeast of Mammoth Cave National Park and near Bedford, Kentucky. A description of Trimble Station units, in-service dates, and existing control equipment follows:

[33] This further supports EPA's determination that 0.08 lb/mmBtu reflects a reasonable emissions rate for representing SCR optimization at coal steam units in identifying uniform control stringency.

- Unit 1: Tangentially-fired 566 MW (1990)
  - SO_2: Wet Limestone Scrubber
  - NO_x: Low-NO_x Burners (LNB) with w/ Closed-coupled OFA and Selective Catalytic Reduction (SCR)
- Unit 2: Dry bottom wall-fired 834 MW (2011)
  - SO_2: Wet Limestone Scrubber
  - NO_x: Selective Catalytic Reduction (SCR)

Trimble County Station is ranked #8 among the Kentucky facilities for haze contributions in NPS Class I areas in the VISTAS region based on AOI source screening results. Using the NPS recommended screening threshold to capture 80% of the total Class I area AOI impact, this source:

- Is on the 80% of total AOI impact list for 8 VISTAS Class I areas, including Mammoth Cave and Great Smoky Mountains NPs.
- Ranks #56 of 238 VISTAS state sources for cumulative impact to VISTAS Class I areas.

Of 1,382 power plants in EPA's Clean Air Markets Database (CAMD) in 2021, Trimble ranked #81 for SO_2 emissions (2,901 tons) and #115 for NO_x emissions (2,036 tons). Trimble County's carbon dioxide emissions of 8,456,469 tons ranked number 36 among U.S. power plants. Trimble County also ranked #82 for EGU mercury emissions with 42.7 lb in 2017. Table 15 below provides unit specific SO_2 and NO_x emissions and their rankings versus the 4,175 EGUs in CAMD.

Table 15: Trimble County Station Unit-specific 2021 SO_2 and NO_x Emissions and Rankings as Reported in CAMD

Trimble County Station	SO_2 (tons)	SO_2 Rank	Calculated Avg. SO_2 Rate (lb/MMBtu)	Calculated Avg. SO_2 Rate (Rank)	NO_x (tons)	NO_x Rank	Avg. NO_x Rate (lb/MMBtu)	Calculated Avg. NO_x Rate (lb/MMBtu)	Calculated Avg. NO_x Rate (Rank)
Unit 1	1,608	153	0.112	269	1,154	198	0.081	0.080	1,040
Unit 2	1,290	190	0.055	420	721	308	0.032	0.031	1,854

3.8.3 NPS Review of Trimble Generating Station:

SO_2 Review

The following figures provide SO_2 emission rates for Trimble County Station Units 1 and 2.

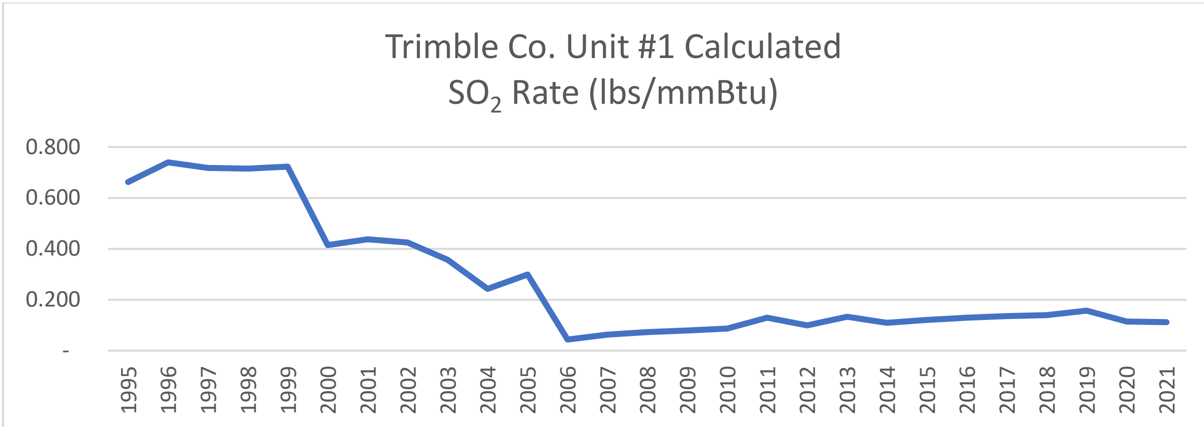

Figure 25: Trimble County Station Unit 1 SO_2 Emission Rate Trends (1995-2021)

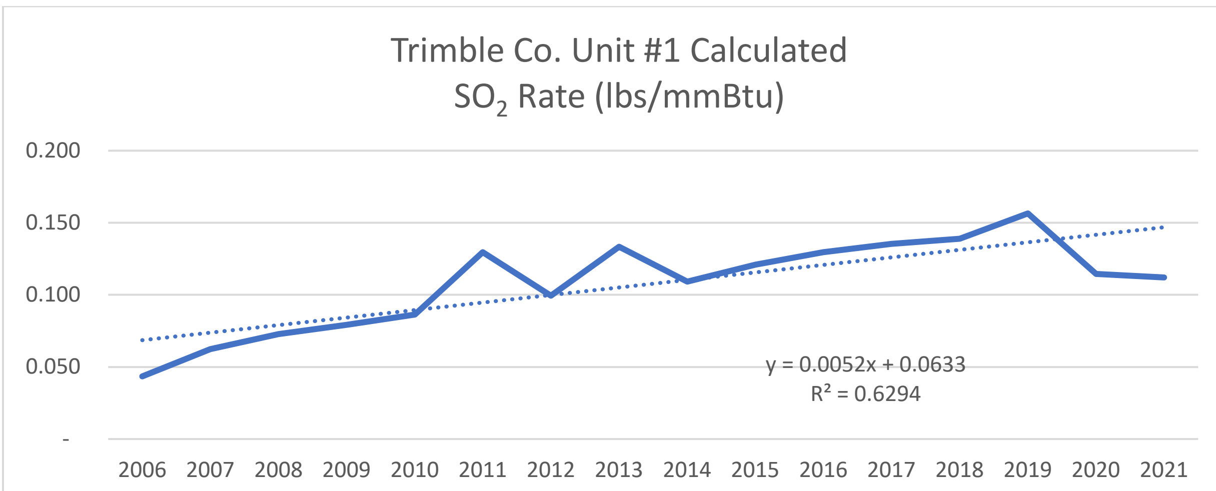

Figure 26: Trimble County Station Unit 1 SO_2 Emission Rate Trends (2006-2021)

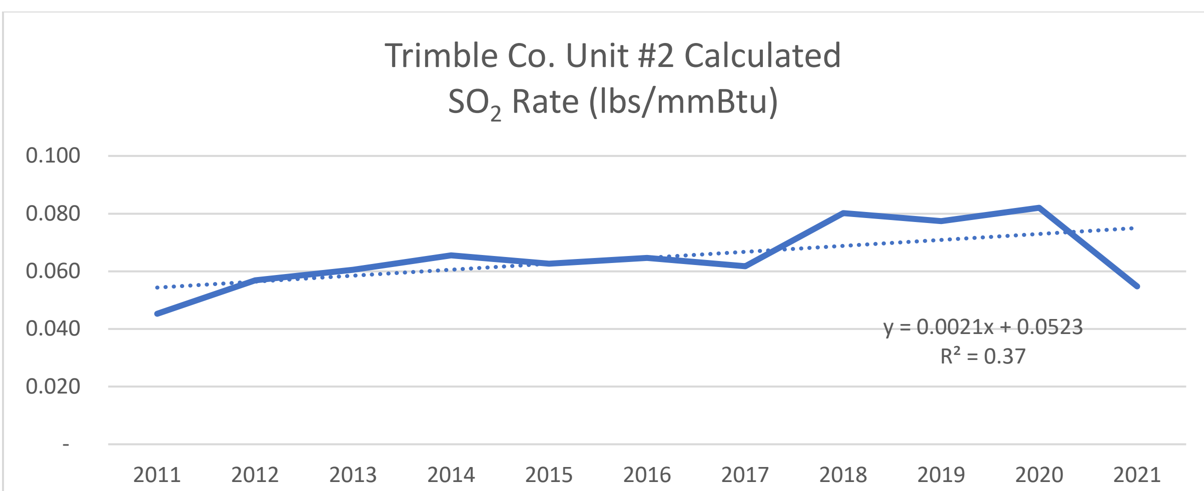

Figure 27: Trimble County Station Unit 2 SO_2 Emission Rate Trends (2011-2021)

Based on the unit-specific emission trends, the NPS recommends the following for the Trimble County Station wet limestone scrubbers:

- Unit 1: As shown in the charts above, SO_2 emission rates decreased significantly until 2006. Since then, SO_2 emission rates have shown a long-term upward trend. SO_2 emission rates have decreased in 2020 and 2021 and the NPS recommends that scrubber optimization be required to reduce these emissions back down to 2006 levels.
- Unit 2: The chart above shows a trend of increasing SO_2 emission rates until 2021. SO_2 emission rates have decreased in 2021 and the NPS recommends that that scrubber optimization be required to reduce these emissions back down to 2011 levels.

