Hearing Officer's Report and Recommendations

Enviva Pellets Sampson, LLC Public Hearing
July 15, 2019
Sampson Community College, Activity Center
Clinton, NC

Public Comment Period: June 12, 2019 through July 19, 2019

Pertaining to Permit Application No. 8200152.18A and
Draft Air Permit No. 10386R04 for:

Enviva Pellets Sampson, LLC
5 Connector Road, US 117
Faison, Sampson County, NC
Facility ID No. 8200152
Fee Class: Title V
PSD Class: Major

Hearing Officer
Joe Foutz, Regional Compliance Supervisor, Mooresville Regional Office

Background

On March 19, 2018, the North Carolina Department of Environmental Quality (NC DEQ), Division of Air Quality (DAQ) received an air quality permit application (App. No. 8200152.18A) from Enviva Pellets Sampson, LLC for the modification of its facility located at 5 Connector Road, US 117 in Faison, North Carolina. The facility produces wood pellets using the following process equipment: log chipper, green wood hammermills, a bark hog, wood-fired rotary dryer, dry hammermills, pellet presses and coolers, product loadout operations, and other ancillary activities. The permit application requests the following operational modifications:

1. Increase pellet production rate from 537,625 oven-dried tons (ODT) per year to 657,000 ODT per year by upgrading pellet dies;
2. Increase the amount of softwood processed from a maximum of 75% to a maximum of 100%;
3. Permit the regenerative thermal oxidizer (CD-RTO) which follows the current wet electrostatic precipitator (CD-WESP) on the wood-fired direct heat drying system;
4. Remove the green wood hammermill bin vents/baghouses and recirculate the exhaust directly to the wet electrostatic precipitator/ regenerative thermal oxidizer (CD-WESP/CD-RTO) system;
5. Decrease the amount of wood bypassing the Dry Hammermills (ES-HM-1 through ES-HM-8) from 25% to 15%;
6. Add dry shavings handling and storage silo to allow the facility to process purchased shavings that will not require drying.

These changes are being requested to meet new customer softwood percentage and production rate demands and to incorporate emission reduction efforts.

The facility is a major source under 40 CFR Part 51 and 15A NCAC 02D .0530 Prevention of Significant Deterioration (PSD) rule and is subject to Best Available Control Technology (BACT) emission limits for VOCs, nitrogen oxides, carbon monoxide, particulate matter (including PM10/2.5), and greenhouse gases. The permit application is being submitted as a PSD modification.

On June 12, 2019, a notice of public hearing was posted in the Fayetteville Observer and Sampson Independent and on the DAQ website. The public hearing was held on July 15, 2019 in Clinton, NC at the Sampson Community College, Activity Center. The public comment period was June 12, 2019 through July 19, 2019. Copies of the permit application review and draft air permit were also posted on the Division of Air Quality website for public review. Copies of the air quality permit application and related documents were available for public review in DAQ's Raleigh Central Office (RCO) and Fayetteville Regional Office (FRO) throughout the public comment period.

Air Quality Permit Application and Review

DAQ's mission is to work with the state's citizens to protect and improve outdoor, or ambient, air quality in North Carolina for the health, benefit and economic well-being of all. To accomplish this mission, DAQ requires industrial facilities to apply for and receive air quality permits prior to construction and operation or modification of the air pollution sources to ensure compliance with all applicable federal and state regulations. The initial permit for construction of the Enviva Sampson facility was issued on

November 17, 2014 as a Title V/PSD major facility. As a result of failed stack tests in 2017 and 2018, Enviva entered into a Special Order by Consent (SOC). Part of the SOC required Enviva to install new control equipment to control emissions from the wood-fired direct heat drying system and green wood hammermill. Enviva submitted an application on March 19, 2018 to install the RTO. In order to reduce emissions as soon as possible, the company commenced construction of the RTO prior to issuance of the PSD permit that incorporates the installation of the RTO on the dryer system. The construction of the RTO was completed and continuous operation began on December 14, 2108. Stack testing to demonstrate compliance with the VOC emission rate of 0.15 lbs per ODT of wood was conducted on February 7, 2019. The stack test report submitted to DAQ indicated compliance with the VOC emission rate for the wood-fired direct heat drying system while processing 50% softwood. The report was reviewed and approved by DAQ's Stationary Source Compliance Branch. Enviva Pellets Sampson, LLC also provided verification by the Planning Director of Sampson County that the requested modification is in compliance with all local zoning ordinances and requirements for this permit modification.

Betty Gatano, permit engineer in the DAQ's RCO, reviewed the application submitted by Enviva and determined that the modifications requested by the facility would comply with all applicable federal and state air quality regulations. This facility is currently in operation and has implemented some of the changes as agreed under the facility's SOC.

Unless the public comments received during the public hearing reveal that DAQ was in error or incomplete in its evaluation of the proposed wood pellets plant from an air quality standpoint, and if the applicant has met all federal and state regulations for the protection of the environment, the division is obligated to issue an air permit to Enviva Pellets Sampson, LLC. The following hearing officer's responses to written and oral public comments will address issues raised in light of these regulations.

Public Comments

119 people were in attendance at the public hearing on July 15, 2019. Twenty-five spoke in favor of the project. Thirty-four spoke against the project. Of the people speaking at the public hearing, four provided written comments in favor of the project and five provided written comments against the project.

Additionally, five written comments and informational materials were received as well as 1,296 emails to the DEQ and 68 emails to DAQ during the public comment period.

Of the written and oral comments received, most opposed DAQ granting the air permit. The comments have been separated into two sections. The first section addresses the comments submitted by the Environmental Integrity Project (EIP) and the Southern Environmental Law Center (SELC). Many of the EIP and SELC comments are associated with the BACT and Section 112 of the Clean Air Act - 40 CFR Part 63 - Maximum Achievable Control Technology (MACT) determination prepared as part of the air permit application. The second section addresses comments received from individuals representing themselves or submitted on behalf of an organization. Those comments with similar concerns have been grouped together.

SECTION 1 - Comments from the Environmental Integrity Project (EIP) and Southern Environmental Law Center (SELC)

Multiple comments were provided by EIP and SELC and submitted on behalf of numerous organizations. In general, the comments state that DAQ's evaluation of the air permit application is flawed and expressed concerns with the precedent the air permit review and BACT determinations establish that will allow similar future sources to evade industry-standard control technology for reducing VOCs. EIP's and SELC's comments are summarized below.

Comment 1 (EIP & SELC Letter Item - I.A):

The draft permit's VOC BACT determinations are deeply flawed and establish an unacceptable precedent. Enviva's BACT analysis, adopted by DAQ, does not require any VOC controls on the plant's dry hammermills and pellet coolers based on the premise that readily available and efficient controls are not cost effective. This determination is in stark contrast to the reality in the wood pellet industry, which is that the vast majority of comparable pellet plants have either installed these controls or have applied for permits to do so in the near future. The Sampson plant will ultimately install controls as MACT, the precedent-setting nature of DAQ's BACT determination will lend credence to the idea that major sources of air pollution subject to stringent BACT requirements can avoid controls that are actually in use at identical minor source facilities simply be utilizing an arbitrary "cost-per-ton" economic analysis which does not appear in any statute or regulations. Post-dryer VOC controls are now industry standard and constitute BACT. There are sixteen wood pellet plants in the US with a production range greater than 500,000 tons per year. All but two of these plants operate VOC controls on at least some post-dryer units and each of the two remaining plants likely will utilize controls in the near future.

Hearing Officer's Response to This Comment:

According to EPA guidance, BACT is a case-by-case, state-by-state analysis defined by economic, environmental, and energy factors. While control technology in use at facilities in other parts of the country can provide valuable input for a state's permitting decision, it cannot substitute for the case-by-case analysis required by the Clean Air Act. It is well established that in the context of the case-by-case analysis required under BACT, there is no guarantee that a facility in one area will have the same emissions or the same control technology requirements as the same type of facility in another area. [1]

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 2 (EIP & SELC Letter - Item I.B):

Enviva's BACT determination is also contrary to recent BACT determinations for similar pellet mills. Many facilities utilize VOC controls, so they can be classified as minor or synthetic minor sources for PSD and thus, these facilities have not undergone a PSD BACT analysis, However, over the past year and a half, three states have made the explicit determination that post dryer VOC

[1] See EPA, Guidance for Determining BACT Under PSD (1974), available at https://www.epa.gov/sites/production/files/2015-07/documents/bactupsd.pdf

controls are cost-effective including RTOs/RCOs or other technology achieving at least 95% VOC reduction is BACT. Texas required a facility, German Pellets, to undergo retroactive PSD permitting as a result of a 2014 audit that determined the VOC potential emissions were 580 tons per year. Although the facility initially determined that "good operating and maintenance practices" constituted BACT for the post-dryer units, Texas eventually found that an RTO or other technology achieving at least 95% VOC reduction is BACT. Texas noted that these technologies have been ***firmly established by industry practice as technically and economically feasible as BACT.***

A facility (Drax Morehouse) in Louisiana was originally permitted as a synthetic minor source but admitted its VOC emissions were well above the major source threshold due to post dryer emissions. Louisiana required the facility to submit a major source PSD application. The facility analyzed both an RTO and and RCO for post dryer VOC controls finding that an RCO would be more cost effective due to lower costs and what it characterized as higher control efficiency for an RCO.

A facility, Enviva Cottondale, in Florida is currently undergoing retroactive PSD permitting after underestimating VOC emissions. The facility stated an RTO or similar device is not economically feasible for the pellet coolers, arriving at a cost per tons figure of $6,991. Florida, however, rejected Enviva's cost figure, and instead found the figure would be between $ 2,947 and $4,090 per ton with the difference in costs arising because Florida rejected the consideration of particulate matter controls in the VOC BACT determination.

Hearing Officer's Response to This Comment:

A BACT determination is a case-by-case, state-by-state analysis and is specific to a given industry, facility, and location. Control devices determined to be BACT for one facility or multiple facilities are not by default deemed BACT at all other similar facilities. There are many factors that may result in a control option being deemed not cost effective in one location while being considered cost effective in another. Equipment and labor costs, fuel availability (e.g., natural gas vs. propane), waste disposal options, and other factors vary across the country and may result in a control option being deemed not cost effective in one area while being considered cost effective in others.

While the three facilities with recent BACT decisions were not specifically identified in Enviva Sampson's BACT analysis, the controls used by the facilities - RTOs and RCOs - were included. DAQ ultimately eliminated these control devices as BACT for the dry hammermills, pellet presses and coolers, and dry wood handling due to economic, environmental and energy factors.

Texas BACT Determination for German Pellets

The Texas Commission on Environmental Quality (TCEQ), cited in EIP's and SELC's comments, applies a different methodology for determining BACT than North Carolina. The TCEQ has developed a three-tiered approach to evaluate BACT proposals in New Source Review (NSR) air permit applications. A BACT evaluation begins at the Tier I and progresses in sequence to the Tier

II and Tier III only if necessary. [2] The TCEQ determined a Tier I BACT was applicable for German Pellets, meaning that the technical practicability and economic reasonableness of RCOs/RTOs at reducing VOC have been demonstrated for the industry.

The three-tiered approach to BACT analysis differs from EPA's and North Carolina's "top-down" process. The "top down" methodology results in the selection of the most stringent control technology in consideration of the technical feasibility and the economic, environmental, and energy factors. Control options are first identified for each pollutant subject to BACT and evaluated for their technical feasibility. Options found to be technically feasible are ranked in order of their effectiveness and then further evaluated for their economic, environmental, and energy factors. In the event that the most stringent control identified is selected, no further analysis of controls is performed. If the most stringent control is ruled out based upon economic, environmental, and energy factors, the next most stringent technology is similarly evaluated until BACT is determined.

EPA's and North Carolina's "top down" approach does not establish controls that are deemed technically practicable and economically reasonable across an industry (i.e., the Tier 1 approach), but controls are evaluated for each specific facility based technical feasibility, control efficiency, and energy, economic, and environmental impacts.

EPA has approved the North Carolina State Implementation Plan, making DAQ the permitting authority for NSR permitting program in the State. With a fully authorized NSR permitting program, DAQ is under no obligation to follow procedures in Texas, other states, or local agencies in conducting BACT analyses. DAQ's evaluation of BACT at Enviva Sampson is consistent with methodology used by the Division and is in line with EPA's "top-down" BACT process.

Louisiana BACT Determination for Drax Morehouse

A BACT analysis is a site-specific, case-by-case, and state-by-state analysis. Controls that may be cost effective in one part of the country (Louisiana) may not be cost effective elsewhere (North Carolina). One example of regional differences in the BACT analyses at Drax and Enviva Sampson is in the cost of natural gas. The cost of natural gas was $3.96/1,000 scf in Louisiana in December 2018 compared to $6.57/1,000 scf in North Carolina (165% higher cost) during that same time period. Further, natural gas is not currently available at the Enviva Sampson site, and the cost of the more expensive propane was used in control cost estimates at Enviva Sampson. Because of the regional cost differences among other factors (e.g., softwood percentage, throughput, etc.), any conclusions drawn from the Drax Morehouse BACT determination are not appropriate for the situation at Enviva Sampson.

Florida BACT Determination for Enviva Cottondale

Florida's cost estimates for VOC controls on the pellet coolers stacks were reduced because the state excluded the cost of the particulate matter (PM) control device. In its request letter for additional

[2] Air Pollution Control How to Conduct a Pollution Control Evaluation, TCEQ, retrieved from https://www.tceq.texas.gov/assets/public/permitting/air/Guidance/NewSourceReview/airpoll_guidance.pdf

information from the Cottondale facility, Florida's Department of Environmental Protection stated, "[s]ince a particulate matter control device is already proposed in the application as BACT for PM, the Department determines that the cost of the PM control device should be considered a "sunk cost" in determining the costs of a VOC control. It is a fundamental principle of engineering economics that sunk costs are not be considered in the analysis of future costs of a project. For this reason, it is improper to lump the cost of the PM control device in with the cost of the RTO in the decision to install, or not install, an RTO."[3]

Because DAQ determined the existing cyclones are BACT for PM for the pellet presses and coolers, the cost of the baghouse or other PM controls post cyclones is not a "sunk cost" and should be included in the cost of the RTO on the pellet presses and coolers at Enviva Sampson (see Response to Comment 9 on page 15 below). Any conclusions drawn from Florida's determination are not appropriate for the situation at Enviva Sampson.

In addition, Florida ultimately decided an RTO was not BACT for the pellet coolers. Florida's technical evaluation for the PSD permit for the Cottondale facility cites economic, environmental, and energy impacts of the RTO as justification for not selecting this control technology as BACT. The technical evaluation states, "[Florida] finds that these additional environmental impacts associated with an RTO, coupled with a control cost effectiveness [$4,090 per ton of VOC removed] at the upper end of the range that could potentially be considered acceptable, make an RTO an inappropriate choice for BACT for the pellet coolers.... Additionally, the Department notes that in a forested rural area with high biogenic VOC emissions and low NO_X emissions, ozone production is NO_X limited. VOC emissions should have little impact on ambient ozone concentrations in this area."[4]

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 3 (EIP & SELC Letter - Item I.C):

Reliance on cost-per-ton economic analysis to reject controls that are widely used in the wood pellet industry is arbitrary and capricious and contrary to the Clean Air Act. The cost-per-ton analysis simply takes the annualized cost to install and operate controls, divides that cost by the tons of pollutant reduced, and compares the resulting number to an opaque, unpublished dollar-per-ton threshold. If the resulting number is above the unpublished threshold, the controls are deemed not "cost effective" and dismissed, without any consideration to what is actually being achieved by comparable sources. "BACT means an emission limitation...based on the maximum degree of reduction for each pollutant...taking into account energy, environmental, and economic impacts and other costs, {which the permitting agency} determines is achievable for the source."
EPA has explained, the so-called "collateral impacts" clause within the definition of BACT holds that selecting anything less than the most stringent control technology is acceptable "only when source-specific energy, environmental or economic impacts or other costs prevent a source using more effective technology." EPA's Draft NSR Manual itself emphasized that "where a control technology has been successfully applied to similar sources in a source category, an applicant shall

[3] Attachment L to EIP's comments, Letter from the Florida Department of Environmental Protection to Enviva Cottondale LLC, September 17, 2108.
[4] Attachment JJ to EIP's comments, Technical Evaluation and Preliminary Determination, February 8, 2019.

concentrate on documenting significant cost differences, if any, between the application of the control technology on these other sources and the particular source under review." Control then may only be dismissed "if the circumstances of the differences are adequately documented and explained in the application and are acceptable to the reviewing agency."

Nothing in the permit record identifies any unique features of Enviva Sampson that would distinguish the facility from the 13 other wood pellet plants in the industry that have installed post-dryer controls or have applied to do so, including the five Enviva plants. Enviva has made the determination that it can operate the Enviva Hamlet plant and the majority of its other plants in an economically-feasible manner while controlling VOC emissions from the post-dryer units, yet the company rejects those same controls as not economically feasible at Enviva Sampson without any basis to do so. This is exactly the scenario where the case-by-case nature of BACT must overrule the use of a static cost-per-ton threshold. Establishing an inflexible monetary threshold is deeply contrary to the case-by-case mandate inherent to BACT. In effect, DAQ has rewritten the statutory definition of BACT to exclude the phrase "case-by-case basis" for any instance where an applicant demonstrates that control costs are $5001 /ton or greater (or whatever the threshold in North Carolina may be). This is unacceptable and has no basis in the Clean Air Act nor its implementing regulations.

Hearing Officer's Response to This Comment:

A BACT determination is a case-by-case, state-by-state analysis defined by economic, environmental, and energy factors. The application of BACT does not always result in the same control technology being applied in all areas of the country at facilities in the same industry. DAQ's process is consistent with applicable statutes and regulations.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 4 (EIP & SELC Letter - Item I.D.1):

Even accepting the cost-per-ton methodology as valid, Enviva has improperly inflated control costs for the pellet coolers and dry hammermills. The economic analysis improperly fails to account for the sunk costs of controls already required under MACT. Enviva and DAQ entered into a settlement agreement whereby Enviva agreed to install and operate RTOs/RCOs on the dry hammermills and pellet coolers. The BACT determinations for these units, however, completely fails to account for the fact that Enviva has already agreed to install these controls. The BACT cost analysis is therefore deficient, because most, if not all, of the costs associated with RTOs/RCOs for these units are sunk costs that must be excluded from the BACT analysis. Sunk costs should be "ignored in engineering economic analyses because they will be equivalent in all decisions for the present and future."

