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APPLICATION FOR INITIAL STATE PERMIT TO CONSTRUCT

ENVIVA PELLETS LUCEDALE, LLC

RAMBOLL

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ACRONYMS AND ABBREVIATIONS

AER	Air Emissions Reporting
AP-42	Compilation of Air Pollutant Emission Factors
bhp	brake horsepower
BMP	Best Management Practice
CAA	Clean Air Act
CAM	Compliance Assurance Monitoring
CFR	Code of Federal Regulations
CI	Compression Ignition
CO	Carbon Monoxide
CO_2	Carbon Dioxide
EPA	Environmental Protection Agency
EPD	Environmental Permits Division
FSC	Forest Stewardship Council
HAP	Hazardous Air Pollutant
hp	Horsepower
H_2O	Water
ICE	Internal Combustion Engine
lb	Pound
MACT	Maximum Achievable Control Technology
MDEQ	Mississippi Department of Environmental Quality
MMBtu	Million British thermal units
NAAQS	National Ambient Air Quality Standards
NCASI	National Council for Air and Stream Improvement
NESHAP	National Emission Standards for Hazardous Air Pollutants
NNSR	Nonattainment New Source Review
NO_X	Nitrogen Oxides ($NO + NO_2$)
NSPS	New Source Performance Standards
NSR	New Source Review
NWS	National Weather Service
ODT	Oven Dried Tons
PCWP	Plywood and Composite Wood Products

PEFC	Programme for the Endorsement of Forest Certifications
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter Less Than 2.5 Micrometers in Aerodynamic Diameter
PM_{10}	Particulate Matter Less Than 10 Micrometers in Aerodynamic Diameter
PSD	Prevention of Significant Deterioration
PSEU	Pollutant Specific Emission Unit
RICE	Reciprocating Internal Combustion Engine
RCO	Regenerative Catalytic Oxidizer
RMP	Risk Management Plan
RTO	Regenerative Thermal Oxidizer
SCAQMD	South Coast Air Quality Management District
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
SFI	Sustainable Forestry Initiative
TCO	Thermal Catalytic Oxidizer
TO	Thermal Oxidizer
tph	tons per hour
tpy	tons per year
VOC	Volatile Organic Compounds
WESP	Wet Electrostatic Precipitator

1. INTRODUCTION

Enviva Pellets Lucedale, LLC (Enviva) is proposing to construct a greenfield wood pellet manufacturing plant (referred to herein as "the Lucedale plant" or "the plant") in Lucedale, George County, Mississippi. It should be noted that on May 20, 2014, Green Circle Energy, Inc (Green Circle) received Construction Permit No. 0840-00022 authorizing construction of a proposed greenfield wood pellet manufacturing plant at the Lucedale site. This construction permit was transferred to Enviva on November 20, 2015; however, construction on the new plant was never initiated by Enviva or Green Circle. On June 16, 2017, Enviva submitted a request to Mississippi Department of Environmental Quality (MDEQ) to revoke Construction Permit No. 0840-00022. Since that time, business conditions have changed and Enviva is now re-starting the permitting process for a new construction permit for the Lucedale plant. The proposed new Lucedale plant will be designed to produce approximately 1,420,500 oven dried tons (ODT) per year of wood pellets utilizing up to 85% softwood. Construction will be completed in two phases with the initial construction phase allowing production of approximately 781,300 ODT per year. The second construction phase will be implemented within 18 months of completing the first construction phase and will allow the facility to achieve the final production capacity of approximately 1,420,500 ODT per year. The plant will include a Log Chipper, Bark Hog, Debarker, Green Screen, Green Hammermills, Rotary Dryers, Dry Hammermills, Pellet Presses and Coolers, product loadout operations and other ancillary activities.

The Lucedale plant will be a major source with respect to the Title V Operating Permit Program because facility-wide potential emissions of one or more criteria pollutants will exceed the major source threshold of 100 tons per year (tpy). Furthermore, the plant will be a major source of hazardous air pollutants (HAP) due to potential total HAP emissions and maximum individual HAP emissions above the major source thresholds of 25 tpy, and 10 tpy, respectively. However, the Lucedale plant will be a minor source with respect to the New Source Review (NSR) permitting programs because facility-wide potential emissions of all regulated pollutants will be below the major source threshold of 250 tpy.

Enviva is submitting this application for a State Permit to Construct to the Mississippi Department of Environmental Quality (MDEQ) Environmental Permits Division (EPD) in accordance with Title 11 of the Mississippi Administrative Code (Miss. Admin. Code) Part (Pt.) 2 Chapter (Ch.) 2 Rule (R.) 2.1.D. A description of the process is provided in Section 2 and methodologies used to quantify potential emissions are summarized in Section 3. Section 4 describes the applicability of federal and state permitting programs. Section 5 includes a detailed applicability analysis of both federal and state regulations.

2. PROCESS DESCRIPTION

Enviva manufactures wood pellets for use as a renewable fuel for energy generation and industrial customers. Enviva's customers use wood pellets in place of coal, significantly reducing emissions of pollutants such as lifecycle carbon dioxide (CO_2)/greenhouse gases (GHG), mercury (Hg), arsenic (As), and lead (Pb). The company is dedicated to improving the environmental profile of energy generation while promoting sustainable forestry in the southeastern United States. Enviva holds certifications from the Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), Programme for the Endorsement of Forest Certification (PEFC), and Sustainable Biomass Program (SBP). Enviva requires that all suppliers adhere to state-developed "Best Management Practices" (BMPs) in their activities to protect water quality and sensitive ecosystems. In addition, Enviva is implementing an industry leading "track and trace" system to further ensure that all fiber resources come from responsible harvests. Enviva pays particular attention to: land use change, use and effectiveness of BMPs, wetlands, biodiversity, and certification status. All of this combined ensures that Enviva's forestry activities contribute to healthy forests both today and in the future.[1] The following process description details the proposed operations at the Lucedale plant.

Wood fiber (round wood, green wood chips, bark, and dry shavings) will be delivered to the Lucedale plant via trucks where it will then be unloaded and stored. The plant will include three (3) chip truck dumps (ID# AA-004, Greenwood Handling Operations), one (1) bark truck dump (ID# Insignificant Activity, Bark Handling Operations), and one (1) dry shavings truck dump (ID # AA-021, Dry Shavings Handling). Round wood will be stored as whole logs and will be debarked (ID# AA-001, Debarker) and chipped (ID# AA-002, Log Chipping), as needed. Bark from the Debarker and purchased bark will be transferred to the Bark Hog (ID# AA-003, Bark Hog) via conveyor for further processing, after which it will be transferred to the Bark Storage Pile (ID# Insignificant Activity, Bark Storage Pile) via conveyor.[2] The bark removed from the round wood, along with purchased bark, will be used as fuel for the dryer furnaces. Conveyors will transport wood chips and fuel to the dryers and furnaces, respectively.[3]

Dry shavings, largely composed of wood planer shavings and sawdust, will be delivered by truck to the plant's dry shavings truck dump. From the dry shavings truck dump, the dry shavings will be transferred to the Dry Shavings Silo (ID# AA-020, Dry Shavings Silo) via an enclosed conveyor and bucket elevator. As the dry shavings will already be dried, they will bypass the dryers. The Dry Shavings Silo will be equipped with a baghouse for control of particulate matter (PM) emissions resulting from air displaced during silo loading.