NO_x Review

The following figures provide NO_x emission rate trends for SCR systems on Trimble County Station Units 1 and 2.

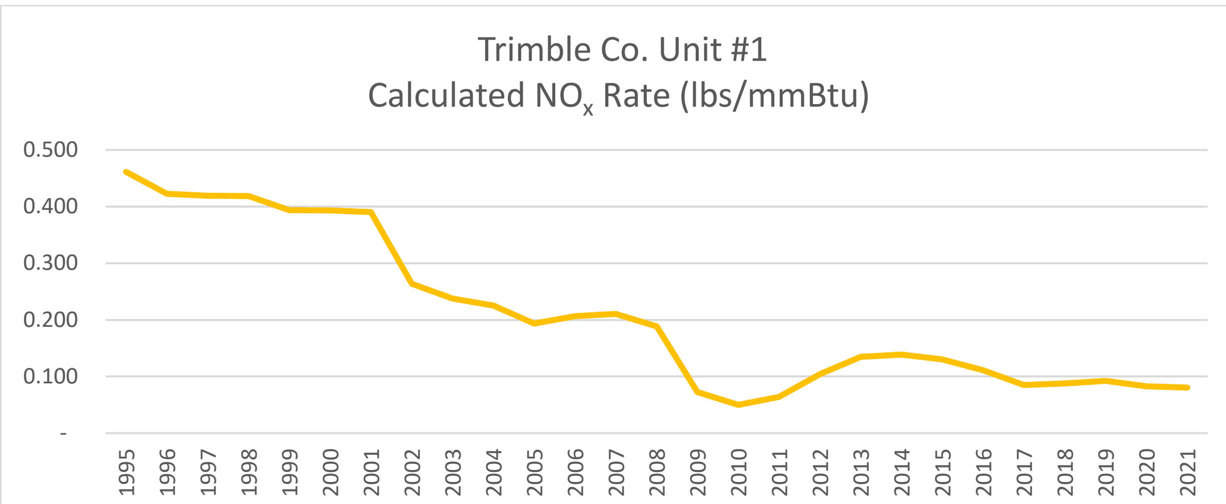

Figure 28: Trimble County Generating Station Unit 1 NO_x Emission Rate Trends (1995-2021)

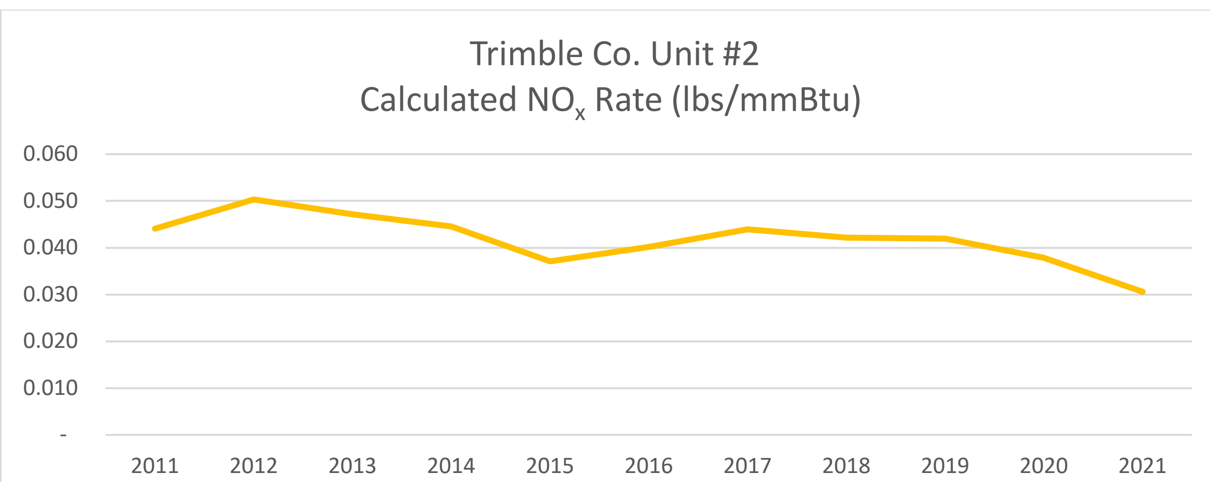

Figure 29: Trimble County Generating Station Unit 2 NO_x Emission Rate Trends (2011-2021)

Based on the unit-specific NO_x emission trends, the NPS recommends the following for the SCR systems on Trimble County Station units 1 and 2:

- Unit 1: The addition of Low NO_x Burner Technology w/ Closed-coupled Overfire Air in 2001 and SCR in 2002 decreased NO_x emissions significantly. However, since 2010, NO_x emissions have fluctuated by almost a factor of three and have consistently exceeded 0.08 lb/mmBtu (annual average) and could trigger optimization under EPA's April 2022 "good neighbor" proposal. The NPS recommends evaluating and optimizing SCR for Trimble County Generating Station Unit 1.
- Unit 2: The chart above indicates that the SCR on Trimble County Station unit 2 is performing well.

3.9 Duke Energy East Bend

3.9.1 Summary of NPS Recommendations for East Bend

SO_2 Recommendations

- The existing scrubber system is achieving 97% control at an average SO_2 emission rate of 0.126 lb/MMBtu.
- The Duke Energy 2021 Integrated Resource Plan (IRP) indicates that the company intends to operate the East Bend unit until 2035. (This is not federally enforceable.)
- The NPS evaluated the costs of replacing the existing wet lime scrubber system with a new unit capable of 99% control efficiency and a 10-year equipment life. Direct cost-effectiveness estimates suggest that a new scrubber would be cost-effective, however, the incremental cost-effectiveness may not be.
- The NPS recommends evaluating scrubber upgrades for the East Bend scrubber system. Achieving 0.046 lb/mmBtu (99% SO_2 control efficiency) would rank Duke Energy East Bend #72, well within the range of achievable emission rates demonstrated in practice.

NO_x Recommendations

- Unit 1:
  - SCR performance on Unit 1 has been steadily improving or consistent in the last seven years.
  - However, rates are still above the 0.08 lb/MMBtu recommended in EPA's good neighbor proposal.
  - The NPS recommends that SCR optimization be considered.

3.9.2 Facility Background:

East Bend is an electric power generating station consisting of one pulverized coal-fired boiler. The boiler, emission unit (EU) 02, has a maximum heat input capacity of 6,313 MMBtu/hr. The unit is wall-fired, equipped with an electrostatic precipitator (ESP), a flue gas desulfurization (FGD) unit, low nitrogen oxide burners, and a Selective Catalytic Reduction (SCR) unit. In addition to this unit, ash, coal, lime and landfill equipment is utilized for the power generating operation.

The Duke Energy East Bend Station is ranked #13 among the Kentucky facilities for haze contributions in NPS Class I areas in the VISTAS region based on AOI source screening results. Using the NPS-recommended screening threshold to capture 80% of the total Class I area AOI impact, this source:

- Is on the 80% of total AOI impact list for 4 VISTAS Class I areas, including Great Smoky Mountains National Park.
- Ranks #95 of 238 VISTAS state sources for cumulative impact to VISTAS Class I areas.

Of 1,382 power plants in EPA's Clean Air Markets Database (CAMD) in 2021, East Bend unit 2 ranked #123 for overall SO_2 emissions (1,756 tons) and #148 for NO_x emissions 1,466 tons). Table 16 below provides a unit-specific 2021 SO_2 and NO_x emissions and rankings versus the 3,219 EGUs in CAMD.

Table 16: East Bend Station Unit-specific 2021 SO_2 and NO_x Emissions and Rankings as Reported in CAMD

SO_2 (tons)	SO_2 Rank	Calculated Avg. SO_2 Rate (lb/MMBtu)	Calculated Avg. SO_2 Rate (Rank)	NO_x (tons)	NO_x Rank	Calculated Avg. NO_x Rate (lb/MMBtu)	Calculated Avg. NO_x Rate (Rank)
1,756	123	0.122	369	1,466	148	0.102	1332

3.9.3 NPS Review of East Bend:

SO_2 Review

The following figures provide SO_2 emission rate trends for the East Bend Station Unit 2. According to CAMD, Unit 2 has operated with a wet limestone scrubber since 1995. It appears scrubber performance increased around 2005 but performance has been steadily declining since 2010. Based on NPS estimates, the scrubber is currently achieving approximately 97% control.