Hearing Officer's Response to This Comment:

The draft permit requires Enviva Sampson to, within six months of issuance of this air permit, submit an application for installation of controls on pellet presses and coolers, and dry

hammermills. This requirement stems from actions taken by DAQ to ensure proper control of HAP emissions pursuant to Section 112(g) of the Clean Air Act.

On March 1, 2019, DAQ sent a letter notifying Enviva of DAQ's conclusion that the case-by-case MACT determination submitted in connection with Enviva's 2014 Air Quality Permit Application (# 8200152.14B) was not conducted in accordance with 40 CFR 63.43(d). The letter stated that, based on DAQ's review of air pollution control devices in place at other wood pellet manufacturing facilities at the time of Enviva's permit application, Enviva's MACT analysis should have included controls on the facility's pellet presses and coolers. DAQ directed Enviva to submit a revised case-by-case MACT determination. Enviva responded by disputing DAQ's assertion that Air Quality Permit Application (# 820152.14B) had been deficient. This dispute was resolved through a settlement agreement, which obligates Enviva to submit an air permit application within six months of issuance of this permit requesting authorization for installation of an RCO/RTO to control VOC and HAP emissions from the pellet presses and coolers as contemplated by DAQ's March 1, 2019 letter. The agreement also requires Enviva to submit an application for installation of an RCO/RTO to control VOC and HAP emissions from the dry hammermills (or an engineering solution that will result in equal or greater VOC and HAP reductions).

As a result of the control technology that will be part of the permit application submitted in accordance with the settlement agreement, and the significant reductions in VOC emissions that will occur as a result of these controls, DAQ anticipates that the facility may no longer be a PSD major source of VOC emissions and, as a result, no longer subject to BACT when this control technology is implemented. In the event that Enviva does not seek reclassification of the Enviva Sampson facility as a PSD minor source in connection with installation of these controls, Enviva will be required to seek a modification of BACT limits in the permit to ensure that such limits are no less stringent than limits established pursuant to Section 112(g) of the Clean Air Act (See Clean Air Act, Section 169).

At this time, the specific design of control technology has not been established and the associated costs are unknown and may depend upon the outcome of the permitting process associated with those controls. Since these are two different permitting actions then it is not appropriate to account for the installation of MACT controls as a sunk cost at this time.

Recommendation: It is recommended that a condition be added to the draft air permit requiring Enviva Sampson to include either a BACT analysis for the dry hammermills and the pellet presses and coolers or a request for PSD avoidance in its permit application for case-by-case MACT. The permit application will be due within six months of this permit issuance.

Comment 5 (EIP & SELC Letter - Item I.D.2) -

Enviva failed to consider numerous control alternative as BACT and therefore, failed to consider more cost-effective control alternatives. Enviva only proposed the option of installing unit specific controls, a single RTO/RCO for the dry hammermills and a separate RTO/RCO for the pellet coolers. This analysis ignores at least two feasible alternatives that would likely lead to lower control costs and which are already in use in the industry or proposed as BACT at comparable

plants. First, Enviva did not propose a single RTO/RCO to control both the dry hammermills and pellet coolers. Second, Enviva did not consider the option of routing emissions to the facility's wood burning furnace and/or existing RTO on the wood dryer.

EPA has previously held that a BACT determination was improper when a permitting authority failed to consider the option of routing emissions to an existing RTO. Enviva should have considered the feasibility of routing the dry hammermills and/or the pellet coolers to the existing RTO controlling the wood dryer. The failure to do so clearly renders the BACT determination deficient. Additionally, several plants with a variety of capacity ratings route dry hammermill and pellet cooler exhaust to single RTOs/RCOs or will do so soon. Therefore, Enviva Sampson's post-dryer units appear to be neither too large nor too small to be controlled effectively by a single RTO or RCO.

Hearing Officer's Response to This Comment:

On August 1, 2019, DAQ requested that Enviva Sampson submit a revised cost analysis for the following control options:

- a single RTO/RCO controlling the combined emissions from the dry hammermills and pellet presses and coolers; and
- rerouting emissions to the dryer furnaces and/or dryer RTO as control alternatives in the cost analysis for BACT.

Enviva Sampson submitted the revised costs on August 15, 2019 (Attachment 1) and is summarized in Table 1 in response to Comment 6 below. The revised costs indicate a larger RTO to control emissions from the combined dry hammermills and pellet presses and coolers is not cost effective.

DAQ received Enviva's cost estimates for RCOs on the dry hammermill and the pellet presses and coolers and for the dry wood handling and combined dry hammermills and pellet presses and coolers. The cost analysis for the RCOs are included in Table 1 in response to Comment 6 below and shows that the RCOs are slightly less expensive to operate and have a slightly lower cost per ton than the RTOs for these sources. Because RCOs were shown to be less expensive to operate, DAQ requested Enviva Sampson to submit an updated BACT analysis for VOC emission sources. DAQ received the revised BACT analysis on September 10, 2019. Enviva Sampson's revised analysis rejected RCOs as BACT based on the cost ineffectiveness and the additional environmental and energy impacts.

In an e-mail dated August 2, 2019, Enviva Sampson provided information indicating that rerouting emissions to the dryer furnaces and/or dryer RTO is technically infeasible due to limitations of the furnace's secondary air fan. Enviva states:

> "The furnace manufacturer advises Enviva that the only safe location to add VOC laden combustion air to the furnace is as secondary combustion air. The amount of VOC laden combustion air added cannot exceed the amount of secondary combustion air needed under the varying operating conditions of the furnace. The amount of secondary combustion air required is affected by variables such as ambient air conditions, fuel quality and moisture content,

operating load, and heat load required for processing. Taking all these factors into consideration, only about 35 % of the capacity of the fan can be substituted as secondary combustion air when the furnace is operated at normal load.

The design air flow for the dry hammermill RCO is 120,000 actual cubic feet per minute (acfm) and is 90,000 acfm for the Pellet Mill/Cooler RCO. Thirty-five percent of fan [capacity] is 20,000 acfm. Even if Enviva were to ignore the varying operating conditions of the furnace discussed above, with the existence of storage vessels between the dryer and downstream unit operations, the furnace secondary air fan is not capable of accommodating the total flow needed for adequate treatment of VOC-laden air."

Recommendation: The final permit review for the PSD permit application should include the revised BACT analysis for VOC emission sources based on the September 10, 2019 submittal.

Comment 6 (EIP & SELC Letter - Item I.D.3):

Enviva's cost estimates for the dry hammermills and pellet coolers are far higher than the cost estimated using EPA's Control Cost Manual. Instead of using EPA's Control Cost Manual for the dry hammermills and pellet coolers, Enviva relies largely on its own in-house estimates, paired with information from various vendors. In contrast, for the BACT analysis for the dried wood handling operations (ES-DWH), Enviva relies on the equations provided by EPA's Control Cost Manual, to reach a cost figure far lower than for an RTO on the dry hammermills and pellet coolers. Again, Enviva has not explained the discrepancy between using opaque, in-house estimates for the pellet coolers and dry hammermills while relying on EPA's Control Cost Manual for the dry wood handling.

We have estimated costs for RTOs on the pellet coolers and dry hammermills using the Control Cost Manual, utilizing information from Enviva's application and stack testing. For the pellet cooler RTO, the Manual's equation produces an annualized cost of approximately $ 1,141,000 and for the dry hammermills, the Manual's equation produces a cost of $1,062,597. Source-specific costs figures are generally preferred to the Cost Control Manual, here the substantial discrepancy between Enviva's numbers and those provided by the Manual strongly suggest the company has improperly inflated costs, for instance by using a 20% contingency factor rather than the 10% recommended by the Manual. Enviva's failure to explain why its numbers are so much higher than the Manual's renders the permit record and BACT determinations deficient.

Hearing Officer's Response to This Comment:

On July 26, 2019, DAQ requested that Enviva Sampson submit a revised cost analysis for controls on the dry hammermills and pellet coolers. On August 15, 2019, Enviva Sampson submitted revised control costs for RTOs on the dry hammermills, the pellet presses and coolers, and the combined exhaust from the dry hammermills and pellet presses and coolers using methodology in EPA's Control Cost Manual. The revised control costs are attached to this hearing report and summarized below. The revised costs indicate that RTOs on these emission units are not cost effective on a dollar-per-ton basis.

Table 1 – Revised Control Costs

VOC Controls- RTOs								
Emission Point Number(s)	**Unit/Service Description**	**Control Option**	**Uncontrolled VOC PTE Emissions (TPY)**	**VOC Control Efficiency (%)**	**VOC Controlled Emission Rate (ton/yr)**	**VOC Reduction (ton/yr)**	**Total Annual Cost ($/yr)**	**Technology Cost Effectiveness ($/ton VOC Removed)**
ES-CLR-1 through 6	Pellet Coolers	RTO	572	95%	28.6	543.4	$3,740,642	$6,884
ES-HM-1 through 8	Dry Hammermills	RTO	168	95%	8.4	159.6	$2,934,883	$18,389
ES-CLR-1 through 6 and ES-HM-1 through 8	Pellet Coolers and Dry Hammermills	RTO	740	95%	37.0	703.0	$6,553,936	$9,294
ES-DWH	Dry wood handling	RTO	41	95%	2.0	36.8	$598,594	$15,440
VOC Controls- RCOs								
ES-CLR-1 through 6	Pellet Coolers	RCO	572	95%	28.6	543.4	$3,715,499	$6,838
ES-HM-1 through 8	Dry Hammermills	RCO	168	95%	8.4	159.6	$2,907,090	$18,215
ES-CLR-1 through 6 and ES-HM-1 through 8	Pellet Coolers and Dry Hammermills	RCO	740	95%	37.0	703.0	$5,869,334	$8,349
ES-DWH	Dry wood handling	RCO	41	95%	2.0	36.8	$541,505	$13,968
PM Controls								
Emission Point Number(s)	**Unit/Service Description**	**Control Option**	**Uncontrolled PTE Emissions (TPY)**	**PM Control Efficiency (%)**	**PM Controlled Emission Rate (ton/yr)**	**PM Reduction (ton/yr)**	**Total Annual Cost ($/yr)**	**Technology Cost Effectiveness ($/ton PM Removed)**
ES-CLR-1 through 6	Pellet Coolers	baghouse	151	99%	1.5	149.5	$1,072,056	$7,171

Notes:
1. VOC control efficiency from USEPA Air Pollution Control Technology Fact Sheet: Regenerative Incinerator (EPA-452/F-03-021). https://www3.epa.gov/ttn/catc/dir1/fregen.pdf
2. Control costs for the RTOs on the pellet coolers includes cost of baghouse, as this equipment is required to ensure proper operation of the RTO.

Comments provided by EIP and SELC included the annualized costs for the RTOs, which were $1,062,597 for the dry hammermills and $1,141,000 for the pellet presses and coolers based on the methodologies in EPA's Control Cost Manual. Information associated with the annualized cost calculations for the RTOs were not provided and do not provide a basis for concluding that Enviva Sampson's annualized cost calculations are incorrect.

Recommendation: The facility has submitted a revised cost analysis and no changes to the draft permit are deemed necessary to address this comment.

Comment 7 (EIP & SELC Letter - Item I.D.4)

Enviva's costs estimates are far higher than in previous Enviva applications. When Enviva Hamlet, a "replica" of the Sampson plant by Enviva's own admission, applied for its initial PSD permit in 2014, Enviva estimated costs for the dry hammermill controls and pellet cooler controls would be vastly lower than the company now calculates for Sampson. Furthermore, in 2014, Enviva consistently estimated that RCOs would be cheaper than RTOs, which is in contrast to the 2018 application, where Enviva has dismissed RCOs because the company claims RCOs are more expensive than RTOs.

Enviva's 2014 cost estimates as compared to the 2018 application:

Unit	*Control*	*Enviva's 2014 annual cost estimates*	*Enviva's 2018 annual cost estimates*
Dry Hammermills	*RTO*	*$1,628,286*	*$3,313,346*
Dry Hammermills	*RCO*	*$1,298,505*	*Did not calculate*
Pellet Coolers	*RTO*	*$1,444,224*	*$3,800,354*
Pellet Coolers	*RCO*	*$1,298,357*	*Did not calculate*

Below, the 2014 costs are adjusted for inflation, and the cost-per-ton figure for the controls are calculated based on Enviva's VOC emission estimates.

Unit	*Control*	*2014 annual cost, adjusted for inflation to 2019*	*Cost/ton*
Dry Hammermills	*RTO*	*$1,761,417*	*$11,078*
Dry Hammermills	*RCO*	*$1,404,673*	*$8,834*
Pellet Coolers	*RTO*	*$1,562,306*	*$2,871*
Pellet Coolers	*RCO*	*$1,404,513*	*$2,581*

Hearing Officer's Response to This Comment:

On August 15, 2019, Enviva Sampson submitted revised control costs for the dry hammermills and the pellet presses and coolers using methodology in EPA's Control Cost Manual. These revised costs are comparable to the costs on vendor estimates submitted in the 2018 permit application and are larger than reported in the 2014 permit application.

Potential emissions of VOC cited in the 2018 permit application increased due to expanded production (25% increase in permitted throughput), increased softwood percent (permitted at 100%), and revised emission factors. The table below compares potential VOC emissions as provided in the 2014 and 2018 permit applications.

Emissions Unit	2014 permit application	2018 permit application	
	Uncontrolled VOC emissions (tpy)	Uncontrolled VOC emissions (tpy)	Controlled VOC emissions (tpy)
Dryer System	288.3	1011.6	50.6
Green Wood Hammermills	72.2		
Dry Hammermills	34.4	167.5	167.5
Pellet Presses and Coolers	227.6	572.2	572.2
Dry Wood Handling	---	40.8	40.8
Total Emissions	622.5	1792.1	831.1

Notes:

- Uncontrolled emissions from dryer system and green wood hammermills calculated with a 95% control efficiency from the RTO.

As noted in the table above, uncontrolled VOC emissions increased from 622.5 tpy to 1,792.1 tons per year in the 2018 permit application. The increase in VOC emissions (2.9 times 2014 levels) results in higher costs due to larger RTOs and increased natural gas/propane consumption. Therefore, the control costs are expected to be higher in the 2018 BACT analysis.

With regard to Enviva Sampson not conducting a cost analysis for the RCO, as noted above, DAQ requested that Enviva Sampson submit a revised BACT analysis that included an economic, environmental, and energy factors for RCOs. As stated in the response to Comment 5 above, the revised analysis rejected RCOs as BACT based on the cost ineffectiveness and the additional environmental and energy impacts.

Recommendation: The facility has submitted a revised cost analysis and no changes to the draft permit are deemed necessary to address this comment.

Comment 8 (EIP & SELC Letter - Item I.D.5):

The pellet cooler cost analysis improperly considered the cost of particulate matter controls as part of the cost of VOC controls. Enviva believes the cost of a new particulate matter control technology, baghouse, should be considered as part of the cost analysis for VOC controls because these advanced controls are needed in order to prevent an RTO/RCO from fouling. We dispute this claim as several pellet plants have successfully operated RTOs/RCOs on pellet coolers in line with cyclones. Even assuming that Enviva is correct that a baghouse or scrubber would be necessary, the cost of this control should not have been considered in the cost analysis of the VOC BACT determination. Because Enviva already must include the cost of particulate matter control under BACT for PM, including the costs of a PM control for VOC BACT is an improper double-counting of costs. The costs associated with a particulate matter control are a sunk cost and should not be considered in the VOC BACT analysis.

Hearing Officer's Response to This Comment:

DAQ concluded that BACT for particulate matter from the pellet presses and coolers are cyclones. Control of particulate matter is essential to ensure proper operation of the RTO. Additional

particulate matter control must be placed upstream of thermal oxidation controls to remove particulate matter that can cause plugging of heat exchange media or result in unsafe operations such as fires and significant operational and maintenance related difficulties. As a result, including the baghouse in the cost analysis is appropriate. Also see response to Comment 9 below.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 9 (EIP & SELC Letter - Item I.D.6):

Enviva has failed to demonstrate that it cannot install RTO/RCOs on the pellet coolers as currently equipped with cyclones. Although the full costs of upgraded particulate matter controls should not be considered in the VOC BACT analysis regardless, Enviva has not established that it needs to upgrade the particulate matter controls to install an RTO or RCO. Enviva's recent application to install an RTO/RCO to control all of the post-dryer units at Enviva Cottondale, including the pellet coolers, Enviva will not upgrade the pellet coolers cyclones currently in place there. If this control scenario, including the existing cyclones, is feasible at Enviva Cottondale, Enviva must demonstrate why the same control scenario would not be feasible at Sampson. Therefore, it is unreasonable to include the cost of baghouses in the pellet cooler BACT analysis.

Hearing Officer's Response to This Comment:

Control of particulate matter is essential to ensure proper operation of RTOs. Additional particulate matter control must be placed upstream of thermal oxidation controls to remove particulate matter that can cause plugging of heat exchange media or result in unsafe operations such as fires and other significant operational and maintenance related difficulties.

Several different types of heat transfer media are used for RTOs, including random packing, monolithic (honeycomb) structured block, and corrugated structured packing. The different media are able to accommodate varying levels of particulate matter in the inlet stream. For instance, "vendors recommend adding particulate removal devices upstream of the RTO if the particulate concentration is greater than 0.005 gr/dscf to 0.002 gr/dscf,"[5] for monolithic packing according the EPA's Control Cost Manual. Other types of RTOs can handle higher PM loads. An online search of literature found some RTOs that can handle inlet streams with particulate matter up to 0.02 gr/dscf.[6] The existing cyclones on the pellet presses and coolers at Enviva Sampson are estimated to have an outlet PM loading of 0.04 gr/dscf, which is higher than inlet PM loading referenced in these examples. Therefore, PM controls beyond the existing cyclones at Enviva Sampson are warranted when used prior to an RTO.