The Lucedale plant will include three (3) Dryer lines (ID#s AA-007, AA-010, and AA-013, Wood-fired Direct Heat Drying System Nos. 1, 2, and 3), each consisting of a bark-fired furnace and a rotary drum dryer. The maximum design heat input rate of each dryer will be

[1] A detailed description of Enviva's Responsible Wood Supply Program can be found at: http://www.envivabiomass.com/sustainability/wood-sourcing/responsible-wood-supply-program/

[2] Bark handling and storage is considered an insignificant activity per 11 Miss. Admin. Code Pt. 2 Ch. 6 R. 6.7.B(13).

[3] Bark will be transferred from the Bark Fuel Storage Pile via a walking floor to a covered conveyor and then to the fully enclosed Bark Fuel Bin. Due to complete enclosure of the Bark Feed Bin, no emissions are expected from transfer of material into the bin.

168 million British thermal units per hour (MMBtu/hr). The products of combustion from each furnace will directly exhaust to the rotary drum dryers, which will dry wood chips conveyed from the Green Wood Storage Pile (ID# AA-006, Green Wood Storage Pile). Prior to drying, the chips will be processed by a Green Screen (ID# AA-005, Green Screen) and three (3) Green Hammermills (ID#s AA-007 and AA-010, Green Hammermills) as needed to ensure proper size.

From the dryers, an induced draft will carry all dried chips and hot air to high efficiency material handling cyclones to remove the wood fiber. The dryer is designed to recirculate a portion of the exhaust gas to improve fuel and drying efficiency and reduce emissions. The non-recirculated portion of each dryer exhaust will flow through a wet electrostatic precipitator (WESP) and a regenerative thermal oxidizer (RTO) (ID# AA-007, AA-010, and AA-013, WESP/RTO Nos. 1, 2, and 3), then out a stack to the atmosphere. Each dryer line will have a dedicated WESP and RTO. The RTO burners will combust natural gas, with propane as a back-up fuel. The Green Hammermills will be part of a closed loop system that will exhaust to the WESP and RTO on Dryer Line 1. In the event Dryer Line 1 is not operational, the exhaust will be routed to the WESP and RTO on Dryer Line 2.

As the flue gas exits the dryer and begins to cool, wood tar can condense and coat the inner walls of the dryer ducts creating a fire risk. In order to prevent condensation from occurring and thus reduce the fire risk, the two (2) ducts (herein referred to as double ducts) on each dryer system will be heated. The duct from the cyclone outlet to the ID fan will be heated by one (1) low-NO_X burner with a maximum heat input rating of 1 MMBtu/hr and a second 1 MMBtu/hr low-NO_X burner will be used to heat the duct used for exhaust gas recirculation and the WESP. The burners will combust natural gas, or propane as back-up, and will exhaust to the WESPs and RTOs (ID# AA-007, AA-010, and AA-013, WESP/RTO Nos. 1, 2, and 3).[4]

Bypass stacks for each furnace (ID# AA-009, AA-012, AA-015, Furnace Bypass Stacks) and rotary drum dryer (ID# AA-008, AA-011, AA-014, Dryer Bypass Stacks) will be used to exhaust hot gases during start-ups (for temperature control), shutdowns, and malfunctions. Specifically, the Furnace Bypass Stacks will be used in the following situations:

- **Cold Start-ups:** The furnace bypass stacks will be used when the furnace is started up from a cold shutdown until the refractory is sufficiently heated and can sustain operations at a low level. The bypass stack will then be closed and the furnace will slowly be brought up to a normal operating rate.
- **Malfunction:** The furnace itself can abort and open the bypass stack in the event of a malfunction. This may be caused by failsafe interlocks associated with the furnace or dryer and emissions control systems as well as utility supply systems (i.e., electricity, compressed air, water/fire protection). As soon as the furnace aborts it will automatically switch to "idle mode" (defined as operation at up to a maximum heat input rate of 5 MMBtu/hr). The fuel feed is stopped and the heat input rate drops rapidly.

[4] Combustion units with a rated input capacity less than 10 MMBtu/hr that are fueled by liquefied petroleum gas or natural gas supplied by a public utility are considered insignificant per 11 Miss. Admin. Code Pt. 2, Ch. 6 R. 6.7.B(2)

- **Planned Shutdown:** In the event of a planned shutdown the furnace heat input will be decreased and all remaining fuel will be moved through the system to prevent a fire. The remaining fuel will be combusted prior to opening the furnace bypass stack.

Conditions under which the Dryer Bypass Stacks will be used are as follows:

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

Use of the Furnace and Dryer Bypass Stacks for start-up, shutdown, and malfunctions will not exceed 100 hours per year for each dryer line at full operating capacity (i.e., 50 hours of furnace bypass at full capacity and 50 hours of dryer bypass at full capacity).

Each furnace may also operate up to 500 hours per year in "idle mode" with emissions routed to the Furnace Bypass Stacks. The purpose of operation in "idle mode" is to maintain the temperature of the fire brick lining the furnaces which may be damaged if it cools too rapidly. Operation in "idle mode" also significantly reduces the amount of time required to restart the dryers.

Emissions from Furnace and Dryer start-up, shutdown and malfunctions, and emissions from Furnace idle mode operations, are quantified and included in maximum allowable emissions presented in this permit application.

The Lucedale plant will include two (2) pelletizing lines, each consisting of twenty-four (24) Dry Hammermills, twelve (12) Pellet Mills, and six (6) Pellet Coolers. Dried wood chips will be stored in the Dry Hammermill Feed Silo and dry shavings in the Dry Shavings Silo (ID# AA-020) prior to being processed by the Dry Hammermills (ID# AA-016, AA-017, Forty-Eight Dry Hammermills). The Dry Hammermills will reduce the dry wood chips to under 4 mm (0.16") in size. From the Dry Hammermills, the processed wood fiber will be conveyed to a Pellet Mill Feed Silo which will be kept under negative pressure by aspiration systems. These aspiration systems will be routed to a wet scrubber and regenerative catalytic oxidizer (RCO) (ID# AA-016, Wet Scrubber-1/RCO-1). The Dry Hammermill Feed Silo, Pellet Mill Feed Silo, and all associated conveyors and transfer points will be sealed and kept under negative pressure.