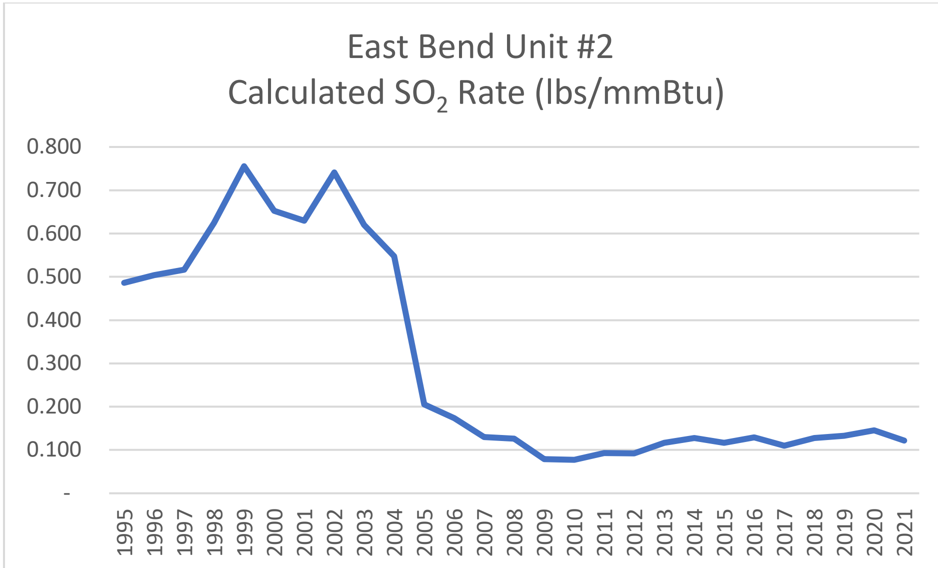

Figure 30: East Bend Station Unit 2 SO_2 Emission Rate Trends (1995-2021)

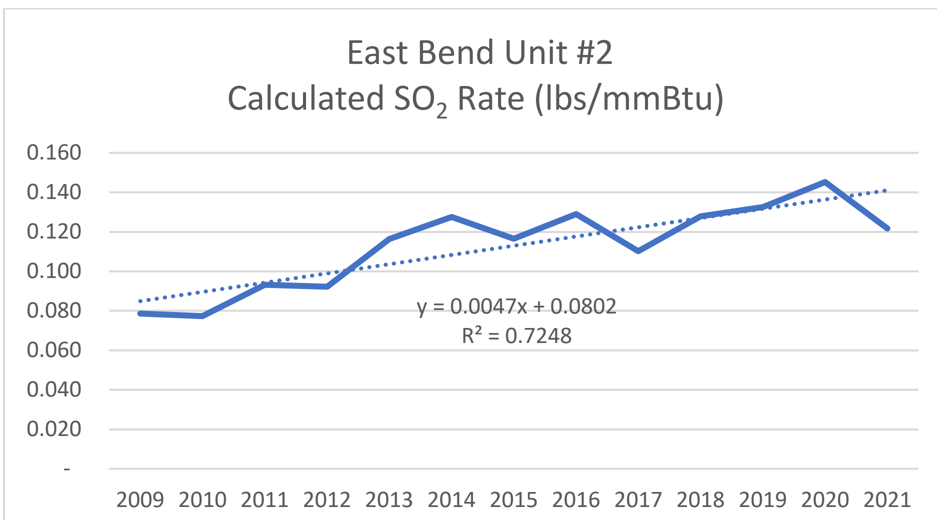

Figure 31: East Bend Station Unit 2 SO_2 Emission Rate Trends (2009-2021)

Similar to the analysis for D.B. Wilson, the NPS evaluated the costs of scrubber replacement with a higher efficiency scrubber. To verify that the assumed emission rates associated with the potential control efficiencies are within the range of rates demonstrated in practice, the NPS compared the anticipated emission rates to values for similar coal-fired units in CAMD. Uncontrolled emissions were calculated using five years of EIA fuels data and AP-42 emission factors for uncontrolled SO_2 emissions from bituminous coal-fired PC dry bottom wall-fired units. [34] Based on this information, the NPS estimates that the existing scrubber system is

[34] To estimate uncontrolled emissions, the NPS used five years (2017-2021) of EIA reported fuel sales data for the D.B. Wilson facility and the AP-42 emission factor (38S) for a PC, dry bottom, wall-fired, bituminous coal unit (38S). This calculated control efficiency is corroborated by control rates reported in BREC's IRP.

achieving 97% control at an average SO_2 emission rate of 0.126 lb/MMBtu over the last five years.

When ranking all coal-fired units from the tightest controlled to the least controlled on a lb/MMBtu basis, the current 97% level of control (0.126 lb/mmBtu) would rank the EGU as 242nd out 460 total coal-fired units. (See attached spreadsheet *CAMD_2021_coal_units_top_performers.xlsx*.)

The NPS evaluated the costs of replacing the existing wet lime scrubber system with a new unit capable of 99% control efficiency. The Duke Energy 2021 Integrated Resource Plan (IRP) indicates that the company intends to operate the East Bend unit until 2035. While the assumed 2035 closure is not federally enforceable, the NPS nonetheless assumed a 10-year equipment life in the wet scrubber analysis. The direct cost-effectiveness estimates suggest that a new scrubber would be cost-effective, however the incremental cost-effectiveness may not be.

In these cases, optimization of the existing scrubber system may be warranted. The NPS recommends that Kentucky evaluate scrubber upgrades to reduce SO_2 emission rates. Achieving 0.046 lb/mmBtu (99% SO_2 control efficiency) would rank Duke Energy East Bend #72, well within the range of achievable emission rates demonstrated in practice.

NO_x Review

The following figure provides NO_x emission rate trends for the East Bend Station Unit 2.

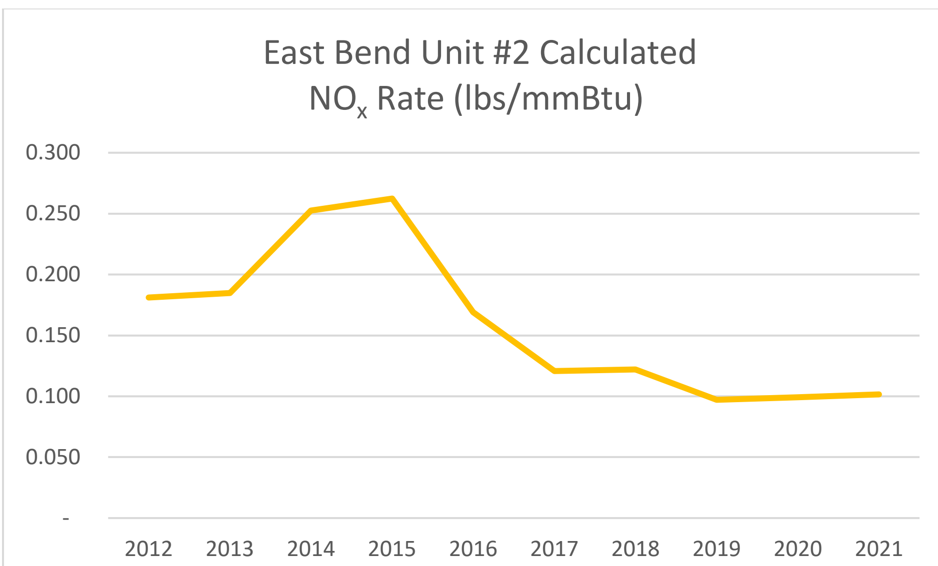

Figure 32: East Bend Station Unit 2 NO_x Emission Rate Trends (2012-2021)

As shown in Figure 32 above, SCR performance on Unit 2 has been steadily improving or consistent in the last seven years. However, rates are still above the 0.08 lb/MMBtu recommended in EPA's good neighbor proposal. The NPS recommends evaluating SCR optimization for Duke Energy East Bend Unit 2.

3.10 Domtar Paper Company, LLC Hawesville Operations

3.10.1 Summary of NPS Recommendations for Domtar Hawesville

NO_x Recommendations

Potential NO_x-emitting units at the facility include two recovery boilers, one bio-fuel "hog" boiler and one lime kiln. The NPS recommends that Kentucky evaluate NO_x control options for these units, including:

- Quaternary air for the recovery boilers;
- SNCR and SCR for the main power bio-fuel boiler;
- SNCR for the lime kiln.