In an e-mail dated August 2, 2019, Enviva Sampson provided specific examples of the operation and safety concerns associated with using only a cyclone for PM control prior to RTO/RCOs. The use of cyclones only to control PM prior to RTO/RCOs has resulted in explosions within ductwork and downstream thermal oxidizers in certain applications. For the Enviva wood pellet facilities,

[5] Chapter 2, Incinerators and Oxidizers, EPA's Cost Control Manual, November 2017, retrieved from https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf
[6] Information on NESTEC RTO retrieved from https://www.nestecinc.com/wp-content/uploads/2017/01/RTO-Sell-Sheet.pdf

cyclones provide insufficient particulate control of flue gas streams being processed by a downstream thermal oxidizer. Wood fiber that would otherwise be controlled by a bagfilter or wet scrubber can accumulate in the RCO/RTO packing and result in the following:

- smoldering resulting in formation of VOC and CO that reduces the overall control efficiency of the thermal oxidative device and contributes to higher than expected emissions;
- causing the RCO to overheat resulting in a shutdown to prevent more catastrophic results;
- causing a series of deflagration events that can damage or destroy the RCO;
- increased risk of upstream equipment failure, and;
- increased safety risk to plant personnel and neighbors.

Therefore, PM controls beyond the existing cyclones are warranted when used prior to an RTO.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 10 (EIP & SELC Letter - Item I.D.7):

Enviva's 20% contingency factor is far too high for RTOs. Contingency factors represent the possible costs arising from unforeseen factors involved in the acquisition and construction of the pollution control technology. Enviva has not explained why a 20% contingency factor is appropriate for such a common control technology as RTOs.

Hearing Officer's Response to This Comment:

A contingency factor of 20% used in Enviva Sampson's cost analysis is higher than the range of 5 to 15 % of the total capital investment cited in EPA's Cost Control Manual. As a result, Enviva Sampson revised the cost analysis using a 10% contingency factor which is in line with guidance from EPA's Control Cost Manual. The revised costs were submitted to DAQ on August 15, 2019. The revised cost analysis (shown in Table 1 in response to Comment 6 above) continues to demonstrate that RTOs on the dry hammermills and pellet presses and coolers and that bagfilters on the pellet presses and coolers are not cost effective.

Recommendation: The facility has submitted a revised cost analysis and no changes to the draft permit are deemed necessary to address this comment.

Comment 11 (EIP & SELC Letter - Item D.8):

The cost analysis for the dry hammermills appears to be inflated compared to the pellet coolers. The cost analysis for the dry hammermill RTO includes many costs that are significantly higher than the RTO cost analysis for the pellet coolers. For instance, RTO media replacement in the dry hammermill RTO is $ 124,797 per year, while media replacement in the pellet cooler RTO is just $ 26,569. The only difference we can see between the two units is that media in the pellet cooler RTO is replaced every 8 years rather than every 7 years, which does not appear to explain the dramatic cost difference.

Other costs which are inexplicably higher for the dry hammermill RTO include the price of acquiring the RTO ($32,000 more expensive despite being a smaller RTO), the foundation for the ID Fan and Drive Foundation ($43,000 more expensive), and the propane tank foundation ($25,000 more expensive despite both RTOs being estimated to consume the same rate of propane). Enviva fails to explain why these costs would be higher for the dry hammermill RTO than they would be for the pellet coolers.

Hearing Officer's Response to This Comment:

Enviva Sampson revised its costs analysis using the EPA's Control Cost Manual. The revised analysis for the dry hammermills eliminated the media replacement cost, reduced fuel usage for the RTO, reduced the contingency factor to 10%, and corrected the life expectancy of the RTO to 20 years. The annual operating cost reported in the 2018 permit application for the RTO on the dry hammermills is $ 2,926,411 compared to the revised estimate based on EPA's Control Cost Manual of $ 2,934,883.

Recommendation: The facility has submitted a revised cost analysis and no changes to the draft permit are deemed necessary to address this comment.

Comment 12 (EIP & SELC Letter - Item I.D.9):

Enviva underestimates VOC emissions from the dry hammermills. Enviva's emission factor for the dry hammermills is apparently "based on stack testing data from comparable Enviva facilities." We are unable to find any stack testing from Enviva facilities conducted at 100% softwood that supports Enviva's emission factor, and all of the available stack tests show emissions are almost certainly much higher, meaning the cost per ton figure based on underestimated VOC emissions is likewise too high.

Although Enviva has not established what particular tests it relies upon for this application, within the context of the recent permitting at Enviva Hamlet, Enviva identified only one stack test as the basis for the dry hammermill VOC emission factor. Because Enviva considers the Hamlet and Sampson plants to be nearly identical, information provided in support of the Hamlet application should be a reasonable basis for estimating emissions at Sampson, except that Sampson will process up to 100% softwood. The test relied upon by Enviva Hamlet—2013 testing at Green Circle, now Enviva Cottondale, produced an emission factor of at least 1.4 lb/ODT while processing 95% softwood. That emission factor equates to dry hammermill VOC emissions of 390 tpy at Enviva Sampson. Assuming Enviva's cost calculations are otherwise correct, which we dispute, the increase in emissions results in a cost-effectiveness figure of $8,921, far lower than the $20,818 estimated by Enviva. Combined with more reasonable cost calculations this number is reduced even further.

Hearing Officer's Response to This Comment:

In absence of other verified data, facilities ideally develop emission factors from site-specific testing during representative operating conditions. Emission factors developed from testing at other similar

facilities can be used absent site-specific test data. However, care must be taken when applying an emission factor from one facility/source to another to ensure the emission factor is representative. For wood pellet facilities, emissions may vary from facility to facility based on the softwood percentage, type of equipment (e.g., vertical vs. horizontal hammermills), die sizes, and other factors.

An example of specific differences between facilities is in the hammermills at Cottondale and Enviva Sampson. The emission factor of 1.4 lb/ODT was developed from testing at the Cottondale facility, which operates mostly vertical hammermills. Enviva Sampson operates only horizontal hammermills. Enviva Sampson indicates that the facility's horizontal hammermills have a fresh air sweep system that conveys the wood fiber to the cyclone. The facility indicates the fresh air sweep systems cool the wood fiber that exits the hammermills causing lower wood temperatures. The lower temperatures may lead to lower VOC emissions from the horizontal hammermills, therefore, applying an emission factor based on testing at vertical hammermills would not be appropriate for Enviva Sampson. The assumption that horizontal hammermills have fewer emissions can be confirmed through the extensive testing that will be required in the final permit.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 13 (EIP & SELC Letter - Item I.D.10 i-iv):

Total Corrected Cost Determinations. While we once again reiterate that reliance on the cost-per-ton analysis is improper in this instance, even using that method and accepting a cost-per-ton threshold of $5,000, post-dryer VOC controls are cost effective based on correcting the errors noted in previous comments.

(i) Dry Hammermills Dedicated RTO/RCO – Using the cost calculated by Enviva in 2014, which are in line with current estimates based on EPA's Control Cost Manual, combined with an emission rate based on the Enviva Cottondale emission factor for the dry hammermills of 390 tons per year results in a cost-per-ton of figure of $ 3,796 for an RCO and $4,760 for an RTO. This assumes a 95% destruction efficiency.

(ii) Pellet Cooler RTO/RCO – As shown above, using Enviva's 2014 costs adjusted for inflation results in a cost per ton of an RCO of $2,581 and for an RTO $2,871.

(iii) Enviva should evaluate single RTO/RCO controlling dry hammermills and pellet coolers. The cost for an RCO in a recent BACT determination and using Enviva's emission estimates result in a cost-per-ton of $5,428. Using the Enviva Cottondale emission factor to estimate dry hammermill emission results in a cost-per-ton of $4,180.

(iv) Enviva should evaluate utilizing the dryer furnaces and/or Dryer RTO.

Hearing Officer's Response to These Comments:

(i) The emission factor of 1.4 lb/ODT for the dry hammermills developed at one facility does not appear to be representative of the Enviva Sampson facility because of operational differences. In addition, adjusting RTO costs to 2018 based on 2014 cost estimates does not take into account several factors. The RTO in 2014 was sized for lower VOC emissions based on a smaller throughput and lower softwood percentages. Therefore, scaling 2014 costs using a cumulative rate of inflation does not give an accurate representation of costs.

(ii) As stated above, adjusting the 2014 costs to 2018 based on cumulative rate of inflation does not take into account the operational changes. The 2014 RTO was sized for lower VOC emissions due to a smaller throughput and lower softwood percentage. Also, the cost of additional PM controls is taken into account because of the need to ensure proper operation of the RTO.

(iii) On August 1, 2019, DAQ requested that Enviva Sampson submit a revised cost analysis for the single RTO/RCO control alternatives. Enviva Sampson submitted a revised cost analysis on August 15, 2019 that indicated a single RTO on the dry hammermills and pellet presses and coolers is not cost effective (see Table 1 in response to Comment 6 on page 12). As noted earlier in this report, control costs are site-specific and the control costs developed for other facilities may not be representative of control costs for the Enviva Sampson facility. Enviva also submitted a cost analysis for a single RCO and updated BACT analysis. The RCO control option was rejected as BACT based on cost ineffectiveness and additional environmental and energy impacts.

(iv) Utilizing the dryer furnaces and/or dryer RTO was evaluated and determined to be technically infeasible as identified in response to Comment 5 on page 10.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 14 (EIP & SELC Letter - Item I.D.11-1):

Neither Enviva nor DAQ have provided support for the vague claim that RTOs/RCOs would not be environmentally beneficial. In dismissing RTOs/RCOs from the BACT analysis, both Enviva and DAQ make vague references to the idea that an RTO or RCO would have "negative energy and environmental impacts." While it is true that an RTO or an RCO would increase the plant's NOx and CO emissions, these increases are small compared to the substantial reduction in VOCs that would be achieved. Controlling both the dry hammermills and pellet coolers with two RTOs would result in an increase of 13.96 tons of NOx and 8.1 tons of CO, but would eliminate 703 tons of VOCs according to Enviva's application. The use of RCOs, meanwhile, would achieve comparable VOC reductions but with lower CO and NOx emissions. Using a single RTO/RCO may likewise be more efficient and reduce CO and NOx emissions.

While it is true that NOx often plays a larger role than VOCs in ozone formation in rural areas, neither DAQ nor Enviva have demonstrated that a massive reduction in VOCs paired with a small

increase in NOx (the VOC decrease is 50 times larger than the NOx increase) would not be an overall net benefit for ground level ozone formation in the region. Such a demonstration could only be made by air dispersion modeling paired with accurate information about ambient air quality near the plant, and we believe that such modeling would find that the benefits of reducing 700 tons of VOCs far outweigh the increase in NOx in terms of ozone formation, and especially beneficial when other impacts of VOCs, such as HAPs and secondary particulate formation, are considered.

In addition, ground level ozone formation requires both NOx and VOCs, but the ratio of the two pollutants for maximum ozone formation is not one-to-one. Peak ozone formation typically occurs when VOCs outnumber NOx by a ratio between eight-to-one to ten-to-one. An ozone isopleth can be used to show ozone formation rates at varying ratios of VOCs to NOx.

Hearing Officer's Response to This Comment:

Ozone formation is a complicated nonlinear process that requires certain meteorological conditions in addition to VOC and NOx emissions.[7] Although decreasing VOC emissions can lead to decreased ozone formation, the importance of increases in NOx emissions should not be discounted, especially in areas like North Carolina that are "NOx limited" with respect to ozone formation. Based on 20 years of experience and scientific research, North Carolina's approach to controlling NOx emissions instead of VOC emissions has proven to be the most effective method for reducing ozone in the state, [8] and future reductions in VOC emissions may have little to no impact on ambient ozone concentrations.[9]

Information is provided in the comments on the VOC/NOx ratios and associated isopleths to identify the benefits of VOC reductions. While ozone isopleths help demonstrate the relationship between VOCs and NOx in ozone formation the use of isopleths has limitations. EPA discusses the limitation of using this approach in determine the effectiveness in ozone reduction in its initial (1996) Photochemical Assessment Monitoring Station (PAMS) Data Analysis "Results" Report. The report states, "while the VOC/NOx method is theoretically sound, application of the technique has several limitations:

1. Historically, applications have relied upon morning, center-city VOC and NOx measurements, yet the ratio varies widely in time and space. PAMS improves the spatial and temporal coverage of data, and therefore tempering this particular concern.

2. Assuming only limited measurement-related difficulties, the ratios delineating NOx and VOC-limited regimes vary with time and location and are affected by vertical mixing processes that often are not accounted for in surface measurements.

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[7] Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and PM2.s under the PSD Permitting Program, April 30, 2019, retrieved from https://www.epa.gov/sites/production/files/2019-05/documents/merps2019.pdf

[8] Letter from the North Carolina Division of Air Quality to Mary S. Walker of the US EPA, May 10, 2019, retrieved from https://files.nc.gov/ncdeq/Air%20Quality/planning/attainment/110l_voc_work_practices/1---Final-Sec110-l--VOC-WP-Stds-Transmittal-Letter-051019-SPeCS.pdf

[9] Letter from the North Carolina Division of Air Quality to EPA Docket Center, February 13, 2017 retrieved from https://www.cleanairact.org/news/documents/NorthCarolinaDEQ-2-13-2017.pdf

Additionally, the prevailing atmospheric chemistry (e.g., composition and age of air mass) can impart different control responses at the same VOC/NOx ratios.

3. Inconsistent and uncertain measurement techniques affect the ratio. These include various interpretations of total [non-methane volatile organic compounds] NMOC, measurement uncertainties and artifacts in NOx and NMOC, and the representativeness of observations (this latter issue is more problematic for emission inventory evaluation).

By themselves, VOC/NOx ratios probably cannot be used unambiguously to infer NOx or VOC control strategy effectiveness. However, in combination with other observational (and gridded model techniques), the VOC/NOx method adds corroborative value."[10]

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 15 (EIP & SELC Letter - Item I.D.11-2):

The environmental impact portion ignores HAP emissions and secondary particulate matter formation. While DAQ and Enviva point to the marginal increase of criteria pollutants, the analysis completely ignores the fact that installing the controls will reduce HAPs by about 130 tons per year. As DAQ is likely aware, without controls, the Sampson plant is one of the largest emitters of HAPs in the state – for instance, toxic acrolein emissions are projected to be higher than any in the state, as reported in 2017's NC emission inventory. Pointing to 10 or 15 tons of NOx while ignoring 130 tons of HAPs that could be reduced renders the analysis of environmental impacts further deficient. Likewise, nothing in the environmental analysis considers the secondary particulate matter formation that may be caused by 700 tons of VOC emissions.

Hearing Officer's Response to This Comment:

The EPA discusses the consideration of emissions of toxic and hazardous air pollutants (HAPs) in its draft guidance for BACT analysis. According to the draft guidance, the generation or reduction of HAPs should be considered as part of the environmental impacts analysis for BACT. Several acceptable methods, including risk assessment, exist to incorporate air toxics concerns into the BACT decision. The EPA has acknowledged that the permitting authority (DAQ) has flexibility in determining the methods by which it factors air toxics considerations into BACT determinations, subject to the obligation to make reasonable efforts to consider air toxics.[11]

DAQ considered the environmental impact of HAPs in its evaluation of the facility's compliance with NC Air Toxics Regulations. Acetaldehyde, acrolein, formaldehyde, methanol, phenol and propionaldehyde are the HAPs expected to be emitted from the dry hammermills and the pellet press and coolers at Enviva Sampson. All of these except for methanol and propionaldehyde are also

[10] Chapter 4, Observational Based Methods for Determining VOC/NOx Effectiveness, in EPA EPA-454/R-96-006, Retrieved from https://www3.epa.gov/ttnamti1/files/ambient/pams/chap4.pdf
[11] New Source Review Workshop Manual: Prevention of Significant Deterioration and Nonattainment Area Permitting, DRAFT, October 1990, retrieved from https://www.epa.gov/sites/production/files/2015-07/documents/1990wman.pdf

considered toxic air pollutants (TAPs) under North Carolina's Air Toxics Regulations. All of these TAPs exceed the Toxic Air Pollutant Emission Rates (TPERs) with the exception of acetaldehyde. The emissions of acetaldehyde (1.64 lbs/hr) are below the TPER limit of 6.8 lbs/hr and, as a result, acetaldehyde was not modeled.

Enviva Sampson conducted facility-wide air dispersion modeling for nine TAPs to demonstrate compliance with NC Air Toxics Regulations. In addition to the three TAPs that exceeded the TPER limits identified above (acrolein, formaldehyde, and phenol), Enviva Sampson modeled the following six TAPs; arsenic, benzene, cadmium, chlorine, hydrogen chloride, and manganese. The dry hammermills and pellet press and coolers were modeled without VOC controls as specified in the permit application. The Air Quality Analysis Branch (AQAB) of DAQ approved the air dispersion modeling in a memorandum dated July 25, 2019. The memo indicated the air dispersion modeling adequately demonstrates compliance on a source-by-source basis for all TAPs modeled. As a result, TAPs/HAPs modeled do not present an "an unacceptable risk to human health," even with no VOC controls on the dry hammermills and pellet presses and coolers.

Because methanol is not a TAP, air dispersion modeling was not conducted for this pollutant. While emissions of methanol are larger than other HAPs/TAPs emitted from Enviva Sampson, methanol is one of the least toxic HAPs. A general indication of relative toxicity can be ascertained by comparing the reference concentrations (RfC) of methanol and chlorine, both of which are noncarcinogens. As noted in the paragraph above, chlorine is one of the TAPs that was modeled. Chlorine has a RfC of 0.00015 mg/m^3 while the RfC for methanol is 20 mg/m^3. Given the low toxicity of methanol and chlorine's margin of compliance with its acceptable ambient level (<1% of the AAL), DAQ does not anticipate any health risks due to emissions of methanol from Enviva Sampson, even with no VOC controls on the dry hammermills and pellet press and coolers.

EPA recently finalized guidance for addressing ambient impacts of ozone and PM2.5 precursors in its Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier I Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program. The MERPs can be viewed as a demonstration tool under the PSD permitting program that provides a method to relate maximum downwind impacts to a critical air quality threshold (significant impact level or SIL). In the context of the PSD program, precursors to ozone include VOCs and NOx and precursors to PM2.5 generally include SO2 and NOx. VOCs are not evaluated as a precursor to PM2.5 in EPA's guidance to a Tier 1 demonstration under the PSD permitting program. [12]

The DAQ did consider environmental impacts resulting from the installation of RTOs/RCOs on the VOC emission sources in determining BACT. At the request of DAQ, Enviva Sampson submitted a revised BACT analysis for VOC emission sources on September 10, 2019. The emissions from these controls are provided in the table below.