Aspiration systems will be used to remove heated moist air from the Dry Hammermills, Pellet Mills, and Pellet Coolers. These aspiration systems will be routed to high efficiency material handling cyclones and then to wet scrubbers and RCOs for control of PM, HAP, and volatile organic compounds (VOC). Emissions from Pelletizing Lines 1 and 2 will be controlled by two (2) wet scrubbers and two (2) RCOs. Wet Scrubber-1/RCO-1 (ID# AA-016) will control emissions from thirty-two (32) Dry Hammermills, sixteen (16) Pellet Mills, and eight (8) Pellet Coolers. Wet Scrubber-2/RCO-2 (ID# AA-017) will control emissions from sixteen (16)

Dry Hammermills, eight (8) Pellet Mills, and four (4) Pellet Coolers. The RCO burners will combust natural gas, with propane as a back-up fuel.

Processed wood from the Pellet Mill Feed Silo will be conveyed to the Pellet Mills where wood fiber will be compressed by rotating press rollers and will exit through a sizing die. Heat from the friction of compressing the wood through the die activates wood lignin in the fiber which effectively bonds the material into a durable pellet. No resin or chemical binder will be used in the process. A dry powder additive may be used which acts as a lubricant for the dies. This additive would be added to sized wood from the Dry Hammermills prior to transfer to the Pellet Presses. The dry powder contains no hazardous chemicals or VOC materials. It will be delivered by truck and pneumatically loaded into an Additive Storage Silo (ID# AA-019, Additive Handling and Storage) which will be equipped with a baghouse to control PM emissions from air displaced during silo loading. The additive will then be conveyed via screw conveyor from the Additive Storage Silo to the milled fiber conveyor which will transfer milled wood to the Pellet Presses.

Pellets exiting the Pellet Mills will be gravity fed to counter air flow Pellet Coolers. From the Pellet Coolers, pellets will be conveyed to two (2) storage bins (ID# AA-018, Finished Product Handling and Pellet Loadout Bins) located above the railcar loading area. The bins will provide approximately one hour of pellet storage and uniformly meter out the pellets for railcar loading. All conveyors will be sealed with dust aspiration air directed to a baghouse. A slight negative pressure will be maintained in the loadout building as a fire prevention measure to prevent any build-up of dust on surfaces within the building. This slight negative pressure will be produced via an induced draft fan that will exhaust to the Finished Product Handling baghouse (ID# AA-018).

The Lucedale plant will also include one (1) 131 horsepower (hp) diesel-fired fire water pump (ID# AA-023, 131 hp Diesel-fired Fire Water Pump) and associated 185 gallon diesel fuel storage tank (ID# Insignificant Activity, 185 Gallon Diesel Storage Tank), one (1) 500 kilowatt (kW) diesel-fired emergency generator (ID# AA-022, 500 kW Diesel-Fired Emergency Generator) and associated 500 gallon diesel fuel storage tank (ID# Insignificant Activity, 500 Gallon Diesel Storage Tank), one (1) additional 5,000 gallon diesel fuel storage tank (ID# Insignificant Activity, 5,000 Gallon Diesel Storage Tank), as well as emissions from paved roads (ID# AA-024, Paved Roads).[5]

A direct-fired Propane Vaporizer (ID# Insignificant Activity, Propane Vaporizer) will be located on-site to vaporize propane gas for combustion by the RTO burners, RCO burners, and burners for the dryer system double ducts.[6] The vaporizer will have a maximum heat input capacity of 1 MMBtu/hr and will combust propane. Natural gas will be the primary fuel for all burners; however, propane may be used as a back-up fuel.

An area map and site plan are provided in Appendix A and a process flow diagram is provided in Appendix B.

[5] Storage tanks used exclusively to store diesel are considered an insignificant activity per 11 Miss. Admin. Code Pt. 2 Ch. 1 R. 6.7.B(7).

[6] Combustion units with a rated input capacity less than 10 MMBtu/hr that are fueled by liquefied petroleum gas or natural gas supplied by a public utility are considered insignificant per 11 Miss. Admin. Code Pt. 2, Ch. 6 R. 6.7.B(2).

3. POTENTIAL EMISSIONS QUANTIFICATION

The following summarizes the data sources and calculation methodologies used in quantifying potential emissions from the proposed Lucedale plant. Detailed potential emissions calculations are provided in Appendix C.

3.1 Debarker (AA-001)

PM emissions will occur as a result of log debarking. Potential PM emissions from debarking were quantified based on an emission factor from EPA's *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants* for Source Classification Code (SCC) 3-07-008-01 (Log Debarking).[7] All PM was assumed to be larger than 2.5 microns in diameter. The debarking drum will be enclosed, except for the two ends where logs enter and material exits after debarking. Detailed potential emission calculations are included in Appendix C, Table 4.

3.2 Log Chipping (AA-002)

The chipping process will result in emissions of VOC and methanol. VOC and methanol emissions were quantified based on emission factors for log chipping from AP-42 Section 10.6.3, *Medium Density Fiberboard* and AP-42 Section 10.6.4, *Hardboard and Fiberboard*.[8] The Chipper will be located inside of a building. As such, there are no quantifiable particulate emissions. Detailed emission calculations are included in Appendix C, Table 5.

3.3 Bark Hog (AA-003)

Processing of bark by the Bark Hog will result in emissions of PM, VOC, and methanol. Particulate emission factors were not available for this specific operation; therefore, potential PM emissions were quantified based on an emission factor from EPA's *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants* for log debarking (SCC 3-07-008-01).[9] This emission factor is conservative given that the Bark Hog is primarily enclosed and thus will have minimal PM emissions. A belt will feed an infeed chute and the chute, hog, and outfeed will all be enclosed. VOC and methanol emissions were quantified based on emission factors for log chipping from AP-42 Section 10.6.3, *Medium Density Fiberboard*.[10] Detailed potential emission calculations are included in Appendix C, Table 6.

3.4 Green Wood Handling Operations (AA-004) and Bark Handling Operations (IA)

Fugitive PM emissions will result from unloading purchased chips and bark from trucks into hoppers and transfer of these materials to storage piles via conveyors. Fugitive PM emissions from chip and bark transfer operations were calculated based on AP-42 Section 13.2.4, *Aggregate Handling and Storage Piles*.[11] Detailed potential emission calculations are included in Appendix C, Table 7.

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[7] U.S. EPA. Office of Air Quality Planning and Standards. *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants*. EPA 450/4-90-003. March 1990.

[8] U.S. EPA AP-42 Section 10.6.3, *Medium Density Fiberboard Manufacturing* (08/02).

[9] Ibid.

[10] Ibid.

[11] U.S. EPA AP-42 Section 13.2.4, *Aggregate Handling and Storage Piles* (11/06).

Green wood and bark contain a high moisture content approaching 50 percent water by weight. Therefore, Green Wood and Bark Handling will have minimal PM emissions. Per 11 Miss. Admin. Code Pt. 2, Ch. 6 R. 6.7.B(7) Bark Handling is an insignificant activity (IA).