3.10.2 Facility Background

The facility is an integrated pulp and paper mill utilizing the Kraft process for the manufacturing of bleached pulp from wood chips. The plant consists of two areas: the Bleach Pulp Mill (BPM) and the Fine Paper Mill (FPM). Hardwood chips and a small portion of softwood are received at the BPM via truck, barge, and rail car. The chips are screened, then sent to a continuous digester in the pulp mill which cooks the chips into pulp. The pulp is then screened and washed, then transferred to a high-density storage tank. The pulp is bleached, then stored in high-density storage vessels. From this point, the pulp is either processed into sheets that are baled and dried to be sold as Market Pulp or transferred to the FPM to be used in the manufacture of paper.

The pulp is transferred to one of two paper machines at the FPM. Various chemicals and dyes are added to the paper to form different types of specialty paper. Sheet is formed on the Fourdrinier wire, and then dried by steam heated dryers to produce the final product.

Based on the Title V permit (V-18-007) facility has two recovery boilers, one bio-fuel boiler and one lime kiln:

- Emission Unit EU-27 BPM Recovery boiler/furnace no. 3
  - Primary Fuel is BLS blended with 0.12 to 1 volume percent ultra-low sulfur diesel fuel
  - Control equipment includes an Electrostatic Precipitator (ESP)
  - NO_x emissions limited to 150 ppmvd at 8% oxygen
- Emission Unit EU-29 BPM Recovery boiler/furnace no. 4
  - Primary Fuel is BLS blended with 0.12 to 1 volume percent ultra-low sulfur diesel fuel
  - Control equipment includes an Electrostatic Precipitator (ESP)
  - NOx emissions shall not exceed 110 ppm at 8% oxygen
- Emission Unit EU-36 BPM Lime kiln No. 3
  - Primary Fuel is pet coke
  - Control equipment includes an Electrostatic Precipitator (ESP)

- NOx emissions shall not exceed 150 ppm at 10% oxygen
- Emission Unit EU-42 BPM Bio-fuel boiler
  - Primary Fuel is Waste wood/hogged fuel
  - Max heat input 1050 MMBtu/hour; (Hogged fuel input: 570 MMBtu/hour, Natural gas fuel input: 480 MMBtu/hour)
  - Control equipment includes an Electrostatic Precipitator (ESP)
  - NO_x emissions shall not exceed 0.25 lb/MMBtu based on a 30-day average and 830.0 tons/year

Domtar Paper Hawesville is ranked #11 among the Kentucky facilities for haze contributions in NPS Class I areas in the VISTAS region based on AOI source screening results. Using the NPS recommended screening threshold to capture 80% of the total Class I area AOI impact, this source:

- Is on the 80% of total AOI impact list for 1 VISTAS Class I area, Mammoth Cave National Park.
- This facility is on the AoI list because it is a large NO_x source located relatively close to Mammoth Cave NP.

3.10.3 NPS Review and Recommendations for Domtar Hawesville:

Without unit-specific information, the NPS could not evaluate the costs of the recommended NO_x controls. The NPS requests that Kentucky provides the unit-specific emissions and maximum rated heat input capacity for the most-recent five years for the two recovery boilers, the bio-fuel "hog" boiler and the lime kiln. Please also provide emissions for any other major NO_x emission sources at the facility.

The NPS recommends that Kentucky evaluate NO_x control options for the two recovery boilers, the bio-fuel "hog" boiler and the lime kiln at the Domtar Paper facility. This includes quaternary air for the recovery boilers, SNCR and SCR for the main power bio-fuel boiler and SNCR for the lime kiln (exact recommendations will depend on unit specific emissions).

3.11 Carmeuse Lime Pendleton County, Black River Plant

3.11.1 Summary of NPS Recommendations for Carmeuse Lime, Black River Plant

The NPS recommends that Kentucky complete a four-factor analysis for the five rotary lime kilns at the Carmeuse Black River Plant to evaluate the feasibility of retrofitting the kilns with NO_x and SO_2 control systems.

3.11.2 Facility Background

The Black River Plant, owned and operated by Carmeuse Lime & Stone, Inc., is a limestone mine, limestone processing and lime manufacturing plant located in Pendleton County, Kentucky (source ID 21-191-00002). According to the title 5 permit (V-19-011), this facility operates the following kilns:

- Rotary Kilns #1 & #2:
    - Constructed in 1970, Kilns 1-2 have a maximum rated input capacity of 61 tons/hr of limestone each; the primary fuel is pulverized coal with a maximum firing rate of 8.9 tons/hr each. The only controls include a Reverse-Air Baghouse (kiln #1) and a Pulse Jet Baghouse (kiln #2).
- Rotary Kiln #3:
    - Constructed in 1974, Kiln 3 has a maximum rated input capacity of 130 tons/hr of limestone; the primary fuel is pulverized coal with a maximum firing rate of 15.5 tons/hr. The only controls include a Reverse-Air Baghouse.
- Rotary Kilns #4 & #5:
    - Constructed in 1995, Kilns #4 & #5 have a maximum rated input capacity of 110 tons/hr of limestone; the primary fuel is pulverized coal with a maximum firing rate of 9.6 tons/hr. The only controls include a Pulse-Jet Baghouse on each kiln.

The Carmeuse Lime Black River Plant was included on the original NPS Q/d list but did not fall on the initial 80% of the AoI list for any NPS Class I area (it was on the 80% of the AoI list for one USFS Class I area). However, the VISTAS 2028 NO_x and SO_2 emissions used to calculate the EWRT*Q/d values for the source are significantly lower than what the Black River Plant is currently emitting based on the most recent NEI, with 1,445 tons/year NO_x in the 2017 NEI versus 821 tons/year in the VISTAS 2028 inventory (57% of current NO_x emissions) and 1,301 tons/year SO_2 in the 2017 NEI versus 699 tons/year in the VISTAS 2028 inventory (54% of current SO_2 emissions).

According to Table 7-31 in the draft SIP (SO_2 Emissions Comparison Between 2017, 2018, 2019, and 2028), facility-wide emissions have remained at 2017 levels through 2019, with emissions in 2018 representing the highest recent emissions year (Table 7-31 acknowledges the lower 2028 estimates). A review of the most recent Title 5 permit did not indicate any recent shutdowns of equipment or installation of new NO_x or SO_2 emission controls. (The facility-wide potential to emit is significantly higher at 4,594 tons/year NO_x and 4,062 tons/year SO_2.)

Beyond emissions reporting in Table 7-31, the source was not addressed in the draft SIP. Unless the emission reductions reflected in the 2028 inventory are federally enforceable or certain via some other regulatory mechanism, the NPS recommends that the source screening analysis reflect recent actual emissions.

To address the emissions discrepancy in the 2028 estimates, the NPS updated the NO_x and SO_2 emissions using the 2017 NEI emissions for the Carmeuse Black River Plant and recalculated the EWRT*Q/d for the facility (we also revised these calculations for the Kosmos Cement Facility, see Section 3.14). The NPS then reranked the facilities using revised EWRT*Q/d values for Mammoth Cave, Great Smoky Mountains, and Shenandoah NPs. After re-ranking with the revised emissions, the Carmeuse Lime Black River facility falls on the 80% of the AoI list for

Great Smoky Mountains National Park. Accordingly, the NPS has determined that the Carmeuse Lime Black River Plant should remain on the NPS list of sources recommended for four factor analysis.

Including the revised rankings for NPS Class I areas, Carmeuse Lime is ranked #14 among the Kentucky facilities for haze contributions in NPS Class I areas in the VISTAS region based on AOI source screening results. Using the NPS recommended screening threshold to capture 80% of the total Class I area AOI impact, this source is on the 80% of total AOI impact list for 2 VISTAS Class I areas, including Great Smoky Mountains National Park.

3.11.3 NPS Recommendations for Carmeuse Lime:

NO_x Recommendations

The NPS is aware of at least four facilities operating pre-heater rotary lime kilns, like those at the Carmeuse facility, that are equipped with selective non-catalytic reduction (SNCR) systems for NO_x control. These include the Mississippi Lime Prairie du Rocher facility in Illinois, the Lhoist Nelson facility in Arizona, and the Unimin Calera and Lhoist O'Neal facilities in Alabama. These systems achieve up to 50% NO_x control from baseline levels. The NPS recommends that Kentucky complete a four-factor NO_x analysis for the five rotary lime kilns at the Carmeuse Black River Plant to evaluate the technical and economic feasibility of retrofitting these kilns with SNCR.

SO_2 Recommendations

Dry and semi-dry SO_2 add-on control systems are available and are likely to be technically feasible for rotary lime kilns. Dry sorbent injection (DSI) has been deemed technically feasible in the four-factor analyses for other lime plants, and at least one lime kiln (at the Graymont Bellefonte facility in Pennsylvania) has a semi-wet SO_2 scrubbing system installed. The NPS recommends that Kentucky complete a four-factor analysis of the five rotary lime kilns at the Carmeuse Black River Plant to evaluate the technical and economic feasibility of retrofitting these kilns with control systems to reduce SO_2 emissions.