[12] Op. Cit., MERPS, April 30, 2019.

Emission Source	Control Technology	Emissions (tpy)					
		NOx	SO_2	PM	CO	VOC	GHG
PPCs	RTO	6.96	0.025	0.32	4.29	0.46	5,697
	RCO	4.24	0.013	0.17	2.72	0.25	3,079
Dry Hammermills	RTO	6.85	0.027	0.035	4.03	0.50	6,298
	RCO	3.84	0.015	0.19	2.30	0.27	3,403
PPCs and Dry Hammermills	RTO	13.82	0.052	0.67	8.32	0.96	11,995
	RCO	8.08	0.028	0.36	5.02	0.52	6,482
Dry Wood Handling	RTO	1.15	0.004	0.06	0.68	0.08	1,030
	RCO	0.65	0.002	0.03	0.40	0.04	557

The greenhouse gas (GHG) emissions above account only for the combustion of propane in the RTOs/RCOs. DAQ estimated additional GHG (CO2) resulting from the complete combustion of VOCs (assumed to be alpha pinene) in the exhaust from the dry hammermills, the pellet presses and coolers, combined dry hammermills and pellet presses and coolers, and the dry wood handling. (See calculation in Attachment 2). The estimated GHG emissions are provided in the table below.

Emission Source	CO2e from RCO/RTO (ton/yr)	CO2 from alpha Pinene (ton/yr)	Total CO2 (ton/yr)
RTO			
PPCs	5,697	1,755	7,452
Dry Hammermills	6,298	516	6,814
PPCs and Dry Hammermills	11,995	2,271	14,266
Dry Wood Handling	1,030	126	1,156
RCO			
PPCs	3,079	1,755	4,834
Dry Hammermills	3,403	516	3,919
PPCs and Dry Hammermills	6,482	2,271	8,753
Dry Wood Handling	557	126	683
Notes: Emission calculations assume 95% control efficiency in the control device.			

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 16 (EIP & SELC Letter - Item II):

The pellet cooler BACT determination for particulates is also flawed. Enviva selected the existing cyclones already in use at the plant as BACT, despite the fact that several controls for particulates are more effective and in use at most other Enviva and non-Enviva pellet plants. As Enviva acknowledges, baghouses, wet scrubbers, and electrostatic precipitators (ESPs) all achieve comparable PM control efficiency, which is significantly higher than cyclones. Many pellet plants with a capacity over 500,000 tpy use or have plans to install these more effective PM controls on their pellet coolers. Further, Enviva Sampson itself utilizes baghouses on eight units at the plant, yet has not explained why the pellet coolers are unique in that it would be less feasible to control them with baghouses as compared to the other units at the plant. As discussed earlier in the context of

VOC controls, relying on a cost-per-ton method to dismiss controls that are industry standard is arbitrary and capricious and contrary to the case-by-case nature of MACT.

Finally, Enviva claims the use of baghouses would lead to the adverse environmental impact "in the form of solid waste generated from the disposal of baghouse filter media." This is in contrast to DAQ's 2014 permit review, which found no adverse environmental impacts from baghouses. While Enviva will need to dispose of the baghouse filter as they are replaced, Enviva fails to quantify the volume of this material and the method of disposal.

Hearing Officer's Response to This Comment:

As stated earlier, DAQ takes into account many factors in making the BACT determination. Enviva Sampson conducted a top down approach which is consistent with procedures developed by EPA for BACT. However, DAQ requested more detailed information from Enviva Sampson regarding the adverse environmental impact of solid waste generated from the disposal of baghouse filter media. In an email dated August 2, 2019, Enviva Sampson provided the following additional information:

> "Bag replacements would be required every 45 days resulting in a total of 960 bags from 6 baghouses to control PM from the pellet coolers. This is estimated to be more than 160,000 lbs of solid waste generation annually that would be disposed of in a landfill."

Enviva stated the exhaust from the pellet coolers has a high moisture content and there is concern that the bagfilter will become "blinded" or overloaded with particulate that it can no longer be cleaned by the baghouse cleaning system. If a bagfilter becomes "blinded" then there is an increased risk of the bagfilter breaking. To minimize this risk the bagfilters need to be replaced frequently.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 17 (EIP & SELC Letter - Item III):

The draft permit authorizes unlawful periods of exemption from BACT limits during startup, shutdown and malfunction. Under the Clean Air Act, "best available control technology" is defined as an "emission limitation" and the term "emission limitation" is defined as "a requirement established by the State or the Administrator which limits the quantity, rate, or concentration of emissions of air pollutants ***on a continuous basis.****"*

EPA has disapproved of comparable BACT exemptions in the past. EPA clearly stated that the only basis for exemption from numerical BACT limits, or substitution of non-numeric BACT limits, during SSM events would be in scenarios where "technological or economic limitations on the use of ***measurement methodologies*** *make the imposition of an emission limitation infeasible." In other words, the only time where a permit may allow exemption from numerical BACT limits is where measuring emissions during SSM is not feasible. Nothing in the permit record indicates that DAQ nor Enviva have argued that measuring emissions at Enviva Sampson during SSM events would*

somehow be infeasible. Nor can we see how that might be the case, given that stack testing during SSM events seems readily feasible and capable of determining emissions during SSM events. In fact, in a recent Enviva permit application, the company states explicitly that emissions associated with bypass events "were calculated based on stack testing data from comparable Enviva facilities." Regardless, because DAQ and Enviva have not invoked the "infeasible measurement" exception, the exemption from BACT limits during SSM events is plainly unlawful and must be removed from the permit.

Hearing Officer's Response to This Comment:

The startup, shutdown, and malfunction (SSM) language in the permit should be clarified. The definition of BACT allows for a design, equipment, work practice, operational standard or combination thereof to be prescribed to satisfy the requirement for the application of BACT in situations where the imposition of an emissions standard is infeasible. The DAQ has determined that such is the case during SSM events. The DAQ Permit Engineer proposes the following permitting language to be BACT for SSM events:

- Operation of the furnace bypass during startup and shutdown shall be limited to 50 hours per year.
- Operation of the dryer bypass during shutdown will be limited to 50 hours per year. (Enviva Sampson indicated the dryer bypass is not used during startup but is required for safety during shutdown.)
- At all times, including periods of startup, shutdown, and malfunction, the Permittee shall, to the extent practicable, maintain and operate all emission sources including associated control devices in a manner consistent with good air pollution control practice for minimizing emissions. Determination of whether acceptable operating and maintenance procedures are being used will be based on information available to DAQ which may include, but is not limited to, monitoring results, opacity observations, review of operating and maintenance procedures, and inspection of the source.

The 50-hour limitation on startup and shutdown is consistent with the air dispersion modeling that Enviva Sampson conducted, which demonstrated compliance with NC Air Toxics Regulation. Dispersion modeling for criteria pollutants is discussed in the response to Comment 18 below.

Recommendation: It is recommended that the language noted above or similar requirements having the same intent be added to the permit in order to clarify BACT during SSM events.

Comment 18 (EIP & SELC Letter - Item IV.A)

Failure to model emissions and provide accurate emissions information regarding bypass scenarios renders the draft permit deficient. After DAQ learned that Enviva utilizes the unpermitted bypass stacks, DAQ did ask Enviva to conduct modeling for certain pollutants, stating that "NCDAQ has requested Enviva to conduct revised air modeling to include the bypass scenarios." This modeling will apparently occur after the draft permit has been issued and does not include criteria pollutants such as NOx and PM2.5, nor does it include those emissions impact the NAAQS. Enviva argues that

because the emission rates during the furnace bypass operations are comparable to or lower than normal operations, Enviva does not need to model the ambient air impacts from bypassing. This analysis is flawed-while the emissions may be comparable, the bypass stacks have different characteristics as compared to the RTO stack, and those differences likely have a significant impact on ambient concentrations.

Hearing Officer's Response to This Comment:

DAQ required Enviva Sampson to submit revised air dispersion modeling to address emissions from the cold startup, the idle mode, and the planned shutdown for the furnace bypass. The shutdown bypass for the dryer was not included in the revised air dispersion modeling due to minimal emissions associated with this scenario because no chips remain in the dryer during a planned shutdown. As noted in the response to Comment 19 below, the dryer bypass stacks only operate during planned shutdown and malfunction, as a result, these scenarios were not included in the modeling.

The revised air dispersion modeling was received on July 1, 2019 and reviewed and approved by DAQ's Air Quality Analysis Branch in a memo dated July 25, 2019. The memo indicated that the revised air dispersion modeling adequately demonstrates that emissions of total suspended particles (TSP) will not cause or contribute to an exceedance of the State Ambient Air Quality Standard (SAAQS). The revised air dispersion modeling also demonstrated that compliance is indicated for all TAPs modeled.

The Class II Area Tier 1 analysis for ozone precursors was not updated because the increase in VOC emissions from the MERP analysis for the additional stacks was 0.02 tons per year and the screening method does not accommodate that level of precision. As noted in the permit review, the NOx emissions are unchanged from the baseline actual emissions.

The malfunction bypass was not included for the furnace and the dryer in the revised air dispersion modeling. 40 CFR Part 51, Section 8.2.2(d) - Source Data Requirements, specifies that malfunctions that may result in excess emissions are not required to be modeled, unless the malfunctions are the result of poor maintenance, careless operation, or other preventable conditions. DAQ anticipates any malfunction emissions from Enviva Sampson will be unplanned and unavoidable and not the result of deficient operational practices. As a result, modeling of malfunction is not required. If excess emissions were not the result of a malfunction, then DAQ could ask for modeling of bypass emissions.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 19 (EIP & SELC Letter - Item IV.B):

Enviva improperly failed to quantify emissions from dryer bypass events. Enviva claims that it did not need to provide information on emissions during dryer bypass events because the dryer bypass is only used during malfunctions, which are "infrequent and unpredictable." This is in contrast to a recent permit application from Enviva for its Lucedale, Mississippi plant, wherein Enviva did

quantify emissions for dryer bypass scenarios. At that plant, Enviva states that the dryer bypass "will be used to exhaust hot gases during start-up (for temperature control), shutdown, and malfunctions." Enviva then provided emission information for dryer bypass events.

Because Enviva Sampson operates a larger dryer with a higher heat input than those evaluated at Lucedale, the hourly emission rates at Enviva Sampson will be much higher. For instance, total PM/PM10/PM2.5 will be 86.8 lb/hr and NOx emissions will be 39.1 lb/hr.

Based on the foregoing, DAQ must incorporate a specific permit condition stating that the use of the dry bypass stack is not authorized and constitutes a violation of the permit. In the alternative, at a minimum, DAQ must at least require Enviva to quantify the emissions from the dryer bypass stacks and conduct modeling to determine whether use of the bypass stacks and the high hourly emissions will not cause or contribute to any NAAQS or increment exceedance.

Hearing Officer's Response to This Comment:

The dryer bypass is only operated under two conditions – malfunction and planned shutdown. In a letter dated May 10, 2019, Enviva Sampson provided the following description of these two events:

> **Malfunction**: The dryer system can abort due to power failure, equipment failure, or furnace abort. If the [RTO] goes offline because of an interlock failure, the dryer immediately aborts. This can occur if the dryer temperature is out of range or due to equipment or power failure. Dryer abort is also triggered if a spark is detected.
>
> **Planned Shutdown**: During planned shutdowns, as the remaining fuel is combusted by the furnace, the operator reduces the chip input to the dryer. When only a small amount of chips remains, the dryer drum is emptied. The dryer bypass stack is then opened, and a purge air fan is used to ensure no explosive build-up occurs in the drum. Emissions during this time are minimal as the furnace and dryer are no longer operating.

Because malfunctions are unexpected emissions and are difficult to quantify, they do not have to be included in the air dispersion modeling as discussed in response to Comment 18 above. Emissions from the dryer bypass during shutdown are minimal because neither the furnace nor dryer are operating, and quantification of these emissions is not needed due to the minimal emissions.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 20 (EIP & SELC Letter - Item V):

DAQ should require stack testing at 100% softwood or the maximum softwood content that the facility is capable and authorized to process.

Hearing Officer's Response to This Comment:

Enviva Sampson is currently limited to 50% softwood by a Special Order by Consent with DAQ (SOC 2018-003). When the revised permit is issued, the facility will be able to operate at up to 100% softwood. The permit limits initial testing to 80% softwood to ensure the facility can demonstrate compliance with emission limits prior to exceeding 80% softwood during normal operation. The limitation should not be construed to mean that DAQ requires no testing above 80% softwood use. The draft permit requires Enviva Sampson to conduct periodic source testing within 90 days of operating at 90% softwood.

The draft permit requires an extensive testing regime, including initial testing when the permit is issued and upon completion of the softwood expansion project. Periodic testing is required when either the softwood percentage or throughput increases by 10 percentage points. At a minimum, Enviva Sampson must conduct testing annually at its maximum normal production rate and the maximum normal operating softwood percentage. Therefore, if Enviva Sampson is operating at a softwood percentage at or near 100% then these conditions will be reflected in the periodic annual performance test.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 21 (EIP & SELC Letter - Item VI):

The draft permit lacks monitoring sufficient to assure compliance with the applicable 20% opacity limit. The monitoring requirement under Permit Condition 2.1(A)(3)(c) allows an untrained individual to pick any time during the first 30 days of the permit's effective period to subjectively determine a "normal" opacity level from the sources. Once a month thereafter, the permittee makes another subjective observation concerning whether the opacity is "above normal". The draft permit does not require the original observer to record his or her qualitative description of the normal level of opacity, and provides no mechanism for the original observer to communicate to any future observer what normal opacity looks like. Likewise, the recordkeeping requirement fails to require the monthly observers to record any description of their observations, the methods they use to make the observation, or the time of day and conditions at the time the observation was made. This method fails to assure compliance with the 20% opacity limit because (1) DAQ has not demonstrated that monthly monitoring is sufficient to assure compliance with a 20% opacity limit that applies at all times, (2) DAQ has not demonstrated that the parameter being monitored ("normal" opacity) correlates with demonstrating that opacity remains below 20% at all times, (3) the permit fails to specify the method that the facility must use to determine opacity, and (4) the permit lacks recordkeeping and reporting needed to document the results of required monitoring.

Hearing Officer's Response to This Comment:

The draft air permit requires the facility to conduct monthly visible observations and establish "normal" within 30 days following commencement of operation of the equipment. If the visible emissions are above normal the appropriate action must be taken to correct the above normal emissions as soon as practicable and record the action taken or demonstrate that the percent opacity

from the emission point is below the opacity limit in accordance with 15A NCAC 2D .2610 (Method 9).

The visible observation procedures are long established by DAQ and are sufficient to ensure compliance with 15A NCAC 02D .0521. The EPA periodically conducts audits of DAQ's Title V permitting program and routinely reviews Title V permits. The EPA has not indicated DAQ's visible observation procedures are deficient nor fail to meet the intent of the Title V monitoring requirements. In addition, during DAQ's annual full compliance evaluation inspection, the DAQ inspector, who is Method 9 certified, observes emission release points to determine compliance with the visible emission standard and reviews the facility's records to ensure the proper information is being recorded. The facility must record the following visible emission observation information:

1) the date and time of each recorded action;
2) the results of each observation and/or test noting those sources with emissions that were observed to be in noncompliance along with any corrective actions taken to reduce visible emissions; and
3) the results of any corrective actions performed.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 22 (EIP & SELC Letter - Item VII):

DAQ should require Enviva Sampson to prepare and implement a fugitive dust control plan. The need for a fugitive dust plan for this facility is especially acute due to the fact that this facility will impact the health and well-being of communities that are already plagued by numerous polluting facilities.

Hearing Officer's Response to This Comment:

As required by 15A NCAC 2D .0540 "Particulates From Fugitive Dust Emissions Sources", Enviva Sampson shall not cause or allow fugitive dust emissions to cause or contribute to substantive complaints or excess visible emissions beyond the property boundary. Enviva shall submit a fugitive dust plan within 30 days of receiving written notification from the Director of two substantive complaints in a 12-month period. Enviva shall also submit a fugitive dust plan if DAQ observes excessive fugitive dust emissions from the facility beyond the property boundaries for six minutes in any one hour (using Reference Method 22 in 40 CFR, Appendix A).

Since Enviva Sampson started operations, there have been no substantive fugitive dust complaints regarding the facility. In addition, the DAQ inspector did not observed any evidence of fugitive dust beyond the property boundaries during the full compliance evaluation inspections. If there are substantive fugitive dust complaints or excessive fugitive dust emissions from the facility, then Enviva Sampson may be required to submit a fugitive dust plant as described in 15A NCAC 2D .0540.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 23 (EIP & SELC Letter - Item VIII):

The draft permit should implement periodic reporting requirements. In contrast to the recent permit for Enviva Hamlet, the draft Enviva Sampson permit does not require semi-annual reporting or monitoring results. This monitoring will ultimately be required once Enviva Sampson holds a Title V permit, so we see no reason to not begin required this reporting now.

Hearing Officer's Response to This Comment:

Facilities that hold Title V permits are required to submit reports of any required monitoring at least every six months pursuant to 40 CFR 70.6(a)(3)(iii)(A). Although classified as a Title V facility, Enviva Sampson has not yet been issued a Title V permit. Air permits issued in accordance with 15A NCAC 2Q .0300, such as Enviva's draft permit, do not require semiannual reporting of monitoring activities. However, semiannual reporting can be included if deemed necessary to ensure compliance pursuant to 15A NCAC 2D .0605(b). DAQ will add semiannual reporting of monitoring activities to the permit.

Recommendation: It is recommended that semiannual reporting requirements for monitoring activities be added to the air permit.

Comment 24 (EIP & SELC Letter - Item IX and A.):

DAQ failed to consider the environmental justice impacts of the proposed modification to nearby communities. DAQ issued the draft permit modification to Enviva Sampson without open and meaningful participation by low-income and minority communities that will be disproportionately impacted. The Department of Environmental Quality (DEQ) also entered into a settlement agreement with several organizations to resolve a complaint filed with EPA under Title VI of the Civil Rights Act alleging that DEQ's issuance of the state's general swine permit had an "unjustified disproportionate impact on the basis of race and national origin against African Americans, Latinos, and native Americans," living in Sampson and Duplin counties. As part of this settlement, DEQ agreed to take steps to address the environmental justice concerns associated with its permitting of swine facilities in the state. Despite its commitment, DAQ did not conduct a full environmental justice analysis prior to issuing the Enviva Sampson draft permit. Instead, an Environmental Justice Snapshot was issued which fails to ensure adequate outreach to potentially impacted communities or inform DAQ of potentially environmental justice concerns.