3.5 Green Screen (AA-005)

Particulate emissions will occur during screening of green wood chips. Emissions from the Green Screen were calculated based on the potential throughput and an emission factor for chip screening from the National Council for Air and Stream Improvement (NCASI) Technical Bulleting No. 1020.[12] Detailed potential emission calculations are included in Appendix C, Table 8.

3.6 Green Wood Storage Pile (AA-006) and Bark Storage Pile (IA)

Particulate emission factors used to quantify emissions from storage pile wind erosion for the Green Wood Storage Pile and Bark Storage Pile were calculated based on EPA's *Control of Open Fugitive Dust Sources*.[13] The number of days with rainfall greater than 0.01 inch was obtained from AP-42 Section 13.2.2, *Unpaved Roads*[14], and the percentage of time that wind speed exceeds 12 miles per hour (mph) was determined based on meteorological data from the Mobile/Bates Field National Weather Service (NWS) Station (KMOB) for 2013-2017. The mean silt content of 8.4% for unpaved roads at lumber mills from AP-42 Section 13.2.2 was conservatively applied in the absence of site-specific data. The exposed surface area of the piles was calculated based on expected worst-case pile dimensions.

VOC emissions from storage piles were quantified based on the exposed surface area of the pile and emission factors from NCASI. NCASI emission factors range from 1.6 to 3.6 pounds (lb) VOC as carbon/acre-day; however, emissions were conservatively based on the maximum emission factor. Detailed potential emission calculations are included in Appendix C, Table 9.

Per 11 Miss. Admin. Code Pt. 2, Ch. 6 R. 6.7.B(7) bark storage is an insignificant activity.

3.7 Dryers, Green Wood Hammermills, and Dryer System Double Duct Burners (IA)

As described in Section 2, aside from normal operation there are several other potential operating conditions for the dryer lines. Emissions were quantified as described in the following subsections.

3.7.1 Normal Operation (AA-007, AA-010, AA-013)

During normal operation the exhaust from each dryer will be routed to a dedicated WESP and RTO for control of PM, VOC, and HAP. Exhaust from the Green Hammermills will be controlled by the WESP/RTO on Dryer Line 1 (ID# AA-007). If Dryer Line 1 is not operational, the Green Hammermill exhaust will be routed to the WESP/RTO on Dryer Line 2 (ID# AA-010). For purposes of potential emissions, emissions from the Green Hammermills are shown under Dryer Line 1 (ID# AA-007) only to avoid double-counting emissions. As shown in Appendix C, Tables 10a, 11a, and 12a, potential emissions of PM, PM less than 10

[12] National Council for Air and Stream Improvement, Inc. (NCASI). 2013. Compilation of criteria air pollutant emissions data for sources at pulp and paper mills including boilers – an update to Technical Bulletin No. 884. Technical Bulletin No. 1020. Research Triangle Park, NC: National Council for Air and Stream Improvement, Inc.

[13] U.S. EPA *Control of Open Fugitive Dust Sources*, Research Triangle Park, North Carolina, EPA-450/3-88-008. September 1988.

[14] U. S. EPA AP-42 Section 13.2.2, *Unpaved Roads* (11/06).

microns in diameter (PM_{10}), PM less than 2.5 microns in diameter ($PM_{2.5}$), carbon monoxide (CO) and oxides of nitrogen (NO_X), including NO_x and CO emissions generated during thermal oxidation, are based on vendor data, stack testing data from comparable Enviva facilities, and AP-42 factors where no other data were available. Potential emissions of sulfur dioxide (SO_2) were calculated based on an emission factor from AP-42 Section 10.6.2, *Particle Board Manufacturing*.[15] VOC emissions are based on data provided by the RTO vendor and stack testing conducted at Enviva facilities.

HAP emissions were calculated based on emission factors from several data sources including stack testing data from other similar facilities and emission factors from AP-42 Section 1.6, *Wood Residue Combustion in Boilers*.[16] HAP emissions from natural gas and propane combustion by the RTO burners were calculated based on AP-42 Section 1.4, *Natural Gas Combustion* and emission factors from the South Coast Air Quality Management District's (SCAQMD) Air Emissions Reporting (AER) Tool, respectively.[17,18]

Combustion of wood by the dryer furnaces and natural gas/propane by the RTO burners will also result in emissions of GHG. GHG emissions were quantified based on emission factors from AP-42, Section 10.6.1 for a rotary dryer with an RTO control device. The potential CO_2 emissions were conservatively calculated using the higher hardwood emission factor because the dryers at the Lucedale plant will use a combination of hardwood and softwood.

As previously described, two (2) low-NOx burners will be used to heat the dryer system ducts to prevent condensation of wood tar from occurring and thus reduce the risk of fire. There will be six (6) total burners (i.e., two for each dryer line). The burners will combust natural gas, or propane as back-up, resulting in emissions of criteria pollutants, HAP, and GHG. Emissions from the burners will be routed to the WESP and RTO on each dryer line. For the purposes of determining potential annual emissions, the worst-case between natural gas and propane was selected on a pollutant-by-pollutant basis.

Potential criteria pollutant emissions from the burners were quantified based on emission factors from AP-42 Section 1.4, *Natural Gas Combustion* and AP-42 Section 1.5, *Liquefied Petroleum Gas Combustion*. [19,20] Potential SO_2 emissions from propane combustion assume a sulfur content of 0.54 grains per 100 cubic feet for propane.[21]

Potential HAP emissions from propane combustion by the burners were quantified based on emission factors from the SCAQMD's AER Tool for external combustion equipment fired with

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[15] U.S. EPA AP-42 Section 10.6.2, *Particle Board Manufacturing* (6/02).

[16] U.S. EPA AP-42 Section 1.6, *Wood Residue Combustion in Boilers* (09/03).

[17] U.S. EPA AP-42 Section 1.4, *Natural Gas Combustion* (07/98).

[18] South Coast Air Quality Management District's (SCAQMD) Air Emissions Reporting (AER) Tool. Available online at: http://www3.aqmd.gov/webappl/help/newaer/index.html

[19] U.S. EPA AP-42 Section 1.4 *Natural Gas Combustion* (07/98).

[20] U.S. EPA AP-42 Section 1.5 *Liquefied Petroleum Gas Production* (7/08).

[21] *A National Methodology and Emission Inventory for Residential Fuel Combustion* (2001). Retrieved from https://www3.epa.gov/ttnchie1/conference/ei12/area/haneke.pdf.

LPG.[22] Potential HAP emissions from natural gas combustion were quantified based on emission factors from AP-42 Section 1.4, *Natural Gas Combustion*.[23]

Potential GHG emissions from the burners were quantified based on emission factors from AP-42 Section 1.4, *Natural Gas Combustion* and AP-42 Section 1.5, *Liquefied Petroleum Gas Combustion*.[24,25] Emissions were converted to CO_2e based on Global Warming Potentials from Subpart A of 40 CFR 98. Potential emissions were quantified based on a rated capacity of 1 MMBtu/hr per burner and assume continuous operation (8,760 hours per year). A 95% control efficiency was applied to particulate and metal HAP which will be controlled by the WESPs and organic HAP which will be controlled by the RTO. Refer to Appendix C, Tables 10a, 11a, and 12a for detailed potential emission calculations.