3.12 Century Aluminum of Kentucky, LLC Hawesville Plant

3.12.1 Century Aluminum of Kentucky Hawesville Summary of NPS Recommendations:

Information request: Please describe the anticipated future status of this facility in the SIP and address how regional haze analysis requirements will be considered if restarts.

3.12.2 Facility Background

Century Aluminum of Kentucky, LLC (Century) owns and operates a primary aluminum production facility near Hawesville, Kentucky and has the capability to produce approximately 316,000 tons per year of aluminum ingot. The facility is an existing major source under the Title V and Prevention of Significant Deterioration (PSD) permit programs due to its source-wide emissions. Century produces primary aluminum from raw alumina (Al2O3) by applying electric current to the alumina in vessels termed reduction cells or "pots". Century operates five nearly identical potlines. Each pot is constructed as a complete electrolytic circuit with an anode, cathode, and electrolyte. When electric current is applied through metal rods to the carbon anodes, alumina is reduced producing aluminum metal (Al) and carbon dioxide (CO2). Pots are periodically tapped and molten aluminum is either transferred in crucibles to customers or is first cast into aluminum sows or ingots and then shipped off-site. Raw material inputs to the pots include alumina, bath, carbon anodes, and various other additives to the aluminum production process such as aluminum fluoride.

Operations at the plant began in 1969, and originally included Potlines 1-4, Anode Bake Furnaces 1 & 2, and other support operations. Potline 5 and Anode Bake Furnace 3 began operation in 1999. In 2010, following the implementation of the amperage increase project, the production capacity of the plant increased to 250,000 tons per year from Potlines 1-4 and 66,000 tons per year from Potline 5 (For a total of 316,000 tons per year).

On their webpage, the company notes that the Hawesville plant is their “largest U.S. facility and the only volume producer of high purity aluminum in Western Hemisphere.” The five potlines have a primary aluminum production capacity of 250,000 mtpy.

On June 22, 2022, Century Aluminum announced it will temporarily idle its smelter in Hawesville, Kentucky for a period of approximately 9 to 12 months due to “skyrocketing” energy costs. When operating, the facility is a potential significant source of SO_2 emissions (recent emissions reflect reduced emission levels). The SIP notes that the “Potential to Emit (PTE) is currently 2,937 tons/year which is well below the projected 2028 SO_2 emissions.” It is not clear whether this is reflected in the permit as an enforceable limit.

3.12.3 NPS Information Requests for Century Aluminum of Kentucky Hawesville:

The NPS requests that Kentucky provide the unit-specific emissions for the most-recent several years representative of typical operations at the facility. Given this facility’s potential impacts to nearby Class I areas (the #2 Kentucky facility based on AoI impacts), the NPS recommends that the SIP address the anticipated future status of this facility and how regional haze analysis requirements will be handled for the facility if or when it restarts.

3.13 Kentucky Utilities Company Brown Station

3.13.1 Brown Station Summary of NPS Recommendations:

NPS Information Request: Online resources indicate that Unit 3 is expected to retire by 2028. Is this the case or will Brown station continue to operate?

If the facility continues operating beyond 2028, the NPS recommends Kentucky require:

- Scrubber operation reflecting 2020 SO_2 emission rates.
- SCR operation reflecting 2019–2021 NO_x rates (this may be required under the “good neighbor” proposal).

3.13.2 Facility Background:

E.W. Brown Generating Station is a 464.0-megawatt (MW) coal-fired power station operated by Kentucky Utilities Company near Harrodsburg, Kentucky. A description of Brown Station units, in-service dates and existing control equipment follows:

- Units 1 & 2 shutdown in 2019.
- Unit 3 is a Tangentially-fired 464 MW boiler
    - SO_2 Control: Wet Limestone Scrubber
    - NO_x Control: Low-NO_x Burners (LNB) with w/ Closed-coupled SOFA and SCR

Brown Station is ranked #9 among the Kentucky facilities for haze contributions in NPS Class I areas in the VISTAS region based on AOI source screening results. Using the NPS-recommended screening threshold to capture 80% of the total Class I area AOI impact, this source:

- Is on the 80% of total AOI impact list for 3 VISTAS Class I areas, including Great Smoky Mountains National Park.
- Ranks #116 of 238 VISTAS state sources for cumulative impact to VISTAS Class I areas.

Of 1,382 power plants in EPA's Clean Air Markets Database (CAMD) in 2021, Brown Station ranked #206 for SO_2 emissions (331 tons) and #322 for NO_x emissions (332 tons).

3.13.3 NPS Review of Brown Station:

SO_2 and NO_x Review:

The following figures provide SO_2 and NO_x emission rate trends for Brown Station Unit 3. Current emissions are much lower than historic levels due to control equipment installations in 2010 and 2012. Furthermore, online resources indicate that Unit 3 is expected to retire by 2028.

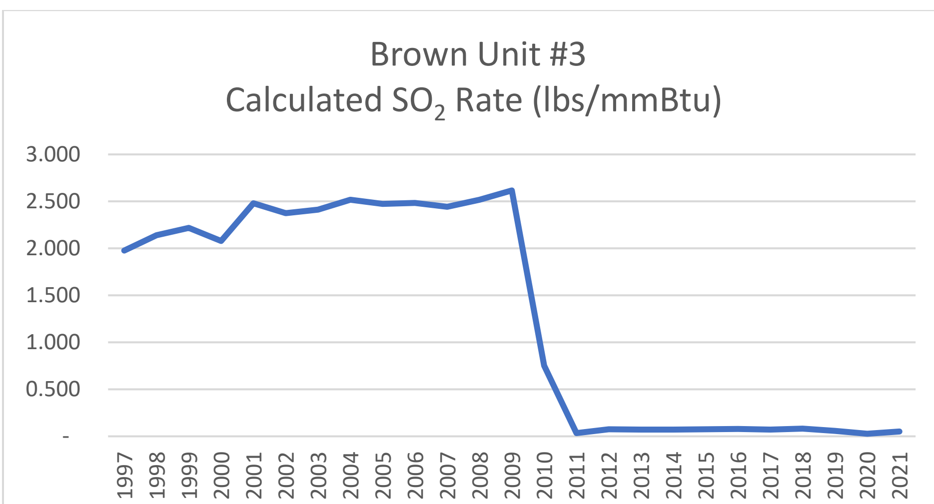

Figure 33: E.W. Brown Station Unit 3 SO_2 Emission Rate Trends in lb/MMBtu (1997-2021)

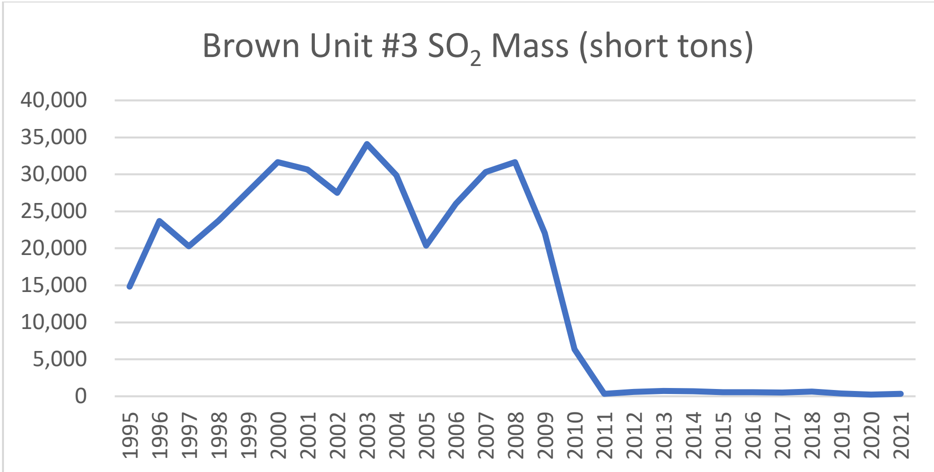

Figure 34: E.W. Brown Station Unit 3 SO_2 Emission Rate Trends in tons/year (1995-2021)