Hearing Officer's Response to This Comment:

DEQ is committed to going beyond the legal and scientific requirements of the permit application to look at the community demographic and socioeconomic make up. DAQ has considered environmental justice and equity by conducting the EJ Snapshot to inform the inclusive and meaningful engagement conducted for the permit application.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 25 (EIP and SELC Letter - Item IX.B)

DAQ appears to have developed a new, two-step process for assessing environmental justice issues in the permitting process. First, DAQ will conduct a "Snapshot...at the beginning of the application process" that will be made available to the public "before the close of the public comment period." Then at some point after close of the comment period DAQ may conduct a full environmental justice review and develop an environmental justice report. ...According to DAQ's own explanation of its process, identification and increased outreach will not occur until after the notice and comment period has ended. This backwards process undercuts rather than supports DEQ's goal of meaningful participation in the permitting process.

Hearing Officer's Response to This Comment:

DEQ utilized the results from the EJ Snapshot to conduct a series of meaningful outreach methods. The outreach performed included:

- Contact with the Sampson County Health Director (epidemiologist) on July 3, 2019.
- Staff trip to Sampson/Duplin County on July 10, 2019 to post flyers and talk with local shop owners and community members to educate about the permit application and promote the public hearing. Over 40 local businesses and churches were visited.
- Translation of vital documents into Spanish (press release with public hearing information and one-page overview of the permit application and how to provide public comment if unable to attend in person).

The final EJ Report was prepared on September 18, 2019 with considerations of comments received during the public comment period.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 26 (EIP and SELC Letter - Item IX.C)

DAQ arbitrary narrowed the geography scope of its Environmental Justice Snapshot in a manner that fails to provide a full picture of the impacts of the proposed modification to nearby minority and low-income communities. The Snapshot does not provide full and accurate information to the public regarding the relevant geographic area that may be impacted by the proposed expansion. As such, the Snapshot failed to ensure that members of the public can meaningfully participate in the permitting process.

The Snapshot's focus was only a two-mile radius around the facility. DAQ implies that because the highest ambient air impacts from the facility are at the fence line, a two-mile radius was used. The passing reference to dispersion modeling is not explained, nor is the modeling or underlying data provided. Increasing the geographic area to a 3-mile radius would provide DAQ with a more complete understanding of the potentially affected communities and environmental justice harms from the Enviva Sampson modification.

Hearing Officer's Response to This Comment:

According to DAQ, the highest off-site ambient air impacts from Enviva Sampson dispersion modeling occur at the plant fence line. The location and magnitude of the maximum modeled toxic impact (66.9 ug/m^3 for acrolein) rapidly decrease as you move away from the facility with predicted concentrations at a 1-mile radius about an order of magnitude less than the maximum concentration. Enviva Sampson's contribution to the total impact is over 99%. Based on the modeling, a two-mile radius was used for analyzing the local demographics and socioeconomic factors.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 27 (EIP and SELC Letter - Item IX.D)

DAQ's Snapshot failed to consider the cumulative impacts of the proposed modification on nearby communities. Specifically, the Snapshot does not present a full picture of other polluting sources in the area – primarily, the large number of industrial animal operations surrounding the facility. Such a high concentration of industrial animal operations has caused an intense pollution burden on nearby waters and communities. Industrial swine and poultry operations generally emit the same types of pollutants, including ammonia and nitrogen, hydrogen sulfide, methane, particulate matter, pathogens, volatile organic compounds and volatile fatty acids. Exposure to pollution from these facilities has been shown to have devastating impacts to the public health and wellbeing. These health and environmental impacts disproportionately impact African American, Latino, and American Indian residents in Southeastern North Carolina. EPA expressed "deep concern about the possibility that African Americans, Latinos, and native Americans have been subjected to discrimination as the result of NC DEQ's" swine facility permitting.

The Snapshot does acknowledge the presence of swine operations in the area around the Sampson facility, it does so only in passing and completely ignores the massive number of poultry operations in the same area. Because DEQ arbitrarily limited its analysis to a 2-mile radius of the Sampson facility, the Snapshot only captured 4 industrial swine operations. At 3 miles, this number increases to 7 and a 5-mile radius, there are almost 40 industrial swine operations surrounding the Enviva Sampson facility, not to mention an unknow number of poultry operations.

Hearing Officer's Response to This Comment:

As the commenters point out, DEQ's EJ Snapshot acknowledges the presence of swine operations in the area around the Enviva Sampson facility. Moreover, the decision to limit its analysis to a two-mile radius was not arbitrary. That decision was based on air quality impacts. The metrics considered within those two miles included race and poverty (decennial census year), per capita income and ability to speak English (most current American Community Survey (ACS) census range), the current North Carolina Department of Commerce county tier, and presence of native American territory. While DEQ is committed to environmental justice and equity, there is no state regulatory law relative to air permitting that either mandates or directs that DEQ perform the more expansive type of cumulative impact analysis envisioned by the commenters.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

Comment 28 (EIP and SELC Letter - Item X)

DAQ's draft permit is inconsistent with Governor Cooper's Executive Order on climate change. On October 29, 2018, Governor Cooper signed Executive Order 80 titled, "North Carolina's Commitment to Address Climate Change and Transition to a Clean Energy Economy." The Executive Order sets several goals, including a 40 percent greenhouse gas emissions reduction from 2005 levels by 2025. The order also creates the North Carolina Climate Change Interagency Council and directs DEQ specifically to develop a North Carolina Clean Energy Plant to encourage the use of clean energy, including wind, solar, energy efficiency, and energy storage. DEQ as the agency charged with protection of North Carolina's environmental resources need to reevaluate the role of biomass and the wood pellet industry in North Carolina. Contrary to Executive Order 80, the wood pellet industry results in a net increase in atmospheric CO2 emissions, destroys forest carbon stocks and thereby reduces the forests ability to absorb CO2, and decreases the resiliency of vulnerable communities when facing extreme weather events.

Despite industry claims to the contrary, burning wood pellets for large-scale electricity production (as is the case with Enviva's products), is not carbon neutral, but actually emits as much or more CO2 per megawatt hour as coal. This instantaneous increase in atmospheric carbon can persist for decades to a century or more, even assuming trees are immediately replanted. Moreover, numerous investigations have uncovered the fact that Enviva uses whole trees from clear-cut forests to supply its wood pellet plants, including those in North Carolina. Such a process liquidates carbon stocks, harms biodiversity, and removes needed storm and flood protections from vulnerable communities. DAQ's draft permit modification allows the Enviva Sampson facility to increase its wood pellet production from 537,625 to 657,000 tons per year. This increased production will result in an additional 2,100 acres of forest being harvested from the area every year. The presumed 60-mile sourcing radius of the Enviva Sampson facility is right in the middle of the area that was most severely impacted by Hurricane Florence. As extreme weather events continue to increase and intensify, standing forests are vital to protect communities from the worst impacts. Enviva has requested production increases at numerous facilities. Collectively, Enviva requests a production increase of approximately 600,000 ton per year, which equates to an additional 10,000 acres of forest being harvested every year primarily from North Carolina. Such an increase in production and resulting forest harvests is inconsistent with the executive order's call for carbon reductions and building more resilient communities.

Hearing Officer's Response to This Comment:

Governor Cooper's Executive Order 80 sets emission reduction goals for the state of North Carolina to strive to achieve. Those goals include a reduction in statewide greenhouse gas emissions of 40% below 2005 levels, an increase in zero emission vehicles, and energy consumption reductions in state owned buildings of 40% from 2002-2003 levels. The NC Climate Change Interagency Council is charged with developing holistic approaches and programs so that North Carolina can strive to accomplish all the goals in Executive Order 80 while ensuring that North Carolina's vibrant economy continues to expand. A specific directive of the council is the development of a North

Carolina Clean Energy Plan by October 2019 that will seek stakeholder input in the expansion of clean energy technologies, energy efficiency measures, and clean transportation solutions. A key outcome from this process is the level of greenhouse gas emissions expected under current conditions and reductions achievable under alternative future scenarios with recommended policy, administrative, and voluntary actions taken by public and private entities. Until such time when legislative or regulatory proposals are considered and acted upon, projects such as this proposed modification must be evaluated based on the current state and federal regulations in place. DAQ will continue to develop an emissions inventory of key sources and monitor the effects of large projects on projected emissions levels.

Recommendation: No changes to the draft permit are deemed necessary to address this comment.

SECTION 2 – Comments Grouped by Similar Concerns

The following comments were provided by individuals representing themselves or an organization. Many of the comments express similar concerns. To address all issues and minimize redundancy, comments addressing similar issues have been grouped together.

Comment Grouping 1:
More than 80% of the comments opposing the air permit reference the paragraph below:

The wood pellet industry is driving the destruction and degradation of tens of thousands of acres of North Carolina forests. This market has resulted in more intensive and extensive logging of forests, depleting the very ecosystems on which we depend for sequestering and storing CO2. We need standing, diverse, healthy forests to store carbon, protect us from flooding and storms, and provide us with clean air and water. Any expansion of this industry hampers North Carolina's ability to meet its commitment on climate mitigation and adaptation, as well as communities' ability to rebound and recover after storms like Hurricane Florence.

Other comments expressed similar concerns:

- *The forest contains wildlife that will be destroyed with clear cutting.*
- *Old growth forests are cut and replanted with fast growing pines that do not support the same ecosystem or filter as much carbon dioxide.*
- *Biomass is not carbon neutral and forests are being destroyed at a pace that exacerbates climate change. Forests are being sustained in publicly managed lands in western NC however forests in eastern NC are being clear cut and no replanting has begun.*
- *Burning wood pellets for electrically produces more carbon than coal.*
- *Wood pellets are not sustainable and increases carbon emissions while destroying forests which are used to limit climate change.*
- *Shipping wood pellets to Europe to be burned in large scale energy production is not carbon neutral.*

- *Studies show that a large portion of the wood production comes from mature hardwood forest and bottomland hardwood forest of NC and logging is a major source of GHG and the climate impacts of logging are not being accurately reported.*
- *CO2 sequestration in topsoil is critical. There is no research on how 7 million pounds of wood chips going to 1 plant in England each year with 20 to 30 percent of it becoming ash. Until research is done on the impacts of losing topsoil and its CO2 sequestration in NC then DAQ should deny the expansion of this facility.*
- *North Carolina needs to make a major commitment to re-forestation as a key strategy for reducing carbon emissions in North Carolina.*

Hearing Officer's Response to These Comments

Many commenters expressed concerns with the impacts that harvesting trees for the forest products industry will have on the local community and environment, and climate worldwide. The sourcing of timber is also a concern especially from bottomland hardwood forests. Healthy trees and and forests are an important part of the environment and it is important to protect and manage this resource.

An important indicator of a sustainable forest is a constant or increasing area to timberland and forest type. According to information from Enviva and their website, Enviva uses a Track and Trace program to manage the sourcing of the wood they process.

> "*Enviva records the geographic location, age, and forest type of all of the primary wood. We know how and by whom each tract was harvested, as well as the proportion of wood that was sent to Enviva versus other forest product industry consumers. Enviva does not source from old growth forest, protected forests or forests that are being harvested for land use conversion. Enviva works with the US Endowment for Forestry and Communities who independently identify bottomland forest ecosystems that may process high conservation value (HCV) attributes. We will only agree to purchase wood from a harvest once we have determined that the tract is a working forest that is likely to regenerate with the desired composition of species. When tracts are determined as non-HCV and where harvest is appropriate, Enviva works with suppliers to develop an individualized harvest technique that is most suitable for the site.*"

Information provided by the United States Department of Agriculture (USDA) indicates the forests in North Carolina are stable. The Forest Inventory and Analysis program shows that approximately 55% of the state land area is forest and the diversity and mix is steady. The North Carolina Forestry Service (NCFS) indicates the forest size and mix has been steady since the early 2000s. The growth to removal rate of softwood is 1.61 and hardwood is 2.36 which indicates that inventory levels are expected to increase over time. The North Carolina Greenhouse Gas Inventory (1990-2030) published January 2019 indicates that carbon sinks are primarily due to carbon sequestered in above ground biomass and storage of carbon in wood products. There has been a 4% increase in the annual carbon sequestered between 2005 and 2017. This annual sequestration of carbon reflects North Carolina's sustainable management of its forests and their economic uses.

An area of concern is the bottomland hardwood forests. The NCFS is aware of the concerns over the sustainability of bottomland hardwood forest and continues to manage and gather data on these areas.

According to the NCFS, the net growth of bottomland hardwood forest has returned to more sustainable levels. The management of bottomland swamp forest is relatively passive and occurs over a much longer timeframe due to the relatively slower growth cycle of timber in swamps.

Properly managed forests provide many benefits to the environment. An unmanaged stand of trees may have high density with too many trees crowded together. This means the trees grow more slowly as they must compete for a limited amount of soil nutrients, water and light and this stress makes trees more susceptible to disease and pests. The NCFS is ultimately charged with overseeing the sustainability of timber crops. The NCFS is familiar with Enviva's operation and believes the suppliers are operating within generally accepted forest management practices.

Recommendation: No changes to the draft permit are deemed necessary to address these comments.

Comment Grouping 2

More than 80% of the comments opposing DAQ issuing the air permit reference the paragraph below:

A shocking pattern of air quality violations and noncompliance with the Clean Air Act have been documented in the wood pellet industry, with Enviva's North Carolina facilities being the most egregious in terms of skirting the Clear Air Act's requirements.
Other comments expressed similar concerns:

- *Enviva has misled the public, government, and investors on their emissions. The company's past actions and missteps make it all the more imperative that it is strongly scrutinized at every step along the way. Unfortunately, NC DEQ has consistently enabled Enviva to expand unchecked in North Carolina.*

Hearing Officer's Response to These Comments
A review of the compliance history for existing Enviva facilities indicate there have been three violations at the Enviva Sampson facility since the facility started operations in late 2016 and a Special Order by Consent (SOC) signed by DAQ in September 2018. The violations are as follows:

Sampson
- SOC signed by Enviva on August 15, 2018 and DAQ on September 21, 2018 to resolve compliance issues as identified in the SOC.
- Notice of Violation with Recommendation for Enforcement (NRE) issued on June 5, 2018 for failed source test in March 2017 for VOC.
- NRE issued November 3, 2017 for failed source test in March 2017 for CO.
- Notice of Violation (NOV) issued February 3, 2017 for visible emissions monitoring and recordkeeping violations.

In addition to Enviva's Sampson facility, Enviva has one transport and three other manufacturing facilities in North Carolina. The facilities are located in Wilmington, Ahoskie, Hamlet, and Northampton. The compliance history for these facilities is as follows:

Wilmington - no violations (transport facility only)

Ahoskie
- NOV issued March 14, 2017 for a late Annual Compliance Certification
- NOV issued July 21, 2016 for 31 days of downtime for grid No. 1 on the WESP due to malfunctions. Grids 2 and 3 continued to operate as designed
- Notice of Deficiency (NOD) issued September 3, 2014 for a late report
- NOD issued July 28, 2014 for recordkeeping deficiencies
- NOD issued August 12, 2013 for late report
- NOV issued May 2, 2013 for fugitive dust plan deficiencies.

Hamlet
- The facility commenced operation on July 24, 2019.

Northampton
- NOD issued December 7, 2016 for late permit renewal application
- NOD issued August 22, 2014 for late report

Of the violations found at the Enviva facilities, two violations pertained to emission exceedances occurred at the Sampson facility. An initial stack test was conducted in March 2017 to assure compliance with designed performance specification for the wood dryer (ES-DRYER). The dryer had been installed but had not yet reached full production rate. The stack test indicated an exceedance of the permit limit for CO and was inconclusive for VOC. Operational changes were made by Enviva to maintain CO within permit limits. In November 2017, DAQ required Enviva to retest for VOCs. A second test was performed in March 2018 for VOC and indicated non-compliance with the permit limit. Enviva attributed both stack test failures to the wood dryer (ES-DRYER) not meeting design specifications. The company responded that "It was only when production was increased for the compliance testing that it was realized the furnace was not designed to adequately operate at the elevated production rates for extended periods." As a result, a Special Order by Consent (SOC) was signed and the facility installed a Regenerative Thermal Oxidizer (RTO) as a control device for the dryer. A stack test was conducted on February 7, 2019. The stack test report was received by DAQ's Fayetteville Regional Office on March 6, 2019 and indicated compliance with the VOC emission rate for the wood-fired direct heat drying system while processing 50% softwood. The report was reviewed and approved by DAQ's Stationary Source Compliance Branch. As part of the air permit requirements, Enviva Sampson will be required to conduct stack testing for select criteria pollutants and hazardous air pollutants to ensure compliance with air emission limits. DAQ staff will continue to conduct unannounced full compliance evaluation inspections to ensure compliance with all conditions of the air permit.

Recommendation: No changes to the draft permit are deemed necessary to address these comments.

Comment Grouping 3

More than 80% of the comments opposing DAQ issuing the air permit reference the paragraph below:

Increased air pollution from Enviva will have a detrimental health impact on the community.