The burners will be an insignificant activity per 11 Miss. Admin. Code Pt. 2, Ch. 6 R. 6.7.B(2).

3.7.2 Dryer Bypass (AA-008, AA-011, AA-014, Full Capacity)

Bypass stacks following each furnace (AA-009, AA-012, and AA-015, Furnace Bypass Stack Nos. 1, 2, and 3) and rotary drum dryer (AA-008, AA-011, and AA-014, Dryer Bypass Stack Nos. 1, 2, and 3) will be used to exhaust hot gases during start-up (for temperature control), shutdown, and malfunctions. Potential emissions associated with dryer bypass were calculated based on stack testing data from comparable Enviva facilities. Condensable PM and SO_2 emissions were calculated based on emission factors from AP-42 Section 1.6, *Wood Residue Combustion in Boilers*.[26] Filterable PM and HAP emissions were calculated based on stack testing data from a comparable Enviva plant. Emissions were based on the full capacity of the furnaces (168 MMBtu/hr) and 50 hours per year per dryer. Detailed potential emission calculations are included in Appendix C, Tables 10b, 11b, and 12b.

3.7.3 Furnace Bypass (AA-009, AA-012, AA-015, Full Capacity)

Potential emissions of CO, NO_x, SO_2, VOC and HAP for furnace bypass conditions were calculated based on emission factors from AP-42 Section 1.6, *Wood Residue Combustion in Boilers*.[27] Filterable PM emissions were calculated based on stack testing data from a comparable Enviva plant. Emissions were based on the full capacity of the furnaces (168 MMBtu/hr) and 50 hours per year per furnace. Detailed potential emission calculations are included in Appendix C, Tables 10c, 11c, and 12c.

3.7.4 Furnace Bypass (AA-009, AA-012, AA-015, Idle Mode)

Each furnace will operate up to 500 hours per year in "idle mode", which is defined as operation up to a maximum heat input rate of 5 MMBtu/hr. During this time, emissions will exhaust out of the furnace bypass stacks. Potential emissions of CO, NO_x, SO_2, VOC, and HAP were calculated based on emission factors from AP-42 Section 1.6, *Wood Residue*

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[22] South Coast Air Quality Management District. AER Reporting tool. Emission factors available in the Help and Support Manual at: http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting.

[23] U.S. EPA AP-42 Section 1.4 *Natural Gas Combustion* (07/98).

[24] U.S. EPA AP-42 Section 1.4 *Natural Gas Combustion* (07/98).

[25] U.S. EPA AP-42 Section 1.5 *Liquefied Petroleum Gas Production* (7/08).

[26] U.S. EPA AP-42, Section 1.6, *Wood Residue Combustion in Boilers*, (09/03).

[27] Ibid.

Combustion in Boilers.[28] Detailed potential emission calculations are included in Appendix C, Tables 10d, 11d, and 12d.

3.8 Pelletizing Lines (AA-016 and AA-017)

As previously described, the Lucedale plant will include two (2) pelletizing lines, each consisting of twenty-four (24) Dry Hammermills, twelve (12) Pellet Mills, and six (6) Pellet Coolers. Aspiration systems will be used to remove heated moist air from the Dry Hammermills, Pellet Mills, and Coolers. The aspiration systems will also keep the dried wood and Dry Hammermill outfeed conveyors and the Pellet Mill Feed Silo under negative pressure. These aspiration systems will be routed to material handling cyclones and then wet scrubbers and RCOs for emissions control.

The Dry Hammermill, Pellet Mill, and Pellet Cooler operations will generate PM, HAP, and VOC emissions during the sizing of wood chips and forming and cooling of wood pellets. VOC, HAP, and PM emissions from Pelletizing Lines 1 and 2 will be controlled by two (2) wet scrubbers and RCOs (ID# AA-016 and AA-017). PM and VOC emissions from the RCO outlets were calculated based on vendor data.

HAP emissions at the RCO outlets were quantified based on stack testing data from comparable Enviva plants. Controlled emissions were estimated based on a 96.3% control efficiency for the RCOs based on vendor data. NO_x and CO emissions resulting from thermal oxidation were calculated using AP-42 Section 1.4, *Natural Gas Combustion*, and the maximum high heating value of the anticipated VOC constituents. [29] Detailed calculations are provided in Appendix C, Tables 13 and 14.

Emissions of criteria pollutants and HAP from natural gas/propane combustion by the RCO burners were estimated using emission factors from AP-42 Section 1.4 and the SCAQMD's AER Tool.[30] Potential GHG emissions from natural gas/propane combustion were quantified based on emission factors from Subpart C of 40 CFR Part 98. Emissions were converted to carbon dioxide equivalent (CO_2e) based on Global Warming Potentials from Subpart A of 40 CFR 98.

3.9 Pellet Loadout Bins and Finished Product Handling (AA-018)

PM emissions will result from the transfer of finished product to the Pellet Loadout Bins. No emissions are anticipated from the transfer of pellets from the bins to railcars because wood pellets will be loaded into closed top railcars. PM emissions from Finished Product Handling and the two (2) Pellet Loadout Bins will be controlled by a baghouse (ID# AA-018). Potential PM emissions from the baghouse were calculated based on a maximum exit grain loading rate and the maximum exhaust flow rate of the baghouse. Detailed potential emissions calculations are provided in Appendix C, Table 15.

3.10 Additive Handling and Storage (AA-019)

A dry powder additive will be used in the pellet production process to serve as a lubricant for the dies. Additive will be pneumatically conveyed from trucks to a storage silo equipped with a baghouse. PM emissions from the baghouse were calculated based on an assumed exit

[28] Ibid.

[29] U.S. EPA AP-42 Section 1.4, *Natural Gas Combustion* (07/98).

[30] South Coast Air Quality Management District's (SCAQMD) Air Emissions Reporting (AER) Tool. Available online at: http://www3.aqmd.gov/webappl/help/newaer/index.html

grain loading rate and the maximum exhaust flow rate of the baghouse. Detailed potential emissions calculations are provided in Appendix C, Table 15.

3.11 Dry Shavings Silo (AA-020) and Dry Shavings Handling (AA-021)

Particulate emissions will occur during unloading of dry shavings from trucks and may also occur due to displacement of air during silo loading. Potential emissions from truck unloading (ID# AA-021) were calculated based on AP-42, Section 13.2.4, *Aggregate Handling and Storage Piles*.[31] Dry shavings will be transferred via an enclosed bucket elevator into the Dry Shavings Silo which will be equipped with a baghouse (ID# AA-020). PM emissions from the baghouse were calculated based on an assumed exit grain loading rate and the maximum exhaust flow rate of the baghouse. Detailed potential emission calculations are provided in Appendix C, Tables 7 and 15.