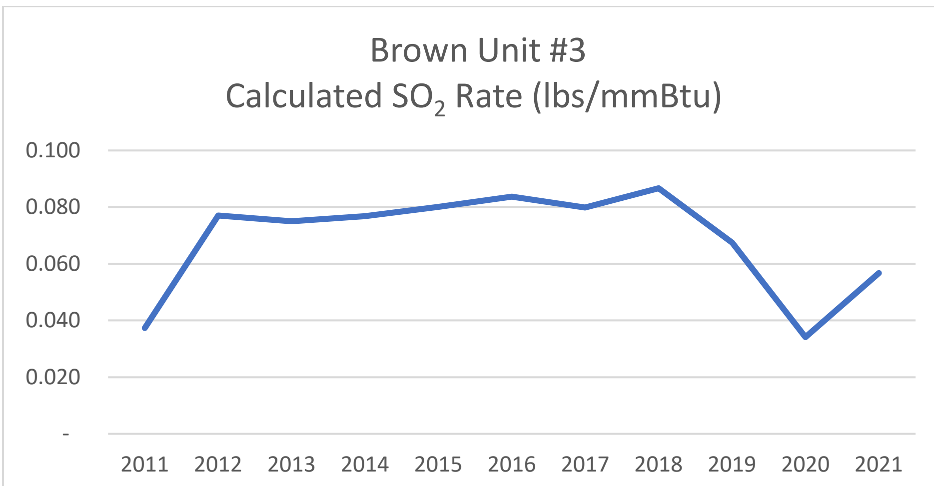

Figure 35: E.W. Brown Station Unit 3 SO_2 Emission Rate Trends in lb/MMBtu (2011-2021)

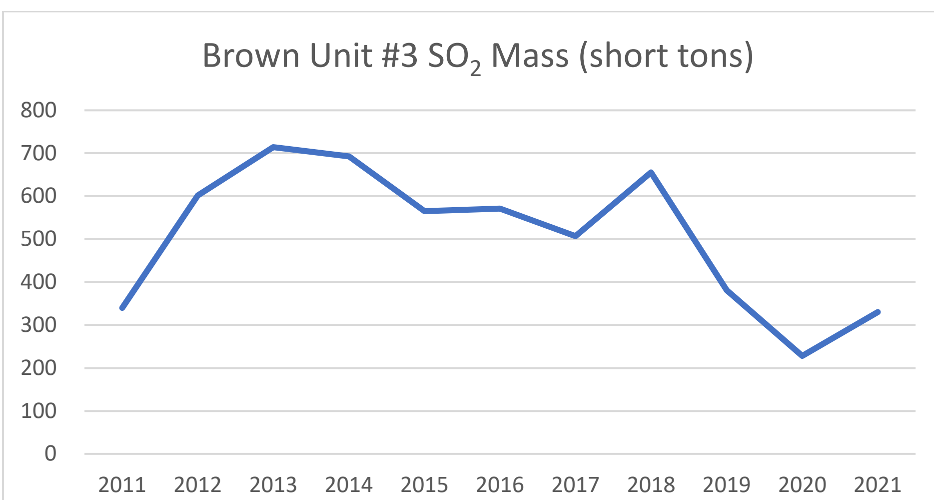

Figure 36: E.W. Brown Station Unit 3 SO_2 Emission Rate Trends in tons/year (2011-2021)

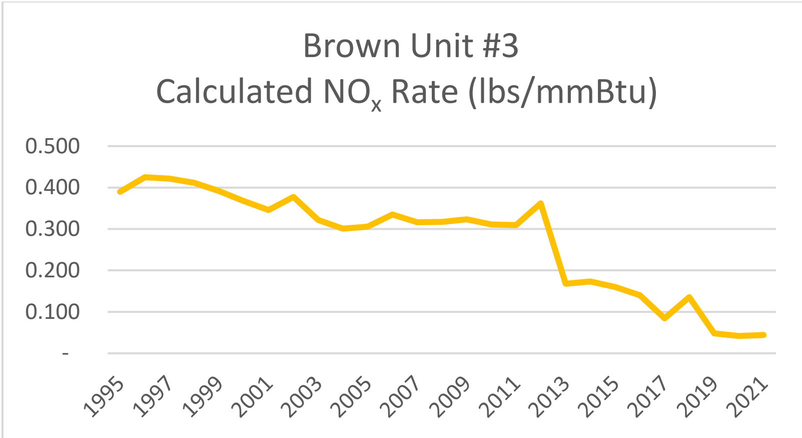

Figure 37: E.W. Brown Station Unit 3 NO_x Emission Rate Trends in lb/MMBtu (1995-2021)

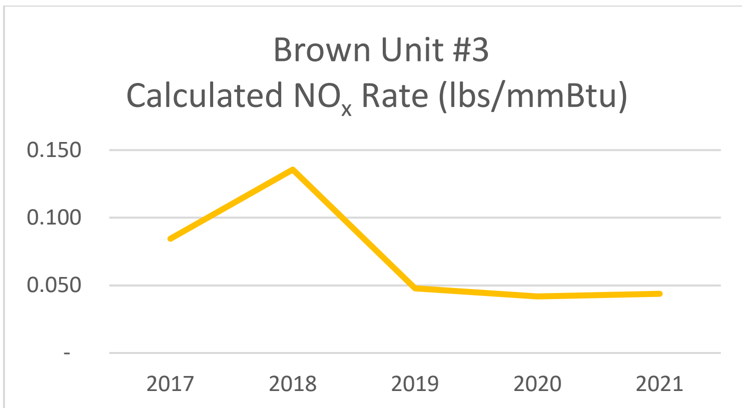

Figure 38: E.W. Brown Station Unit 3 NO_x Emission Rate Trends in lb/MMBtu (2017-2021)

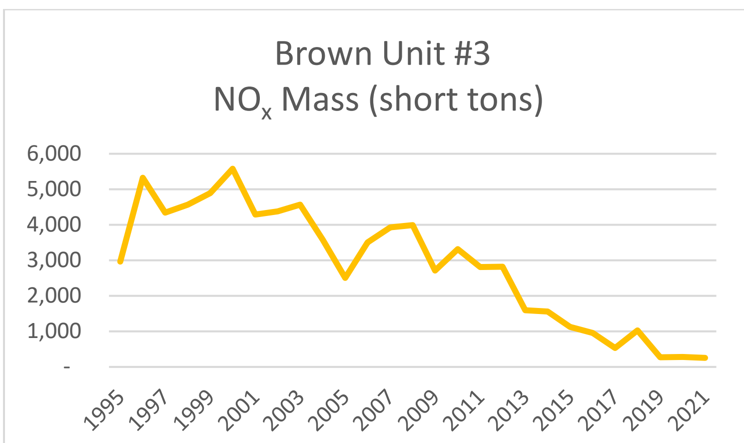

Figure 39: E.W. Brown Station Unit 3 NO_x Emission Rate Trends in tons/year (1995-2021)

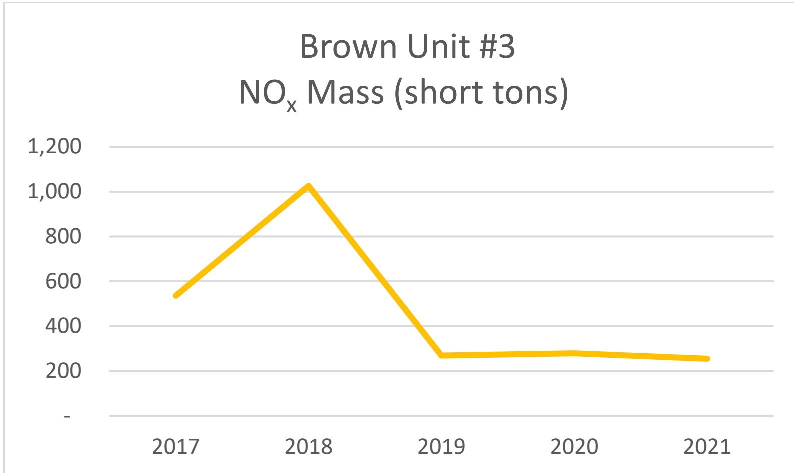

Figure 40: Brown Station Unit 3 NO_x Emission Rate Trends in tons/year (2017-2021)

If the facility continues operating beyond 2028, the NPS recommends requiring scrubber operation such that SO_2 emissions reflect 2020 emission rates. In addition, the SCR may require limits to ensure that controlled NO_x rates remain at 2019-2021 levels. This may be required under the "good neighbor" proposal.)

3.14 Kosmos Cement Company

3.14.1 Kosmos Cement Summary of NPS Recommendations:

The NPS requests that Kentucky:

- Provide a unit-specific emission inventory for all major NO_x-emitting units at the facility,
- Verify when the SNCR began operation, and
- Provide the revised annual NO_x emissions from the facility in the draft SIP.

NO_x limits required under the Consent Decree (CD) may address NPS concerns with respect to this facility. However, the NPS requests an opportunity to review the additional information prior to providing final conclusions and recommendations for the facility.

3.14.2 Facility Background:

The Louisville Plant, owned and operated by Kosmos Cement Company, LLC., is a Portland and masonry cement manufacturing plant located in Jefferson County, Kentucky (source ID 0060). According to the most recent Title V operating permit (O-0060-19-V), this facility operates a Preheater/Precalciner Kiln (Kiln K-90).