Other comments expressed similar concerns:
- *DAQ does not know how bad the air quality is in Sampson and Duplin Counties because there are no local air monitors. The health scores for Sampson County is one of the lowest in North Carolina ranking 80 out of 100 counties.*

- *Although NC DAQ has initiated limited monitoring of the air from surrounding CAFO operations, the monitoring system does not include monitoring for ground level ozone. Existing NC DAQ ozone monitoring are too distant from Sampson and Duplin Counties to address the issue.*
- *Extractive industries do not provide communities with economic stimulus. Forests areas should be managed in a way that reduces poverty and increases wellbeing. The world's leading scientists show a link between land degradation and degradation of communities.*
- *There are more negative impacts than those helped by an increase in jobs.*
- *In areas where Enviva has facilities the poverty rates are stagnate or increases.*
- *The area is already impacted by emissions from swine and poultry farms. Be careful not to violate the civil rights of North Carolinians.*
- *Sampson County is already home to many other sources of air pollution including hundreds of CAFOs (concentrated animal feeding operations). It doesn't make sense to expose residents to additional pollutants in an area already facing some of the worst health outcomes.*
- *The poor people and people of color do not want pellet factories in their areas because of serious health effects and property value declines.*

Hearing Officer's Response to These Comments

The DAQ works with the state's citizens to protect and improve outdoor air quality in North Carolina for the health, benefit and economic well-being of all. To carry out this mission, DAQ operates a statewide air quality monitoring network to measure the level of pollutants in outdoor air. The Clean Air Act requires EPA to set National Ambient Air Quality Standard (NAAQS) for pollutants considered harmful to public health and the environment. Two types of standards are established; primary and secondary standards. The primary standards provide public health protection, including protecting the health of sensitive populations such as asthmatics, children and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

DAQ gathers data to evaluate the ambient air quality. DAQ operates and maintains air monitors for particulate matter and ozone in counties near Sampson and Duplin Counties. The monitors for fine particulate matter (PM 2.5) are located in Cumberland, Johnston, and New Hanover Counties and show that PM2.5 emissions are below NAAQS primary standards. As can be seen by the data below, fine particulate matter at the monitoring sites are below the NAAQS standards.

	PM 2.5 Standard	Cumberland Co	Johnston Co	New Hanover Co
Daily	35 ug/m^3	18 ug/m^3	15 ug/m^3	13 ug/m^3
Annual	12 ug/m^3	7.1 ug/m^3	7.8 ug/m^3	4.8 ug/m^3

Data provided are 3-year averages.

The monitors for ozone are located in Lenoir, Johnston and New Hanover Counties and two ozone monitoring sites are located in Cumberland County. The sites range from approximately 30 to 50 miles away from the Enviva Sampson facility. All ozone monitors show the area to be in compliance with the NAAQS for ozone. In addition, upwind monitoring sites in South Carolina also indicate the ozone levels are likely not to exceed the NAAQS for ozone.

More recently, DAQ has initiated a monitoring program for ammonia, hydrogen sulfide, and fine particulate matter (PM2.5) in Duplin County. Data collection started in mid-2018 and is ongoing. Preliminary evaluation of the data suggests the monitored values are below acceptable ambient levels (AAL) and the NAAQS and indicates the air quality is comparable to the air quality across the state.

The increase in criteria air pollutants from the facility's modifications was analyzed as part of the air permit application. The increases were compared to the significant emission rate (SER) for each Prevention of Significant Deterioration (PSD) pollutant to determine if the expansion project was major under PSD. It was determined that the emission increases exceed the significant emission rate (SER) for VOC and PM. The emission increases for the remaining criterial pollutants (CO, NOx, PM10, PM2.5, and SO2) did not exceed the SER. As a result, a PSD significant impact analysis was conducted for ozone precursors (NOx and VOC) and PM.

A screen modeling analysis was conducted to evaluate the impact NOx and VOC emissions will have. The results from the modeling were compared to modeled emission rates for precursors (MERPs) values determined by EPA to conservatively be expected to have a significant impact on ozone formation. A compared value of less than 100% indicates the combined impacts will not exceed the critical air quality threshold. As shown below, the emissions increase of NOx and VOC is significantly below (18%) of the MERPs and indicates the project will not cause or contribute to a violation of the NAAQS for ozone.

Precursor	MERP (TPY)	Emission Increase (TPY)	Percentage of MERP
NOx	170	0	0 %
VOC	1,159	214	18 %
		Total	18 %

Although total suspended particulate (TSP) NAAQS was revised in 1987 to focus and regulate PM10; the North Carolina State Ambient Air Quality Standards (SAAQS) still requires evaluation of both PM10 and PM (TSP) separately. As a result, modeling was conducted for facility wide PM TSP emissions. The tables below show the modeled concentrations for the 24-hr and annual PM TSP from the furnace as a result of this expansion project and during bypass mode. The PM TSP modeled concentrations are below the SAAQS.

Averaging Period	Scenario	TSP Modeled Concentration ($\mu g/m^3$)	SAAQS ($\mu g/m^3$)	Exceeds SAAQS?
24-Hour	Furnace Operation	145	150	No
Annual		21.8	75	No

Averaging Period	Scenario	TSP Modeled Concentration ($\mu g/m^3$)	SAAQS ($\mu g/m^3$)	Exceeds SAAQS?
24-Hour	Furnace Bypass – Idle	146	150	No
Annual	Furnace Bypass – Idle and Cold Start-Up	21.8	75	No

In accordance with 15A NCAC 02Q. 0702(a)(27)(b), modeling of toxic air pollutants was not required as part of the air permit analysis since all sources at Enviva Sampson that emit toxics are subject to either a case-by-case MACT or 40 CFR Part 63. However, modeling of air toxics was conducted for various

operating scenarios including the furnace bypass stacks. As shown in the table below, the modeling demonstrates that all toxics evaluated are below the acceptable ambient levels (AAL) and the proposed project will not present an unacceptable risk to human health.

Pollutant	Averaging Period	Scenario	Maximum Impact ($\mu g/m^3$)	AAL ($\mu g/m^3$)	% of AAL
Acrolein	1-hour	Normal and Furnace Idle	66.9	80	84 %
Arsenic	Annual	Furnace Cold Start-Up	0.00021	0.0021	1 %
Benzene	Annual	Normal	0.0053	0.12	5 %
Cadmium	Annual	Furnace Cold Start-Up	0.0000392	0.0055	1 %
Chlorine	1-hour	Furnace Cold Start-Up	0.17	900	<1 %
	24-hour	Furnace Cold Start-Up	0.065	37.5	<1 %
Formaldehyde	1-hour	Normal and Furnace Idle	42.4	150	28 %
Hydrogen Chloride	1-hour	Furnace Cold Start-Up	4.1	700	1 %
Manganese	24-hour	Furnace Cold Start-Up	0.13	31	<1 %
Phenol	1-hour	Normal and Furnace Idle	33.3	950	4 %

Recommendation: No changes to the draft permit are deemed necessary to address these comments.

Comment Grouping 4:

General comments not directly related to the expressed intent of the public hearing.

Below are sample comments paraphrased and in no particular order:

- *Enviva only exists because of subsidies from the United Kingdom and the subsidies for bioenergy will not last.*
- *Enviva has been a good corporate citizen where they have facilities in Sampson and Richmond Counties.*
- *The increase in logging trucks will damage our roads and increase fuel costs.*
- *My neighborhood is under noise assault from the increase truck traffic and operation of conveyors at the bulk wood pellet storage facility in Wilmington.*
- *NC needs a Clean Energy Plan that commits to 100% clean, renewable energy and the de-carbonization of the energy economy, phase out all coal and gas-fired power plants and storage facilities and a permanent remediation of coal ash contamination to be paid for in full by Duke Energy, the responsible party, and not at the expense of taxpayers and/or customers through a rate hike.*

Hearing Officer's Response to These Comments
While most of the comments received were thoughtful and worth considering in the proper forum, some of the comments received were not directly related to the Enviva Sampson, LLC air quality permit application or the air quality permitting process. As such, these comments fall outside the purview of this public hearing and are therefore not directly addressed in this report.

Conclusions and Recommendations

After considering all the public comments regarding whether or not DAQ should issue an air quality permit to Enviva Pellets Sampson, LLC to allow the modification of a wood pellet manufacturing facility at 5 Connector Road, US 117 in Faison, Sampson County, North Carolina, it is the recommendation of the hearing officer that the Director issue the Air Quality permit after considering the following:

- In response to Comment 4, it is recommended that a condition be added to the air permit requiring Enviva Sampson to include either a BACT analysis for the dry hammermills and the pellet presses and coolers or a request for PSD avoidance in its permit application for case-by-case MACT. The permit application will be due within six months of this permit issuance.

- In response to Comment 5, it is recommended that the final air permit review for this PSD permit application include the revised BACT analysis for VOC emission sources based on the September 10, 2019 submittal from Enviva Sampson.

- In response to Comment 17, it is recommended the following permitting language or similar requirements having the same intent be BACT for start-up, shut-down, and malfunction events:
    - Operation of the furnace bypass during startup and shutdown shall be limited to 50 hours per year.
    - Operation of the dryer bypass during shutdown will be limited to 50 hours per year.
    - At all times, including periods of startup, shutdown, and malfunction, the Permittee shall, to the extent practicable, maintain and operate all emission sources including associated control devices in a manner consistent with good air pollution control practice for minimizing emissions. Determination of whether acceptable operating and maintenance procedures are being used will be based on information available to DAQ which may include, but is not limited to, monitoring results, opacity observations, review of operating and maintenance procedures, and inspection of the source.

- In response to Comment 23, it is recommended that semiannual report requirements for monitoring activities be added to the air permit.

Additionally, I recommend DAQ staff remain sensitive to the health of the nearby communities and to the concerns that will remain should this modification be completed. This can be accomplished through thorough air quality inspections and prompt responses to the citizen's air quality concerns and complaints.

Joseph E. Foutz, Hearing Officer

9-26-19
Date

SUPPORTING DOCUMENTS

(The following supporting documents are located on the DAQ SharePoint site)

Air Quality Permit Application Review and Draft Permit
Public Hearing Attendance Forms
Audio Recording of July 15, 2019 Public Hearing
Summary of Public Hearing Comments
Emails received during the Public Comment Period
Written Comments received during the Public Comment Period
Environmental Justice Study

Attachment 1

VOC BACT Cost Calculations

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Enviva Sampson

VOC Controls: Average Cost Effectiveness ($/ton) Summary

Summary of Average Cost Effectiveness ($/ton)

Emission Point Number(s)	Unit/Service Description	Control Option	Uncontrolled PTE Emissions (TPY)	VOC Control Efficiency (%)	VOC Controlled Emission Rate (ton/yr)	VOC Reduction (ton/yr)	Total Annual Cost ($/yr)	Technology Cost Effectiveness ($/ton VOC Removed)
ES-HM-1 through 8	Dry Hammermills	RTO[1]	168	95%	8.4	159.6	$2,934,883	$18,389

[1] VOC control efficiency from USEPA Air Pollution Control Technology Fact Sheet: Regenerative Incinerator (EPA-452/F-03-021). https://www3.epa.gov/ttn/catc/dir1/fregen.pdf

RTO Cost Calculations
Dry Hammermill VOC Emissions
ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Incinerator + auxiliary equipment	$	1,975,364	Equation 2.33 from EPA Cost Control Manual, Oxidizer and Incinerator Section, based on maximum measured flow rates corrected to standard conditions.
Instrumentation	$	197,536	10% of incinerator and auxiliary equipment costs
Sales tax	$	59,261	3% of incinerator and auxiliary equipment costs
Freight	$	98,768	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	**$**	**2,330,929**	
Direct installation costs			
Foundations and supports	$	186,474	8% of total purchased equipment costs
Handling and erection	$	326,330	14% of total purchased equipment costs
Electrical	$	93,237	4% of total purchased equipment costs
Piping	$	46,619	2% of total purchased equipment costs
Insulation for ductwork	$	23,309	1% of total purchased equipment costs
Painting	$	23,309	1% of total purchased equipment costs
Total Direct Installation Costs	**$**	**699,279**	
Total Direct Costs	**$**	**3,030,208**	
Indirect installation costs			
Engineering	$	233,093	10% of total purchased equipment costs
Construction and field expenses	$	116,546	5% of total purchased equipment costs
Contractor fees	$	233,093	10% of total purchased equipment costs
Start-up	$	46,619	2% of total purchased equipment costs
Performance test	$	23,309	1% of total purchased equipment costs
Total Indirect Installation Costs	**$**	**652,660**	
Contingency at 10%	$	368,286.83	Default contingency factor of 10% from EPA Cost Control Manual, Oxidizer and Incinerators Section
Total Capital Investment	**$**	**4,051,155**	
Annual Operating Cost			
Direct Annual Costs			
Operating Labor			
Operator	$	13,350	Based on $26.70/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Supervisor	$	2,003	15% Operator
Maintenance			
Labor	$	13,625	Based on $27.25/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Materials	$	13,625	100% Maintenance Labor
Utilities			
Propane Usage	$	2,048,911	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal, Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2008-2010, US Energy Information Administration).
Electricity	$	273,361	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 hr/yr at $0.0689/kWh
Indirect Annual Costs			
Overhead	$	25,562	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges	$	81,023	2% TCI
Property Taxes	$	40,512	1% TCI
Insurance	$	40,512	1% TCI
Capital Recovery	$	382,400	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	**$**	**2,934,883**	Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers* , November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

RTO Cost Calculations
Dry Hammermill VOC Emissions
ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate	122,243	scfm (based on actual measured data for Sampson dry hammermills)

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	122,243	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	1600	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	1.08	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	0.33	auxiliary fuel usage (scfm), per Equation 2.45
	838.74	btu/min
Total Energy Input	3,508,409.04	btu/min, per Equation 2.22
5% of Total Energy Input	175,420.45	btu/min
Max of Equation 2.45 and Equation 2.22	175,420.45	Per Section 2.4.2 and Step 8t of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.

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Enviva Sampson

VOC Controls: Average Cost Effectiveness ($/ton) Summary

Summary of Average Cost Effectiveness ($/ton)

Emission Point Number(s)	Unit/Service Description	Control Option	Uncontrolled PTE Emissions (TPY)	VOC Control Efficiency (%)	VOC Controlled Emission Rate (ton/yr)	VOC Reduction (ton/yr)	Total Annual Cost ($/yr)	Technology Cost Effectiveness ($/ton VOC Removed)
ES-HM-1 through 8	Dry Hammermills	RCO	168	95%	8.4	159.6	$2,907,090	$18,215

RCO Cost Calculations
Dry Hammermill VOC Emissions
ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Incinerator + auxiliary equipment	$	1,975,364	Equation 2.33 from EPA Cost Control Manual, Oxidizer and Incinerator Section, based on maximum measured flow rates corrected to standard conditions.
Instrumentation	$	197,536	10% of incinerator and auxiliary equipment costs
Sales tax	$	59,261	3% of incinerator and auxiliary equipment costs
Freight	$	98,768	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	**$**	**2,330,929**	
Direct installation costs			
Foundations and supports	$	186,474	8% of total purchased equipment costs
Handling and erection	$	326,330	14% of total purchased equipment costs
Electrical	$	93,237	4% of total purchased equipment costs
Piping	$	46,619	2% of total purchased equipment costs
Insulation for ductwork	$	23,309	1% of total purchased equipment costs
Painting	$	23,309	1% of total purchased equipment costs
Total Direct Installation Costs	**$**	**699,279**	
Total Direct Costs	**$**	**3,030,208**	
Indirect installation costs			
Engineering	$	233,093	10% of total purchased equipment costs
Construction and field expenses	$	116,546	5% of total purchased equipment costs
Contractor fees	$	233,093	10% of total purchased equipment costs
Start-up	$	46,619	2% of total purchased equipment costs
Performance test	$	23,309	1% of total purchased equipment costs
Total Indirect Installation Costs	**$**	**652,660**	
Contingency at 10%	$	368,286.83	Default contingency factor of 10% from EPA Cost Control Manual, Oxidizer and Incinerators Section
Total Capital Investment	**$**	**4,051,155**	
Annual Operating Cost			
Direct Annual Costs			
Operating Labor			
Operator	$	13,350	Based on $26.70/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Supervisor	$	2,003	15% Operator
Maintenance			
Labor	$	13,625	Based on $27.25/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Materials	$	13,625	100% Maintenance Labor
Catalyst Bed Replacement	$	535,235	Based on 4 year catalyst life, catalyst cost of $3,000/ft^3 (noble metal catalysts), and catalyst volume of 733 ft^3.
Utilities			
Propane Usage	$	1,107,192	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal, Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2008-2010, US Energy Information Administration).
Electricity	$	330,911	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 hr/yr at $0.0689/kWh
Indirect Annual Costs			
Overhead	$	346,703	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges	$	81,023	2% TCI
Property Taxes	$	40,512	1% TCI
Insurance	$	40,512	1% TCI
Capital Recovery	$	382,400	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	**$**	**2,907,090**	Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers* , November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

RCO Cost Calculations
Dry Hammermill VOC Emissions
ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate	122,243	scfm (based on actual measured data for Sampson dry hammermills)
Catalyst Life	4	years
FWF =	0.225	

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	122,243	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	900	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	1.08	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	0.34	auxiliary fuel usage (scfm), per Equation 2.45
	876.96	btu/min
Total Energy Input	1,895,876.98	btu/min, per Equation 2.22
5% of Total Energy Input	94,793.85	btu/min
Max of Equation 2.45 and Equation 2.22	94,793.85	Per Section 2.4.2 and Step 8t of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.
Vcat	733	Overall bulk volume of cataslyst bed (ft3), per Equation 2.28, space velocity of 10,000 h^{-1}

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Enviva Sampson

VOC Controls: Average Cost Effectiveness ($/ton) Summary

Summary of Average Cost Effectiveness ($/ton)

Emission Point Number(s)	Unit/Service Description	Control Option	Uncontrolled PTE Emissions (TPY)	VOC Control Efficiency (%)	VOC Controlled Emission Rate (ton/yr)	VOC Reduction (ton/yr)	Total Annual Cost ($/yr)	Technology Cost Effectiveness ($/ton VOC Removed)
ES-DWH	Dried wood handling operations	RTO[1]	41	95%	2.0	38.8	$598,594	$15,440

[1] VOC control efficiency from USEPA Air Pollution Control Technology Fact Sheet: Regenerative Incinerator (EPA-452/F-03-021). https://www3.epa.gov/ttn/catc/dir1/fregen.pdf

RTO Cost Calculations
Dried Wood Handling VOC Emissions
ES-DWH
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Incinerator + auxiliary equipment	$	546,000	Equation 2.33 from EPA
Instrumentation	$	54,600	10% of incinerator and auxiliary equipment costs
Sales tax	$	16,380	3% of incinerator and auxiliary equipment costs
Freight	$	27,300	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	**$**	**644,280**	
Direct installation costs			
Foundations and supports	$	51,542	8% of total purchased equipment costs
Handling and erection	$	90,199	14% of total purchased equipment costs
Electrical	$	25,771	4% of total purchased equipment costs
Piping	$	12,886	2% of total purchased equipment costs
Insulation for ductwork	$	6,443	1% of total purchased equipment costs
Painting	$	6,443	1% of total purchased equipment costs
Total Direct Installation Costs	**$**	**193,284**	
Total Direct Costs	**$**	**837,564**	
Indirect installation costs			
Engineering	$	64,428	10% of total direct costs
Construction and field expenses	$	32,214	5% of total direct costs
Contractor fees	$	64,428	10% of total direct costs
Start-up	$	12,886	2% of total direct costs
Performance test	$	6,443	1% of total direct costs
Total Indirect Installation Costs	**$**	**180,398**	
Contingency at 10%	$ 101,796.24		Default contingency factor of 10% from EPA Cost Control Manual, Oxidizer and Incinerators Section
Total Capital Investment	**$**	**1,119,759**	
Annual Operating Cost			
Direct Annual Costs			
Operating Labor			
Operator	$	13,350	Based on $26.70/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Supervisor	$	2,003	15% Operator
Maintenance			
Labor	$	13,625	Based on $27.25/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Materials	$	13,625	100% Maintenance Labor
Utilities			
Propane Usage	$	335,218	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal, Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2008-2010, US Energy Information Administration).
Electricity	$	44,724	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 hr/yr at $0.0689/kWh
Indirect Annual Costs			
Overhead	$	25,562	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges	$	22,395	2% TCI
Property Taxes	$	11,198	1% TCI
Insurance	$	11,198	1% TCI
Capital Recovery	$	105,697	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	**$**	**598,594**	Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers*, November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

RTO Cost Calculations
Dried Wood Handling VOC Emissions
ES-DWH
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate of 2 DWH baghouses	20,000	cfm

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	20,000	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	1600	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	1.60	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	2.03	auxiliary fuel usage (scfm), per Equation 2.45
	5170.35	btu/min
Total Energy Input	574,003.47	btu/min, per Equation 2.22
5% of Total Energy Input	28,700.17	btu/min
Max of Equation 2.45 and Equation 2.22	28,700.17	Per Section 2.4.2 and Step 8t of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.