3.12 Emergency Generator (AA-022) and Fire Water Pump Engine (AA-023)

Operation of the Emergency Generator and Fire Water Pump will generate emissions of criteria pollutants, HAP, and GHG. Potential PM, NO_X, VOC, and CO emissions from operation of the Emergency Generator and Fire Water Pump Engine were calculated based on emission factors from their respective manufacturer specification sheets and the maximum horsepower rating of the engines. VOC emissions were calculated based on the manufacturer's emission factor for hydrocarbons. Potential SO_2 emissions were calculated based on the fuel sulfur restriction in NSPS Subpart IIII, assuming that all the sulfur present in the diesel fuel is emitted as SO_2.[32] Potential HAP emissions from the Emergency Generator and Fire Water Pump were quantified based on emission factors from AP-42 Sections 3.4, *Large Stationary Diesel and All Stationary Dual-fuel Engines* and 3.3, *Gasoline and Diesel Industrial Engines*, respectively.[33,34] Annual potential emissions were conservatively calculated based on operation of these sources for 500 hours per year.

Combustion of diesel fuel by the engines will also result in emissions of GHG. Potential GHG emissions from each engine were quantified based on emission factors from Subpart C of 40 CFR Part 98. Emissions were converted to CO_2e based on Global Warming Potentials from Subpart A of 40 CFR 98. Refer to Appendix C, Tables 16 and 17 for detailed potential emission calculations.

3.13 Diesel Storage Tanks (IA)

The storage of diesel in on-site storage tanks will generate emissions of VOC. VOC emissions from the three (3) Diesel Storage Tanks were calculated using EPA's TANKS 4.0 software based on actual tank characteristics (e.g., orientation, dimensions, etc.) and potential annual throughput. The storage tanks will exclusively store diesel fuel and are thus considered insignificant activities per 11 Miss. Admin. Code Pt. 2 Ch. 6 R. 6.7.B(7). Refer to Appendix C, Table 19 for detailed potential emission calculations.

3.14 Paved Roads (AA-024)

Fugitive PM emissions will occur as a result of trucks and employee vehicles traveling on paved roads on the Lucedale plant property. Emission factors were calculated based on

[31] U.S. EPA AP-42 Section 13.2.4, *Aggregate Handling and Storage Piles* (11/06).

[32] Sulfur content in accordance with Year 2010 standards of 40 CFR 80.510(b) as required by NSPS Subpart IIII.

[33] U.S. EPA AP-42 Section 3.4, *Large Stationary Diesel and All Stationary Dual-fuel Engines*, (10/96).

[34] U.S. EPA AP-42 Section 3.3, *Gasoline and Diesel Industrial Engines*, (10/96).

Equation 2 from AP-42 Section 13.2.1, *Paved Roads*[35] using the mean silt loading for quarries (8.2 g/m^2) and 110 days with rainfall greater than 0.01 inch based on Figure 13.2.1-2. A 90% control efficiency was applied for water/dust suppression activities followed by sweeping. This control efficiency is based on data from the *Air Pollution Engineering Manual* of the Air and Waste Management Association. Refer to Appendix C, Table 18 for detailed potential emissions calculations.

3.15 Propane Vaporizer (IA)

The direct-fired Propane Vaporizer will be used to heat liquid propane to convert it to a gas for combustion by the RTO burners, RCO burners, and dryer system double duct burners. Combustion of propane by the vaporizer's 1 MMBtu/hr burner will result in emissions of criteria pollutants, HAP, and GHG. Potential criteria pollutant emissions were quantified based on emission factors from AP-42 Section 1.5, *Liquefied Petroleum Gas Combustion*.[36] Potential SO_2 emissions assume a sulfur content of 0.54 grains per 100 cubic feet for propane.[37] Potential HAP emissions were quantified based on emission factors from the SCAQMD's AER Tool for external combustion equipment fired with LPG.[38]

Potential GHG emissions were quantified based on emission factors from AP-42 Section 1.5, *Liquefied Petroleum Gas Combustion*.[39] Emissions were converted to CO_2e based on Global Warming Potentials from Subpart A of 40 CFR 98. Potential emissions from the Propane Vaporizer were quantified based on a rated capacity of 1 MMBtu/hr and assume continuous operation (8,760 hours per year). Refer to Appendix C, Table 20 for detailed potential emission calculations.

The Propane Vaporizer will be an insignificant activity per 11 Miss. Admin. Code Pt. 2, Ch. 6 R. 6.7.B(2).

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[35] U.S. EPA AP-42 Section 13.2.1, *Paved Roads* (01/11).

[36] U.S. EPA AP-42 Section 1.5 *Liquefied Petroleum Gas Production* (7/08).

[37] *A National Methodology and Emission Inventory for Residential Fuel Combustion* (2001). Retrieved from https://www3.epa.gov/ttnchie1/conference/ei12/area/haneke.pdf.

[38] South Coast Air Quality Management District. AER Reporting tool. Emission factors available in the Help and Support Manual at: http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting.

[39] U.S. EPA AP-42 Section 1.5 *Liquefied Petroleum Gas Production* (7/08).

APPENDIX C
POTENTIAL EMISSIONS CALCULATIONS

Table 1
Calculation Inputs
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Operational Data	
Facility-wide	
Production (ODT/yr)	1,420,539
Moisture Content of Finished Pellets	5.5%
Softwood Composition	85%
Green Hammermills	
Short-Term Throughput (ODT/hr)	159
Annual Throughput (ODT/yr)	1,390,475
Hours of Operation (hr/yr)	8,760
Dryers (Per Dryer)	
Number of Dryers	3
Short-Term Throughput (ODT/hr)	42
Annual Throughput (ODT/yr)	367,920
Hourly Heat Input Capacity	168
Annual Heat Input Capacity	1,471,680
Hours of Operation (hr/yr)	8,760
Dry Hammermills	
Short-Term Throughput (ODT/hr)	162
Annual Throughput (ODT/yr)	1,420,539
Hours of Operation (hr/yr)	8,760
Pellet Mills/Coolers	
Short-Term Throughput (ODT/hr)	162
Annual Throughput (ODT/yr)	1,420,539
Hours of Operation (hr/yr)	8,760