At the facility, raw Gypsum, flyash, some clay and mill scale are purchased, dried, and crushed into a fine powder, preheated and added to the rotary kiln. The kiln is fired by coal and petroleum coke, which are milled and injected into the kiln in a fine powder form. Tire-derived fuel, No. 2 fuel oil (diesel) and natural gas, as well as used and waste oils, may also be utilized.

The clinker is cooled with ambient air, and gypsum is added in the finishing mill process to form either Portland or masonry cements. The cement is either bagged or bulk-loaded onto trucks, rail cars or barges in the product handling or "shipping" process.

The Kosmos Cement Plant was included on the original NPS Q/d list but did not fall on the initial 80% of the AoI list for any NPS Class I area. However, the VISTAS 2028 NO_x emissions used to calculate the EWRT*Q/d values for the source are significantly lower than what the Louisville plant is currently emitting based on 1,947 tons/year NO_x in the 2017 NEI versus 850 tons/year in the VISTAS 2028 inventory (56% of reported 2017 NO_x emissions).

Using 2017 emission estimates for the facility, Kosmos Cement is ranked #10 among the Kentucky facilities for haze contributions in NPS Class I areas in the VISTAS region based on AOI source screening results. Using the NPS-recommended screening threshold to capture 80% of the total Class I area AOI impact (revised), this source falls on the 80% of total AOI impact list for Mammoth Cave National Park.

Based on the most recent Title V permit (O-0060-19-V), a requirement to install and operate Selective Non-Catalytic Reduction (SNCR) to control NO_x emissions from the Kiln (K-901) was incorporated into the permit in 2017 (Construction Permit C-0060-1055-17-V). This requirement was added to comply with a Consent Decree (CD). The CD limits NO_x emissions for Louisville Kiln to 2.1 lbs NO_x/ton of clinker (30-Day Rolling Average).[35]

3.14.3 NPS Information Request for Kosmos Cement:

The NPS requests that Kentucky provide a unit-specific emission inventory for all major NO_x-emitting units at the facility. The NO_x limits required under the CD may address NPS concerns with respect to this facility. However, the NPS requests an opportunity to review the additional information prior to providing final conclusions and recommendations for the facility.

3.15 Isp Chemicals Inc.

3.15.1 Isp Chemicals Summary of NPS Recommendations:

The NPS requests that Kentucky:

- Clarify the emission discrepancy between the 2028 VISTAS AoI inventory and the 2017 NEI.
- Address the operational status of this facility in the SIP.
- If SO_2 emissions are projected to increase above 2017 levels, please provide a summary of the major SO_2-emitting units at the plant.

3.15.2 Facility Background:

Isp Chemicals is ranked #12 among the Kentucky facilities for haze contributions in NPS Class I areas in the VISTAS region based on AOI source screening results. Using the NPS-

[35] EPA's "good neighbor" proposal includes a 2.8 lb NO_x/ton clinker 30-day rolling average limit for a preheater/precalciner kiln.

recommended screening threshold to capture 80% of the total Class I area AOI impact, this source:

- Is on the 80% of total AOI impact list for 1 VISTAS Class I area, Great Smoky Mountains National Park.
- Ranks #104 of 238 VISTAS state sources for cumulative impact to VISTAS Class I areas.

However, the NPS notes that the VISTAS 2028 inventory used to develop the AoI rankings projects that plantwide SO_2 emissions will be 2,095 tons/year in 2028. The most-recent NEI reports 0.5 tons/year of SO_2 emitted in 2017.

3.15.3 NPS Information Request for Isp Chemicals:

Please clarify the emission discrepancy between the 2028 VISTAS AoI inventory and the 2017 NEI address the operational status of this facility in the SIP. If SO_2 emissions are projected to increase beyond 2017 levels, please provide a summary of the major SO_2-emitting units at the plant.

3.16 East Kentucky Power Coop Cooper Station

3.16.1 Cooper Station Summary of NPS Recommendations:

The NPS requests that Kentucky clarify the operational status of the Cooper Station. Recent utilization rates for Cooper units 1 and 2 are low. If the facility does not continue with current (low) utilization rates additional review may be necessary. Specifically:

- SO_2:
  - If the unit increases operation to previous levels, the NPS recommends evaluating and optimizing the FGD system on Unit 1 to achieve SO_2 emission rates consistent with those on Unit 2.
- NO_x
  - Unit 1 lacks post-combustion NO_x controls:
    - Additional NO_x control is likely not cost-effective under the current low utilization rates.
    - The NPS recommends evaluating and implementing SCR or SNCR if the facility increases operation to previous levels.
  - Unit 2 is equipped with SCR:
    - The SCR on Unit 2 is not very efficient on a lb/MMBtu basis
    - The NPS recommends evaluating upgrades/optimization the SCR on this unit to achieve better performance.
  - Neither unit would meet the NO_x limit recommended for utility boilers under EPA's proposed "good neighbor" rule of 0.08 lb/MMBtu.

3.16.2 Facility Background:

The Cooper Station is an electric power generation plant located on Lake Cumberland, in Pulaski County, Kentucky. The station consists of two coal-fired boilers (with No. 2 fuel oil for start-up and stabilization), each supplying steam to a dedicated turbine-generator. Cooper emission unit (EU) 1 is an existing pulverized coal-fired, dry bottom, wall-fired boiler equipped with an electrostatic precipitator (ESP), low NO_x burners, Dry Flue gas Desulfurization (DFGD) system, and Pulse Jet Fabric Filter (PJFF). Cooper EU 2 is an existing pulverized coal fired dry bottom boiler equipped with low NO_x burners, DFGD system, Selective Catalytic Reduction (SCR), PJFF and FuelSolv.

Cooper Station is ranked #15 among the Kentucky facilities for haze contributions in NPS Class I areas in the VISTAS region based on AOI source screening results. Using the NPS recommended screening threshold to capture 80% of the total Class I area AOI impact, this source:

- Is on the 80% of total AOI impact list for 2 VISTAS Class I areas, including Great Smoky Mountains National Park.
- Ranks #120 of 238 VISTAS state sources for cumulative impact to VISTAS Class I areas.

Of 1,382 power plants in EPA's Clean Air Markets Database (CAMD) in 2021, Cooper Station ranked #223 for SO_2 emissions (165 tons) and #313 for NO_x emissions (349 tons).

3.16.3 NPS Review of Cooper Station:

SO_2 and NO_x Review

The following figures provide SO_2 and NO_x emission rate trends for Cooper Station Units 1 and 2. The NPS notes that current emissions are much lower than historic levels due to low utilization beginning in 2015.

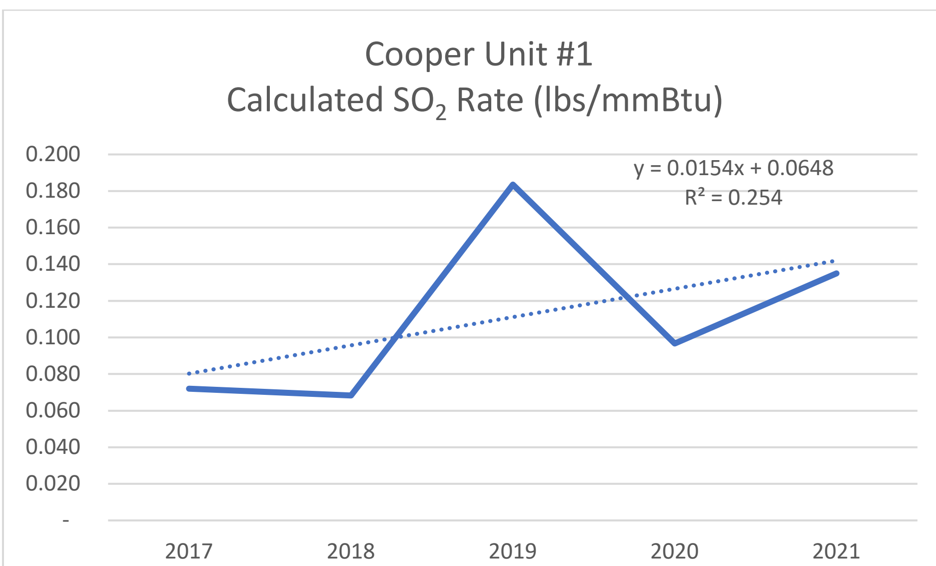

Figure 41: Cooper Station Unit 1 SO_2 Emission Rate Trends (2017-2021)