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Enviva Sampson

VOC Controls: Average Cost Effectiveness ($/ton) Summary

Summary of Average Cost Effectiveness ($/ton)

Emission Point Number(s)	Unit/Service Description	Control Option	Uncontrolled PTE Emissions (TPY)	VOC Control Efficiency (%)	VOC Controlled Emission Rate (ton/yr)	VOC Reduction (ton/yr)	Total Annual Cost ($/yr)	Technology Cost Effectiveness ($/ton VOC Removed)
ES-DWH	Dried wood handling operations	RCO	41	95%	2.0	38.8	$541,505	$13,968

RCO Cost Calculations

Dried Wood Handling VOC Emissions ES-DWH

Enviva Pellets Sampson, LLC Faison, Sampson

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Incinerator + auxiliary equipment	$	546,000	Equation 2.33 from EPA
Instrumentation	$	54,600	10% of incinerator and auxiliary equipment costs
Sales tax	$	16,380	3% of incinerator and auxiliary equipment costs
Freight	$	27,300	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	**$**	**644,280**	
Direct installation costs			
Foundations and supports	$	51,542	8% of total purchased equipment costs
Handling and erection	$	90,199	14% of total purchased equipment costs
Electrical	$	25,771	4% of total purchased equipment costs
Piping	$	12,886	2% of total purchased equipment costs
Insulation for ductwork	$	6,443	1% of total purchased equipment costs
Painting	$	6,443	1% of total purchased equipment costs
Total Direct Installation Costs	**$**	**193,284**	
Total Direct Costs	**$**	**837,564**	
Indirect installation costs			
Engineering	$	64,428	10% of total direct costs
Construction and field expenses	$	32,214	5% of total direct costs
Contractor fees	$	64,428	10% of total direct costs
Start-up	$	12,886	2% of total direct costs
Performance test	$	6,443	1% of total direct costs
Total Indirect Installation Costs	**$**	**180,398**	
Contingency at 10%	$ 101,796.24		Default contingency factor of 10% from EPA Cost Control Manual, Oxidizer and Incinerators Section
Total Capital Investment	**$**	**1,119,759**	
Annual Operating Cost			
Direct Annual Costs			
Operating Labor			
Operator	$	13,350	Based on $26.70/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Supervisor	$	2,003	15% Operator
Maintenance			
Labor	$	13,625	Based on $27.25/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Materials	$	13,625	100% Maintenance Labor
Catalyst Bed Replacement	$	87,569	Based on 4 year catalyst life, catalyst cost of $3,000/ft^3 (noble metal catalysts), and catalyst volume of 120 ft^3.
Utilities			
Propane Usage	$	181,145	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal, Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2008-2010, US Energy Information Administration).
Electricity	$	54,140	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 hr/yr at $0.0689/kWh
Indirect Annual Costs			
Overhead	$	25,562	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges	$	22,395	2% TCI
Property Taxes	$	11,198	1% TCI
Insurance	$	11,198	1% TCI
Capital Recovery	$	105,697	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	**$**	**541,505**	Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers*, November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

RCO Cost Calculations

Dried Wood Handling VOC Emissions ES-DWH

Enviva Pellets Sampson, LLC Faison, Sampson

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate	20,000	cfm
Catalyst Life	4	years
FWF =	0.225	

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	20,000	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	900	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	1.60	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	2.13	auxiliary fuel usage (scfm), per Equation 2.45
	5408.01	btu/min
Total Energy Input	310,180.47	btu/min, per Equation 2.22
5% of Total Energy Input	15,509.02	btu/min
Max of Equation 2.45 and Equation 2.22	15,509.02	Per Section 2.4.2 and Step 8t of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.
Vcat	120	Overall bulk volume of cataslyst bed (ft3), per Equation 2.28, space velocity of 10,000 h^{-1}

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Enviva Sampson

VOC Controls: Average Cost Effectiveness ($/ton) Summary

Summary of Average Cost Effectiveness ($/ton)

Emission Point Number(s)	Unit/Service Description	Control Option	Uncontrolled PTE Emissions (TPY)	VOC Control Efficiency (%)	VOC Controlled Emission Rate (ton/yr)	VOC Reduction (ton/yr)	Total Annual Cost ($/yr)	Technology Cost Effectiveness ($/ton VOC Removed)
ES-CLR-1 through 6	Pellet Coolers	RTO[1]	572	95%	28.6	543.4	$3,740,642	$6,884

[1] VOC control efficiency from USEPA Air Pollution Control Technology Fact Sheet: Regenerative Incinerator (EPA-452/F-03-021). https://www3.epa.gov/ttn/catc/dir1/fregen.pdf

RTO Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Incinerator + auxiliary equipment	$	1,812,441	Equation 2.33 from EPA Cost Control Manual, Oxidizer and Incinerator Section, based on maximum measured flow rates corrected to standard conditions.
Instrumentation	$	181,244	10% of incinerator and auxiliary equipment costs
Sales tax	$	54,373	3% of incinerator and auxiliary equipment costs
Freight	$	90,622	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	**$**	**2,138,680**	
Direct installation costs			
Foundations and supports	$	171,094	8% of total purchased equipment costs
Handling and erection	$	299,415	14% of total purchased equipment costs
Electrical	$	85,547	4% of total purchased equipment costs
Piping	$	42,774	2% of total purchased equipment costs
Insulation for ductwork	$	21,387	1% of total purchased equipment costs
Painting	$	21,387	1% of total purchased equipment costs
Total Direct Installation Costs	**$**	**641,604**	
Total Direct Costs	**$**	**2,780,284**	
Indirect installation costs			
Engineering	$	213,868	10% of total purchased equipment costs
Construction and field expenses	$	106,934	5% of total purchased equipment costs
Contractor fees	$	213,868	10% of total purchased equipment costs
Start-up	$	42,774	2% of total purchased equipment costs
Performance test	$	21,387	1% of total purchased equipment costs
Total Indirect Installation Costs	**$**	**598,830**	
Contingency at 10%	$ 337,911.47		Default contingency factor of 10% from EPA Cost Control Manual, Oxidizer and Incinerators Section
Total Capital Investment	**$**	**3,717,026**	
Annual Operating Cost			
Direct Annual Costs			
Operating Labor			
Operator	$	13,350	Based on $26.70/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Supervisor	$	2,003	15% Operator
Maintenance			
Labor	$	13,625	Based on $27.25/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Materials	$	13,625	100% Maintenance Labor
Utilities			
Propane Usage	$	1,853,579	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal, Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2008-2010, US Energy Information Administration).
Electricity	$	247,301	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 hr/yr at $0.0689/kWh
Indirect Annual Costs			
Overhead	$	25,562	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges	$	74,341	2% TCI
Property Taxes	$	37,170	1% TCI
Insurance	$	37,170	1% TCI
Capital Recovery	$	350,861	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	**$ 2,668,586**		Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers*, November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

RTO Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate	110,589	scfm (based on actual measured data for Sampson pellet coolers)

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	110,589	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	1600	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	3.93	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	0.38	auxiliary fuel usage (scfm), per Equation 2.45
	972.07	btu/min
Total Energy Input	3,173,937.08	btu/min, per Equation 2.22
5% of Total Energy Input	158,696.85	btu/min
Max of Equation 2.45 and Equation 2.22	158,696.85	Per Section 2.4.2 and Step 8t of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.

Baghouse Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Fabric Filter (with insulation)(EC)	$	236,803	Figure 1.9 of EPA Cost Control Manual for Pulse-Jet Filters (modular)
Bags	$	16,254	Bag cost from Table 1.8 based on 6-8 inch bag diameter for Pulse Jet, TR polyester bags
Auxiliary Equipment	$	118,402	Conservatively assumed 50% of Fabric Filter cost
Fabric Filter + Bags + Auxiliary	$	371,459	
Instrumentation	$	37,146	10% of incinerator and auxiliary equipment costs
Sales tax	$	11,144	3% of incinerator and auxiliary equipment costs
Freight	$	18,573	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	**$**	**809,780**	
Direct installation costs			
Foundations and supports	$	32,391	4% of total purchased equipment costs
Handling and erection	$	404,890	50% of total purchased equipment costs
Electrical	$	64,782	8% of total purchased equipment costs
Piping	$	8,098	1% of total purchased equipment costs
Insulation for ductwork	$	56,685	7% of total purchased equipment costs
Painting	$	32,391	4% of total purchased equipment costs
Total Direct Installation Costs	**$**	**599,238**	
Total Direct Costs	**$**	**1,409,018**	
Indirect installation costs			
Engineering	$	80,978	10% of total purchased equipment costs
Construction and field expenses	$	161,956	20% of total purchased equipment costs
Contractor fees	$	80,978	10% of total purchased equipment costs
Start-up	$	8,098	1% of total purchased equipment costs
Performance test	$	8,098	1% of total purchased equipment costs
Contingencies	$	24,293	3% of total purchased equipment costs
Total Indirect Installation Costs	**$**	**364,401**	
Total Capital Investment	**$**	**1,773,419**	
Annual Operating Cost			
Direct Annual Costs			
Operating Labor			
Operator	$	57,672	Based on $26.70/hr (2015), 2 hr/shift, 3 shifts/day, and 360 days/yr.
Supervisor	$	8,651	15% Operator
Maintenance			
Labor	$	29,430	Based on $27.25/hr (1998), 1 hr/shift, 3 shifts/day, and 360 days/yr.
Materials	$	29,430	100% Maintenance Labor
Replacement Bags	$	10,053	Equation 1.13, assumes $0.28/ft2 of bag area for labor cost
Utilities			
Compressed air	$	32,041	Based on methodology from EPA Cost Control Manual, Section 6, Chapter 1. Assumes 2 scfm of air per 1,000 acfm of flue gas and $0.25 per 1,000 scf of air, 8,640 hr/yr
Electricity	$	133,605	Based on methodology from EPA Cost Control Manual, Section 6, Chapter 1.
Waste disposal	$	457,730	
Indirect Annual Costs			
Overhead	$	75,110	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges	$	35,468	2% TCI
Property Taxes	$	17,734	1% TCI
Insurance	$	17,734	1% TCI
Capital Recovery	$	167,398	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	**$ 1,072,056**		

Note:

Estimation based on *EPA Cost Control Manual, Section 6, Chapter 1, Baghouses and Filters* , December 1998. https://www3.epa.gov/ttn/ecas/docs/cs6ch1.pdf

Cost adjusted for inflation due to cost in manual being in 1998 dollars.

Baghouse Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
CFRB	0.55309	
Interest rate	0.07	
Life of Equipment	2	
Combined exhaust flow rate	110,589	scfm (based on actual measured data for Sampson pellet coolers)
Exhaust flow rate per pellet cooler	20,603	
Gas to cloth ratio	12	acfm/ft2, pulse jet for saw dust per Table 1.1
Net fabric area	10301.27	ft2
Gross fabric area	15451.90	ft2, per Table 1.2
Initial bag cost	10352.78	

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Enviva Sampson

VOC Controls: Average Cost Effectiveness ($/ton) Summary

Summary of Average Cost Effectiveness ($/ton)

Emission Point Number(s)	Unit/Service Description	Control Option	Uncontrolled PTE Emissions (TPY)	VOC Control Efficiency (%)	VOC Controlled Emission Rate (ton/yr)	VOC Reduction (ton/yr)	Total Annual Cost ($/yr)	Technology Cost Effectiveness ($/ton VOC Removed)
ES-CLR-1 through 6	Pellet Coolers	RCO	572	95%	28.6	543.4	$3,715,499	$6,838

RCO Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Incinerator + auxiliary equipment	$	1,812,441	Equation 2.33 from EPA Cost Control Manual, Oxidizer and Incinerator Section, based on maximum measured flow rates corrected to standard conditions.
Instrumentation	$	181,244	10% of incinerator and auxiliary equipment costs
Sales tax	$	54,373	3% of incinerator and auxiliary equipment costs
Freight	$	90,622	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	**$**	**2,138,680**	
Direct installation costs			
Foundations and supports	$	171,094	8% of total purchased equipment costs
Handling and erection	$	299,415	14% of total purchased equipment costs
Electrical	$	85,547	4% of total purchased equipment costs
Piping	$	42,774	2% of total purchased equipment costs
Insulation for ductwork	$	21,387	1% of total purchased equipment costs
Painting	$	21,387	1% of total purchased equipment costs
Total Direct Installation Costs	**$**	**641,604**	
Total Direct Costs	**$**	**2,780,284**	
Indirect installation costs			
Engineering	$	213,868	10% of total purchased equipment costs
Construction and field expenses	$	106,934	5% of total purchased equipment costs
Contractor fees	$	213,868	10% of total purchased equipment costs
Start-up	$	42,774	2% of total purchased equipment costs
Performance test	$	21,387	1% of total purchased equipment costs
Total Indirect Installation Costs	**$**	**598,830**	
Contingency at 10%	$ 337,911.47		Default contingency factor of 10% from EPA Cost Control Manual, Oxidizer and Incinerators Section
Total Capital Investment	**$**	**3,717,026**	
Annual Operating Cost			
Direct Annual Costs			
Operating Labor			
Operator	$	13,350	Based on $26.70/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Supervisor	$	2,003	15% Operator
Maintenance			
Labor	$	13,625	Based on $27.25/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Materials	$	13,625	100% Maintenance Labor
Catalyst Bed Replacement	$	484,209	Based on 4 year catalyst life, catalyst cost of $3,000/ft^3 (noble metal catalysts), and catalyst volume of 664 ft^3
Utilities			
Propane Usage	$	1,001,639	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal, Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2008-2010, US Energy Information Administration).
Electricity	$	299,364	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 hr/yr at $0.0689/kWh
Indirect Annual Costs			
Overhead	$	316,087	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges	$	74,341	2% TCI
Property Taxes	$	37,170	1% TCI
Insurance	$	37,170	1% TCI
Capital Recovery	$	350,861	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	**$ 2,643,443**		Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers*, November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

RCO Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate	110,589	scfm (based on actual measured data for Sampson pellet coolers)
Catalyst Life	4	years
FWF =	0.225	

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	110,589	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	900	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	3.93	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	0.40	auxiliary fuel usage (scfm), per Equation 2.45
	1018.60	btu/min
Total Energy Input	1,715,134.75	btu/min, per Equation 2.22
5% of Total Energy Input	85,756.74	btu/min
Max of Equation 2.45 and Equation 2.22	85,756.74	Per Section 2.4.2 and Step 8t of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.
Vcat	664	Overall bulk volume of cataslyst bed (ft3), per Equation 2.28, space velocity of 10,000 h^{-1}

Baghouse Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Fabric Filter (with insulation)(EC)	$	236,803	Figure 1.9 of EPA Cost Control Manual for Pulse-Jet Filters (modular)
Bags	$	16,254	Bag cost from Table 1.8 based on 6-8 inch bag diameter for Pulse Jet, TR polyester bags
Auxiliary Equipment	$	118,402	Conservatively assumed 50% of Fabric Filter cost
Fabric Filter + Bags + Auxiliary	$	371,459	
Instrumentation	$	37,146	10% of incinerator and auxiliary equipment costs
Sales tax	$	11,144	3% of incinerator and auxiliary equipment costs
Freight	$	18,573	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	**$**	**809,780**	
Direct installation costs			
Foundations and supports	$	32,391	4% of total purchased equipment costs
Handling and erection	$	404,890	50% of total purchased equipment costs
Electrical	$	64,782	8% of total purchased equipment costs
Piping	$	8,098	1% of total purchased equipment costs
Insulation for ductwork	$	56,685	7% of total purchased equipment costs
Painting	$	32,391	4% of total purchased equipment costs
Total Direct Installation Costs	**$**	**599,238**	
Total Direct Costs	**$**	**1,409,018**	
Indirect installation costs			
Engineering	$	80,978	10% of total purchased equipment costs
Construction and field expenses	$	161,956	20% of total purchased equipment costs
Contractor fees	$	80,978	10% of total purchased equipment costs
Start-up	$	8,098	1% of total purchased equipment costs
Performance test	$	8,098	1% of total purchased equipment costs
Contingencies	$	24,293	3% of total purchased equipment costs
Total Indirect Installation Costs	**$**	**364,401**	
Total Capital Investment	**$**	**1,773,419**	
Annual Operating Cost			
Direct Annual Costs			
Operating Labor			
Operator	$	57,672	Based on $26.70/hr (2015), 2 hr/shift, 3 shifts/day, and 360 days/yr.
Supervisor	$	8,651	15% Operator
Maintenance			
Labor	$	29,430	Based on $27.25/hr (1998), 1 hr/shift, 3 shifts/day, and 360 days/yr.
Materials	$	29,430	100% Maintenance Labor
Replacement Bags	$	10,053	Equation 1.13, assumes $0.28/ft2 of bag area for labor cost
Utilities			
Compressed air	$	32,041	Based on methodology from EPA Cost Control Manual, Section 6, Chapter 1. Assumes 2 scfm of air per 1,000 acfm of flue gas and $0.25 per 1,000 scf of air, 8,640 hr/yr
Electricity	$	133,605	Based on methodology from EPA Cost Control Manual, Section 6, Chapter 1.
Waste disposal	$	457,730	
Indirect Annual Costs			
Overhead	$	75,110	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges	$	35,468	2% TCI
Property Taxes	$	17,734	1% TCI
Insurance	$	17,734	1% TCI
Capital Recovery	$	167,398	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	**$**	**1,072,056**	

Note:

Estimation based on *EPA Cost Control Manual, Section 6, Chapter 1, Baghouses and Filters* , December 1998. https://www3.epa.gov/ttn/ecas/docs/cs6ch1.pdf

Cost adjusted for inflation due to cost in manual being in 1998 dollars.