Table 2
Summary of Facility-wide Potential Emissions
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Emission Point ID	Source Description	Control Device Description	CO (tpy)	NO_x (tpy)	PM (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_2 (tpy)	VOC (tpy)	CO_2e (tpy)	Total HAP (tpy)
AA-001	Debarker	--	--	--	20.9	11.5	--	--	--	--	--
AA-002	Log Chipping	--	--	--	--	--	--	--	2.19	--	0.44
AA-003	Bark Hog	--	--	--	9.91	5.45	--	--	1.36	--	0.27
IA[1]	Bark Handling Operations	--	--	--	0.039	0.018	0.0028	--	--	--	--
IA[1]	Bark Storage Pile	--	--	--	1.81	0.91	0.14	--	0.82	--	--
AA-004	Green Wood Handling Operations	--	--	--	0.19	0.088	0.013	--	--	--	--
AA-005	Green Screen	--	--	--	2.64	2.64	2.64	--	--	--	--
AA-006	Green Wood Storage Pile	--	--	--	3.88	1.94	0.29	--	1.76	--	--
AA-007[2,3]	One (1) 168 MMBtu/hr Wood-fired Direct Heat Drying System; Three (3) Green Hammermills; Two (2) 1 MMBtu/hr Burners for Double Ducts	WESP-1; RTO-1	62.9	75.1	33.1	33.1	33.1	18.4	50.1	144,712	9.25
AA-008	Dryer 1 Bypass Stack	--	0.54	0.66	1.46	1.46	1.46	0.11	0.35	880	0.50
AA-009	Furnace 1 Bypass Stack	--	3.27	1.20	3.05	3.00	2.91	0.14	0.09	1,142	0.17
AA-010[2,3]	One (1) 168 MMBtu/hr Wood-fired Direct Heat Drying System; Two (2) 1 MMBtu/hr Burners for Double Ducts	WESP-2; RTO-2	62.9	75.1	33.1	33.1	33.1	18.4	38.3	144,712	6.21
AA-011	Dryer 2 Bypass Stack	--	0.54	0.66	1.46	1.46	1.46	0.11	0.35	880	0.50
AA-012	Furnace 2 Bypass Stack	--	3.27	1.20	3.05	3.00	2.91	0.14	0.09	1,142	0.17
AA-013[3]	One (1) 168 MMBtu/hr Wood-fired Direct Heat Drying System; Two (2) 1 MMBtu/hr Burners for Double Ducts	WESP-3; RTO-3	62.9	75.1	33.1	33.1	33.1	18.4	38.3	144,712	6.21
AA-014	Dryer 3 Bypass Stack	--	0.54	0.66	1.46	1.46	1.46	0.11	0.35	880	0.50
AA-015	Furnace 3 Bypass Stack	--	3.27	1.20	3.05	3.00	2.91	0.14	0.09	1,142	0.17
AA-016	Thirty-two (32) Dry Hammermills; Sixteen (16) Pellet Mills, Eight (8) Pellet Coolers	Wet Scrubber-1; RCO-1	4.93	6.04	9.67	9.67	9.67	0.025	34.3	6,334	7.56
AA-017	Sixteen (16) Dry Hammermills; Eight (8) Pellet Mills, Four (4) Pellet Coolers	Wet Scrubber-2; RCO-2	2.36	5.21	4.83	4.83	4.83	0.012	17.2	2,973	3.78
AA-018	Finished Product Handling Two (2) Pellet Loadout Bins	One (1) baghouse	--	--	0.45	0.41	0.0077	--	--	--	--
AA-019	Additive Handling and Storage	One (1) baghouse	--	--	0.15	0.15	0.15	--	--	--	--
AA-020	Dry Shavings Silo	One (1) baghouse	--	--	0.15	0.15	0.15	--	--	--	--
AA-021	Dry Shavings Handling	--	--	--	0.17	0.08	0.012	--	--	--	--
IA[4]	500 gallon Diesel Storage Tank	--	--	--	--	--	--	--	2.10E-04	--	--
IA[4]	185 gallon Diesel Storage Tank	--	--	--	--	--	--	--	1.85E-04	--	--
IA[4]	5,000 gallon Diesel Storage Tank	--	--	--	--	--	--	--	0.0038	--	--
AA-022	500 kW Diesel-fired Emergency Generator	--	0.14	2.46	0.0078	0.0078	0.0078	6.63E-04	1.68	179	0.0017
AA-023	131 hp Diesel-fired Fire Water Pump	--	0.070	0.18	0.0092	0.0092	0.0092	4.79E-04	0.0081	50.4	8.88E-04
AA-024	Paved Roads	--	--	--	8.81	1.76	0.43	--	--	--	--
IA[3]	Propane Vaporizer	--	0.36	0.62	0.034	0.034	0.034	0.0026	0.048	611	0.010
		Total Emissions:	**208**	**245**	**176**	**152**	**131**	**56.0**	**187**	**450,350**	**35.8**
		Total Excluding Fugitives[5]:	**208**	**245**	**159**	**145**	**127**	**56.0**	**185**	**450,350**	**35.8**
		PSD Major Source Threshold:	**250**	**250**	**250**	**250**	**250**	**250**	**250**	**--**	**--**

Notes:

1. Bark storage and handling is considered an insignificant activity per 11 Miss. Admin. Code Pt. 2 Ch. 6 R. 6.7.B(13).
2. The three (3) Green Hammermills will be controlled by the WESP and RTO on Dryer Line 1. If Dryer Line 1 is not operational, the Green Hammermill exhaust will be routed to the WESP/RTO on Dryer Line 2. For potential emissions purposes, emissions from the Green Hammermills are shown under Dryer Line 1 (AA-007) only to avoid double-counting emissions.
3. The propane vaporizer and six (6) burners for the dryer line double duct systems are considered insignificant activities per 11 Miss. Admin. Code Pt. 2 Ch. 6 R. 6.7.B(2).
4. Storage tanks used exclusively to store diesel are considered an insignificant activity per 11 Miss. Admin. Code Pt. 2 Ch. 1 R. 6.7.B(7).
5. Fugitive emissions are not included in comparison against the major source threshold because the facility is not on the list of 28 source categories in 40 CFR 52.21.

Abbreviations:

CO - carbon monoxide
CO_2e - carbon dioxide equivalent
IA - Insignificant Activity
NO_x - nitrogen oxides
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RCO - Regenerative Catalytic Oxidizer
RTO - Regenerative Thermal Oxidizer
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compounds
WESP - Wet Electrostatic Precipitator