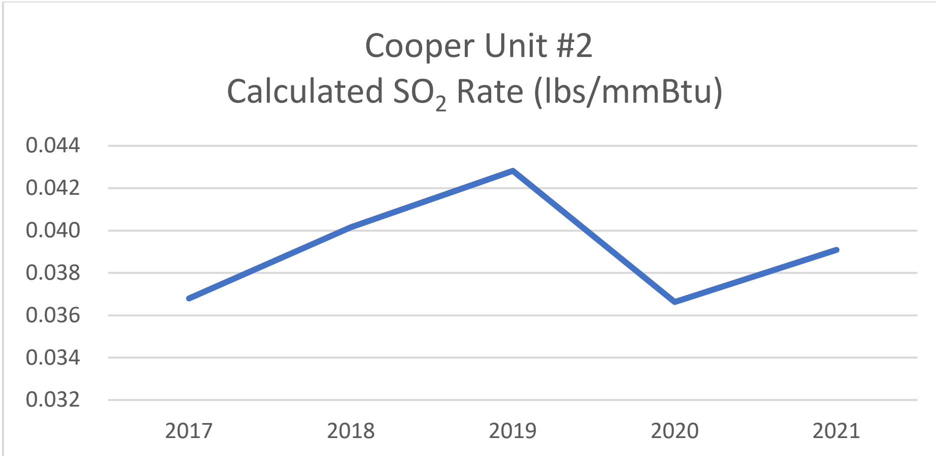

Figure 42: Cooper Station Unit 2 SO_2 Emission Rate Trends (2017-2021)

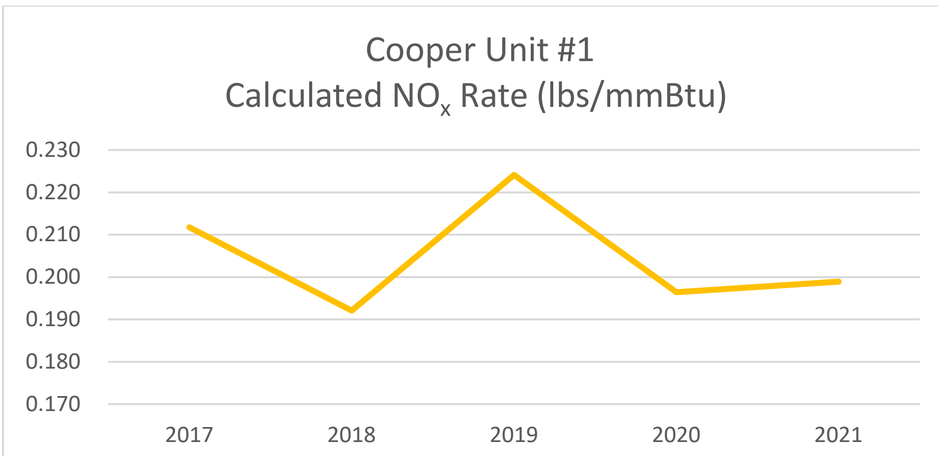

Figure 43: Cooper Station Unit 1 NO_x Emission Rate Trends (2017-2021)

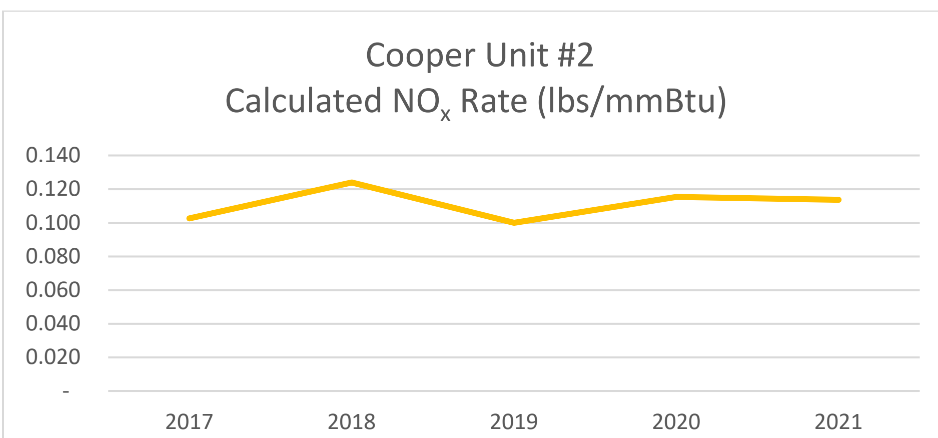

Figure 44: Cooper Station Unit 2 NO_x Emission Rate Trends (2017-2021)

Cooper Unit 1:

- SO_2
  - SO_2 mass emissions are quite low (2017-2021 average is 53 tons/year SO_2) due to low utilization (1,465 hours/year operation on average 2017-2021).
  - A spike in SO_2 emissions occurred in 2019.
  - If the facility increases operation to previous levels, the NPS recommends that the FGD system on unit 1 be optimized to achieve SO_2 emission rates consistent with those achieved on unit 2 and to ensure emission spikes, such as the one that occurred in 2019 do not occur.
- NO_x
  - Unit 1 lacks post combustion controls and NO_x emissions are poorly controlled.
  - Under the current low utilization rates, the addition of post combustion controls is likely not cost-effective for unit 1. If the facility increases utilization in the future, the NPS recommends evaluating the addition of post-combustion NO_x controls.

Cooper Unit 2:

- SO_2
  - SO_2 mass emissions are quite low (2017–2021 average is 57 tons/year SO_2) due to low utilization (2,020 hours/year operation on average 2017–2021).
  - SO_2 appears consistently well-controlled on a lb/MMBtu basis.

- NO_x
  - The existing SCR on Unit 2 is not very efficient (emission rates between 0.103 lb/MMBtu and 0.125 lb/MMBtu) and may be a candidate for optimization.
  - The NPS recommends that Kentucky consider whether the SCR on this unit could achieve better performance.

Unit 1 and Unit 2 do not currently meet the NO_x limit recommended for utility boilers under EPA's proposed "good neighbor" rule of 0.08 lb/MMBtu. If East Kentucky Power Cooperative continues to operate these units, additional NO_x control may be necessary.

Appendix H-3

Public Hearing Notice

KENTUCKY DIVISION FOR AIR QUALITY
PUBLIC NOTICE FOR
Revision to Kentucky Regional Haze SIP for the Second Planning Period

The Kentucky Energy and Environment Cabinet (Cabinet) herby gives notice regarding its pre-hearing draft of the Regional Haze State Implementation Plan (SIP) for Kentucky's Class I area (Mammoth Cave National Park) for the Second Planning Period (2019-2028). This pre-hearing draft SIP was prepared in accordance with the Federal Regional Haze Rule provisions specified in 40 CFR 51.308(f) and the U.S. Environmental Protection Agency's guidance for implementing the rule to comply with Section 169 of the Clean Air Act, as amended in 1990. On August 9, 2022, the Cabinet submitted the draft plan to Federal Land Managers (FLMs) from the U.S. Fish & Wildlife Service, National Park Service, and U.S. Forest Service. Comments from the U.S. Forest Service and National Park Service were received on October 10, 2022 and October 11, 2022, respectively. These comments are being made available to the public as part of the prehearing submittal. The FLM's comments and the Cabinet's responses are located in Appendix H.

In accordance with 40 CFR 51.102, the Cabinet is making this proposed plan available for public inspection and provides the opportunity for public comment. The proposed plan can be found at **https://eec.ky.gov/Environmental-Protection/Air/Pages/Public-Notices.aspx**. The public comment period will be open from June 4, 2024 through July 11, 2024. Comments should be submitted in writing to the contact person by either mail or email.

The Cabinet will conduct a virtual public hearing on July 11, 2024, at 10:00 a.m. (Eastern Time). This hearing will be held to receive comments on the proposed SIP revision. This hearing is open to the public and all interested persons will be given the opportunity to present testimony. To assure that all comments are accurately recorded, the Division requests that oral comments presented at the hearing are also provided in written form, if possible. It is not necessary that the hearing be held or attended in order for persons to comment on the proposed submittal to EPA. If no request for a public hearing is received by July 5, 2024, the hearing will be cancelled, and notice of the cancellation will be posted at **https://eec.ky.gov/Environmental-Protection/Air/Pages/Public-Notices.aspx**. Written comments should be sent to the contact person and must be received by close of business on July 11, 2024, to be considered part of the public record.

Please note that registration is required to participate in this hearing. You must either email your name and mailing address to lesliem.poff@ky.gov or mail this information to Leslie Poff, Division for Air Quality, 300 Sower Building, 2nd Floor, Frankfort, KY 40601. Please put "Registration for Kentucky Regional Haze Public Hearing" as the subject line, and state in the body of the message if you plan to speak during the hearing.

CONTACT PERSON: Leslie Poff, Environmental Scientist Consultant, Program Planning & Administrative Branch, Division for Air Quality, 300 Sower Boulevard, Frankfort, Kentucky 40601. Phone: (502) 782-6735; Email: lesliem.poff@ky.gov.