Baghouse Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
CFRB	0.55309	
Interest rate	0.07	
Life of Equipment	2	
Combined exhaust flow rate	110,589	scfm (based on actual measured data for Sampson pellet coolers)
Exhaust flow rate per pellet cooler	20,603	
Gas to cloth ratio	12	acfm/ft2, pulse jet for saw dust per Table 1.1
Net fabric area	10301.27	ft2
Gross fabric area	15451.90	ft2, per Table 1.2
Initial bag cost	10352.78	

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Enviva Sampson

VOC Controls: Average Cost Effectiveness ($/ton) Summary

Summary of Average Cost Effectiveness ($/ton)

Emission Point Number(s)	Unit/Service Description	Control Option	Uncontrolled PTE Emissions (TPY)	VOC Control Efficiency (%)	VOC Controlled Emission Rate (ton/yr)	VOC Reduction (ton/yr)	Total Annual Cost ($/yr)	Technology Cost Effectiveness ($/ton VOC Removed)
ES-CLR-1 through 6 and ES-HM-1 through 8	Pellet Coolers and Dry Hammermills	RTO[1]	740	95%	37.0	703.0	$6,533,936	$9,294

[1] VOC control efficiency from USEPA Air Pollution Control Technology Fact Sheet: Regenerative Incinerator (EPA-452/F-03-021). https://www3.epa.gov/ttn/catc/dir1/fregen.pdf

RTO Cost Calculations
Pellet Cooler and Dry Hammermill VOC Emissions
ES-CLR-1 through 6 and ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Incinerator + auxiliary equipment	$	3,521,405	Equation 2.33 from EPA Cost Control Manual, Oxidizer and Incinerator Section, based on maximum measured flow rates corrected to standard conditions.
Instrumentation	$	352,140	10% of incinerator and auxiliary equipment costs
Sales tax	$	105,642	3% of incinerator and auxiliary equipment costs
Freight	$	176,070	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	**$**	**4,155,258**	
Direct installation costs			
Foundations and supports	$	332,421	8% of total purchased equipment costs
Handling and erection	$	581,736	14% of total purchased equipment costs
Electrical	$	166,210	4% of total purchased equipment costs
Piping	$	83,105	2% of total purchased equipment costs
Insulation for ductwork	$	41,553	1% of total purchased equipment costs
Painting	$	41,553	1% of total purchased equipment costs
Total Direct Installation Costs	**$**	**1,246,577**	
Total Direct Costs	**$**	**5,401,835**	
Indirect installation costs			
Engineering	$	415,526	10% of total purchased equipment costs
Construction and field expenses	$	207,763	5% of total purchased equipment costs
Contractor fees	$	415,526	10% of total purchased equipment costs
Start-up	$	83,105	2% of total purchased equipment costs
Performance test	$	41,553	1% of total purchased equipment costs
Total Indirect Installation Costs	**$**	**1,163,472**	
Contingency at 10%	$ 656,530.69		Default contingency factor of 10% from EPA Cost Control Manual, Oxidizer and Incinerators Section
Total Capital Investment	**$**	**7,221,838**	
Annual Operating Cost			
Direct Annual Costs			
Operating Labor			
Operator	$	13,350	Based on $26.70/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Supervisor	$	2,003	15% Operator
Maintenance			
Labor	$	13,625	Based on $27.25/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Materials	$	13,625	100% Maintenance Labor
Utilities			
Propane Usage	$	3,902,490	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal, Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2008-2010, US Energy Information Administration).
Electricity	$	520,662	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 hr/yr at $0.0689/kWh
Indirect Annual Costs			
Overhead	$	25,562	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges	$	144,437	2% TCI
Property Taxes	$	72,218	1% TCI
Insurance	$	72,218	1% TCI
Capital Recovery	$	681,690	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	**$ 5,461,880**		Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers*, November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

RTO Cost Calculations
Pellet Cooler and Dry Hammermill VOC Emissions
ES-CLR-1 through 6 and ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate	232,833	scfm (based on actual measured data for Sampson pellet coolers and dry hammermills)

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	232,833	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	1600	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	2.45	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	0.18	auxiliary fuel usage (scfm), per Equation 2.45
	450.42	btu/min
Total Energy Input	6,682,346.12	btu/min, per Equation 2.22
5% of Total Energy Input	334,117.31	btu/min
Max of Equation 2.45 and Equation 2.22	334,117.31	Per Section 2.4.2 and Step 8t of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.

Baghouse Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Fabric Filter (with insulation)(EC)	$	236,803	Figure 1.9 of EPA Cost Control Manual for Pulse-Jet Filters (modular)
Bags	$	16,254	Bag cost from Table 1.8 based on 6-8 inch bag diameter for Pulse Jet, TR polyester bags
Auxiliary Equipment	$	118,402	Conservatively assumed 50% of Fabric Filter cost
Fabric Filter + Bags + Auxiliary	$	371,459	
Instrumentation	$	37,146	10% of incinerator and auxiliary equipment costs
Sales tax	$	11,144	3% of incinerator and auxiliary equipment costs
Freight	$	18,573	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	**$**	**809,780**	
Direct installation costs			
Foundations and supports	$	32,391	4% of total purchased equipment costs
Handling and erection	$	404,890	50% of total purchased equipment costs
Electrical	$	64,782	8% of total purchased equipment costs
Piping	$	8,098	1% of total purchased equipment costs
Insulation for ductwork	$	56,685	7% of total purchased equipment costs
Painting	$	32,391	4% of total purchased equipment costs
Total Direct Installation Costs	**$**	**599,238**	
Total Direct Costs	**$**	**1,409,018**	
Indirect installation costs			
Engineering	$	80,978	10% of total purchased equipment costs
Construction and field expenses	$	161,956	20% of total purchased equipment costs
Contractor fees	$	80,978	10% of total purchased equipment costs
Start-up	$	8,098	1% of total purchased equipment costs
Performance test	$	8,098	1% of total purchased equipment costs
Contingencies	$	24,293	3% of total purchased equipment costs
Total Indirect Installation Costs	**$**	**364,401**	
Total Capital Investment	**$**	**1,773,419**	
Annual Operating Cost			
Direct Annual Costs			
Operating Labor			
Operator	$	57,672	Based on $26.70/hr (2015), 2 hr/shift, 3 shifts/day, and 360 days/yr.
Supervisor	$	8,651	15% Operator
Maintenance			
Labor	$	29,430	Based on $27.25/hr (1998), 1 hr/shift, 3 shifts/day, and 360 days/yr.
Materials	$	29,430	100% Maintenance Labor
Replacement Bags	$	10,053	Equation 1.13, assumes $0.28/ft2 of bag area for labor cost
Utilities			
Compressed air	$	32,041	Based on methodology from EPA Cost Control Manual, Section 6, Chapter 1. Assumes 2 scfm of air per 1,000 acfm of flue gas and $0.25 per 1,000 scf of air, 8,640 hr/yr
Electricity	$	133,605	Based on methodology from EPA Cost Control Manual, Section 6, Chapter 1.
Waste disposal	$	457,730	
Indirect Annual Costs			
Overhead	$	75,110	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges	$	35,468	2% TCI
Property Taxes	$	17,734	1% TCI
Insurance	$	17,734	1% TCI
Capital Recovery	$	167,398	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	**$ 1,072,056**		

Note:

Estimation based on *EPA Cost Control Manual, Section 6, Chapter 1, Baghouses and Filters* , December 1998. https://www3.epa.gov/ttn/ecas/docs/cs6ch1.pdf

Cost adjusted for inflation due to cost in manual being in 1998 dollars.

Baghouse Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
CFRB	0.55309	
Interest rate	0.07	
Life of Equipment	2	
Combined exhaust flow rate	110,589	scfm (based on actual measured flow for Sampson pellet cooler)
Exhaust flow rate per pellet cooler	20,603	acfm
Gas to cloth ratio	12	acfm/ft2, pulse jet for saw dust per Table 1.1
Net fabric area	10301.27	ft2
Gross fabric area	15451.90	ft2, per Table 1.2
Initial bag cost	10352.78	

RAMBOLL

Enviva Sampson

VOC Controls: Average Cost Effectiveness ($/ton) Summary

Summary of Average Cost Effectiveness ($/ton)

Emission Point Number(s)	Unit/Service Description	Control Option	Uncontrolled PTE Emissions (TPY)	VOC Control Efficiency (%)	VOC Controlled Emission Rate (ton/yr)	VOC Reduction (ton/yr)	Total Annual Cost ($/yr)	Technology Cost Effectiveness ($/ton VOC Removed)
ES-CLR-1 through 6 and ES-HM-1 through 8	Pellet Coolers and Dry Hammermills	RCO	740	95%	37.0	703.0	$5,869,334	$8,349

RCO Cost Calculations
Pellet Cooler and Dry Hammermill VOC Emissions
ES-CLR-1 through 6 and ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Incinerator + auxiliary equipment	$	3,521,405	Equation 2.33 from EPA Cost Control Manual, Oxidizer and Incinerator Section, based on maximum measured flow rates corrected to standard conditions.
Instrumentation	$	352,140	10% of incinerator and auxiliary equipment costs
Sales tax	$	105,642	3% of incinerator and auxiliary equipment costs
Freight	$	176,070	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	**$**	**4,155,258**	
Direct installation costs			
Foundations and supports	$	332,421	8% of total purchased equipment costs
Handling and erection	$	581,736	14% of total purchased equipment costs
Electrical	$	166,210	4% of total purchased equipment costs
Piping	$	83,105	2% of total purchased equipment costs
Insulation for ductwork	$	41,553	1% of total purchased equipment costs
Painting	$	41,553	1% of total purchased equipment costs
Total Direct Installation Costs	**$**	**1,246,577**	
Total Direct Costs	**$**	**5,401,835**	
Indirect installation costs			
Engineering	$	415,526	10% of total purchased equipment costs
Construction and field expenses	$	207,763	5% of total purchased equipment costs
Contractor fees	$	415,526	10% of total purchased equipment costs
Start-up	$	83,105	2% of total purchased equipment costs
Performance test	$	41,553	1% of total purchased equipment costs
Total Indirect Installation Costs	**$**	**1,163,472**	
Contingency at 10%	$ 656,530.69		Default contingency factor of 10% from EPA Cost Control Manual, Oxidizer and Incinerators Section
Total Capital Investment	**$**	**7,221,838**	
Annual Operating Cost			
Direct Annual Costs			
Operating Labor			
Operator	$	13,350	Based on $26.70/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Supervisor	$	2,003	15% Operator
Maintenance			
Labor	$	13,625	Based on $27.25/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Materials	$	13,625	100% Maintenance Labor
Catalyst Bed Replacement	$	1,019,444	Based on 4 year catalyst life, catalyst cost of $3,000/ft^3 (noble metal catalysts), and catalyst volume of 1,397 ft^3.
Utilities			
Propane Usage	$	2,108,831	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal, Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2008-2010, US Energy Information Administration).
Electricity	$	630,275	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 hr/yr at $0.0689/kWh
Indirect Annual Costs			
Overhead	$	25,562	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges	$	144,437	2% TCI
Property Taxes	$	72,218	1% TCI
Insurance	$	72,218	1% TCI
Capital Recovery	$	681,690	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	**$ 4,797,278**		Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers*, November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

RCO Cost Calculations
Pellet Cooler and Dry Hammermill VOC Emissions
ES-CLR-1 through 6 and ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate	232,833	scfm (based on actual measured data for Sampson pellet coolers and dry hammermills)
Catalyst Life	4	years
FWF =	0.225	

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	232,833	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	900	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	2.45	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	0.19	auxiliary fuel usage (scfm), per Equation 2.45
	471.43	btu/min
Total Energy Input	3,611,011.72	btu/min, per Equation 2.22
5% of Total Energy Input	180,550.59	btu/min
Max of Equation 2.45 and Equation 2.22	180,550.59	Per Section 2.4.2 and Step 8t of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.
Vcat	1397	Overall bulk volume of cataslyst bed (ft3), per Equation 2.28, space velocity of 10,000 h^{-1}

Baghouse Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Fabric Filter (with insulation)(EC)	$	236,803	Figure 1.9 of EPA Cost Control Manual for Pulse-Jet Filters (modular)
Bags	$	16,254	Bag cost from Table 1.8 based on 6-8 inch bag diameter for Pulse Jet, TR polyester bags
Auxiliary Equipment	$	118,402	Conservatively assumed 50% of Fabric Filter cost
Fabric Filter + Bags + Auxiliary	$	371,459	
Instrumentation	$	37,146	10% of incinerator and auxiliary equipment costs
Sales tax	$	11,144	3% of incinerator and auxiliary equipment costs
Freight	$	18,573	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	**$**	**809,780**	
Direct installation costs			
Foundations and supports	$	32,391	4% of total purchased equipment costs
Handling and erection	$	404,890	50% of total purchased equipment costs
Electrical	$	64,782	8% of total purchased equipment costs
Piping	$	8,098	1% of total purchased equipment costs
Insulation for ductwork	$	56,685	7% of total purchased equipment costs
Painting	$	32,391	4% of total purchased equipment costs
Total Direct Installation Costs	**$**	**599,238**	
Total Direct Costs	**$**	**1,409,018**	
Indirect installation costs			
Engineering	$	80,978	10% of total purchased equipment costs
Construction and field expenses	$	161,956	20% of total purchased equipment costs
Contractor fees	$	80,978	10% of total purchased equipment costs
Start-up	$	8,098	1% of total purchased equipment costs
Performance test	$	8,098	1% of total purchased equipment costs
Contingencies	$	24,293	3% of total purchased equipment costs
Total Indirect Installation Costs	**$**	**364,401**	
Total Capital Investment	**$**	**1,773,419**	
Annual Operating Cost			
Direct Annual Costs			
Operating Labor			
Operator	$	57,672	Based on $26.70/hr (2015), 2 hr/shift, 3 shifts/day, and 360 days/yr.
Supervisor	$	8,651	15% Operator
Maintenance			
Labor	$	29,430	Based on $27.25/hr (1998), 1 hr/shift, 3 shifts/day, and 360 days/yr.
Materials	$	29,430	100% Maintenance Labor
Replacement Bags	$	10,053	Equation 1.13, assumes $0.28/ft2 of bag area for labor cost
Utilities			
Compressed air	$	32,041	Based on methodology from EPA Cost Control Manual, Section 6, Chapter 1. Assumes 2 scfm of air per 1,000 acfm of flue gas and $0.25 per 1,000 scf of air, 8,640 hr/yr
Electricity	$	133,605	Based on methodology from EPA Cost Control Manual, Section 6, Chapter 1.
Waste disposal	$	457,730	
Indirect Annual Costs			
Overhead	$	75,110	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges	$	35,468	2% TCI
Property Taxes	$	17,734	1% TCI
Insurance	$	17,734	1% TCI
Capital Recovery	$	167,398	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	**$ 1,072,056**		

Note:

Estimation based on *EPA Cost Control Manual, Section 6, Chapter 1, Baghouses and Filters* , December 1998. https://www3.epa.gov/ttn/ecas/docs/cs6ch1.pdf

Cost adjusted for inflation due to cost in manual being in 1998 dollars.

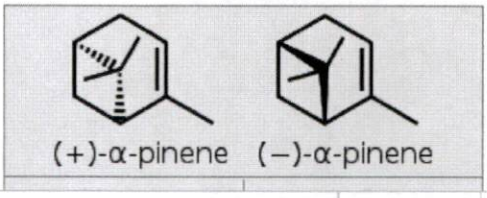
Baghouse Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
CFRB	0.55309	
Interest rate	0.07	
Life of Equipment	2	
Combined exhaust flow rate	110,589	scfm (based on actual measured flow for Sampson pellet cooler)
Exhaust flow rate per pellet cooler	20,603	acfm
Gas to cloth ratio	12	acfm/ft2, pulse jet for saw dust per Table 1.1
Net fabric area	10301.27	ft2
Gross fabric area	15451.90	ft2, per Table 1.2
Initial bag cost	10352.78	

Attachment 2

Calculation of CO2 Emissions from Combustion of alpha Pinene

α-Pinene



C10H16 (MW)	136.2	lb/lbmol
CO2(MW)	44	lb/lbmol

Complete Oxidation

$$C_{10}H_{16} + 14O_2 \rightarrow 10CO_2 + 8H_2O$$

Emission Source	Total VOC (ton/yr)	VOC Destroyed (ton/yr)	C10H16 lbmol/yr	CO2 lbmol/yr	CO2 ton/yr
Pellet Mills and Pellet Coolers	572	543.4	7,979.4	79,794.4	1,755.5
Dried Wood Handling	41	38.95	572.0	5,719.5	125.8
Dry Hammermills	168	159.6	2,343.6	23,436.1	515.6
Pellet Mills and Pellet Coolers and Dry Hammermills	740	703	10,323.1	103,230.5	2,271.1

Notes:

Assume VOC is α-pinene

Assume 95% control efficiency of RTO