Table 3
Summary of Facility-wide HAP Emissions
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Pollutant	Log Chipping AA-002 (tpy)	Bark Hog AA-003 (tpy)	RTO-1 AA-007[1] (tpy)	Dryer 1 Bypass AA-008 (tpy)	Furnace 1 Bypass AA-009 (tpy)	RTO-2 AA-010[1] (tpy)	Dryer 2 Bypass AA-011 (tpy)	Furnace 2 Bypass AA-012 (tpy)	RTO-3 AA-013[1] (tpy)	Dryer 3 Bypass AA-014 (tpy)	Furnace 3 Bypass AA-015 (tpy)	RCO-1 AA-016[3] (tpy)	RCO-2 AA-017[3] (tpy)	Emergency Generator AA-022 (tpy)	Fire Water Pump AA-023 (tpy)	Propane Vaporizer IA (tpy)	Total HAP (tpy)
Acetaldehyde	--	--	1.48	0.10	0.0045	0.90	0.10	0.0045	0.90	0.10	0.0045	0.31	0.15	2.75E-05	1.76E-04	--	4.08
Acetophenone	--	--	1.18E-07	1.34E-08	1.74E-08	1.18E-07	1.34E-08	1.74E-08	1.18E-07	1.34E-08	1.74E-08	--	--	--	--	--	4.46E-07
Acrolein	--	--	0.99	0.051	0.022	0.45	0.051	0.022	0.45	0.051	0.022	1.07	0.54	8.61E-06	2.12E-05	--	3.71
Antimony and compounds	--	--	2.91E-04	3.32E-05	4.31E-05	2.91E-04	3.32E-05	4.31E-05	2.91E-04	3.32E-05	4.31E-05	--	--	--	--	--	0.0011
Arsenic and compounds	--	--	8.23E-04	9.24E-05	1.20E-04	8.23E-04	9.24E-05	1.20E-04	8.23E-04	9.24E-05	1.20E-04	8.42E-06	3.95E-06	--	--	--	0.0031
Benzene	--	--	0.20	--	--	0.20	--	--	0.20	--	--	3.05E-02	1.43E-02	8.48E-04	2.14E-04	0.0031	0.66
Benzo(a)pyrene	--	--	9.57E-05	1.09E-05	1.42E-05	9.57E-05	1.09E-05	1.42E-05	9.57E-05	1.09E-05	1.42E-05	5.05E-08	2.37E-08	2.81E-07	4.31E-08	--	3.63E-04
Beryllium metal	--	--	4.13E-05	4.62E-06	6.00E-06	4.13E-05	4.62E-06	6.00E-06	4.13E-05	4.62E-06	6.00E-06	5.05E-07	2.37E-07	--	--	--	1.56E-04
Butadiene, 1,3-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.96E-06	--	8.96E-06
Cadmium Metal	--	--	2.27E-04	1.72E-05	2.23E-05	2.27E-04	1.72E-05	2.23E-05	2.27E-04	1.72E-05	2.23E-05	4.63E-05	2.17E-05	--	--	--	8.67E-04
Carbon tetrachloride	--	--	0.0017	1.89E-04	2.45E-04	0.0017	1.89E-04	2.45E-04	0.0017	1.89E-04	2.45E-04	--	--	--	--	--	0.0063
Chlorine	--	--	0.58	0.0033	0.0043	0.58	0.0033	0.0043	0.58	0.0033	0.0043	--	--	--	--	--	1.77
Chlorobenzene	--	--	0.0012	1.39E-04	1.80E-04	0.0012	1.39E-04	1.80E-04	0.0012	1.39E-04	1.80E-04	--	--	--	--	--	0.0046
Chloroform	--	--	0.0010	--	--	0.0010	--	--	0.0010	--	--	--	--	--	--	--	0.0031
Chromium VI	--	--	9.68E-05	--	--	9.68E-05	--	--	9.68E-05	--	--	5.89E-05	2.77E-05	--	--	--	3.77E-04
Chromium--Other compounds	--	--	6.44E-04	7.35E-05	9.98E-05	6.44E-04	7.35E-05	9.98E-05	6.44E-04	7.35E-05	9.98E-05	--	--	--	--	--	0.0025
Cobalt compounds	--	--	2.45E-04	2.73E-05	3.54E-05	2.45E-04	2.73E-05	3.54E-05	2.45E-04	2.73E-05	3.54E-05	3.53E-06	1.66E-06	--	--	--	9.28E-04
Dichlorobenzene	--	--	8.30E-05	--	--	8.30E-05	--	--	8.30E-05	--	--	5.05E-05	2.37E-05	--	--	--	3.23E-04
Dichloroethane, 1,2-	--	--	0.0011	1.22E-04	1.58E-04	0.0011	1.22E-04	1.58E-04	0.0011	1.22E-04	1.58E-04	--	--	--	--	--	0.0040
Dichloropropane, 1,2-	--	--	0.0012	1.39E-04	1.80E-04	0.0012	1.39E-04	1.80E-04	0.0012	1.39E-04	1.80E-04	--	--	--	--	--	0.0046
Dinitrophenol, 2,4-	--	--	6.62E-06	7.56E-07	9.81E-07	6.62E-06	7.56E-07	9.81E-07	6.62E-06	7.56E-07	9.81E-07	--	--	--	--	--	2.51E-05
Di(2-ethylhexyl)phthalate	--	--	1.73E-06	1.97E-07	2.56E-07	1.73E-06	1.97E-07	2.56E-07	1.73E-06	1.97E-07	2.56E-07	--	--	--	--	--	6.55E-06
Ethyl benzene	--	--	0.0011	1.30E-04	1.69E-04	0.0011	1.30E-04	1.69E-04	0.0011	1.30E-04	1.69E-04	--	--	--	--	--	0.0043
Formaldehyde	--	--	0.71	0.060	0.024	0.63	0.060	0.024	0.63	0.060	0.024	0.75	0.37	8.62E-05	2.71E-04	0.0066	3.35
Hexane	--	--	0.12	--	--	0.12	--	--	0.12	--	--	0.076	0.036	--	--	--	0.48
Hydrochloric acid	--	--	1.40	0.080	0.10	1.40	0.080	0.10	1.40	0.080	0.10	--	--	--	--	--	4.74
Lead and lead compounds	--	--	0.0018	2.02E-04	2.62E-04	0.0018	2.02E-04	2.62E-04	0.0018	2.02E-04	2.62E-04	2.10E-05	9.88E-06	--	--	--	0.0068
Manganese and compounds	--	--	0.059	0.0067	0.0087	0.059	0.0067	0.0087	0.059	0.0067	0.0087	1.60E-05	7.51E-06	--	--	--	0.22
Mercury	--	--	1.47E-04	1.47E-05	1.91E-05	1.47E-04	1.47E-05	1.91E-05	1.47E-04	1.47E-05	1.91E-05	1.09E-05	5.14E-06	--	--	--	5.58E-04
Methanol	0.44	0.27	2.41	0.089	--	0.78	0.089	--	0.78	0.089	--	4.37	2.18	--	--	--	11.5
Methyl bromide	--	--	5.52E-04	6.30E-05	8.18E-05	5.52E-04	6.30E-05	8.18E-05	5.52E-04	6.30E-05	8.18E-05	--	--	--	--	--	0.0021
Methyl chloride	--	--	8.46E-04	9.66E-05	1.25E-04	8.46E-04	9.66E-05	1.25E-04	8.46E-04	9.66E-05	1.25E-04	--	--	--	--	--	0.0032
Methylene chloride	--	--	0.011	--	--	0.011	--	--	0.011	--	--	--	--	--	--	--	0.032
Naphthalene	--	--	0.0036	4.07E-04	5.29E-04	0.0036	4.07E-04	5.29E-04	0.0036	4.07E-04	5.29E-04	2.57E-05	1.20E-05	1.42E-04	1.95E-05	--	0.014
Nickel metal	--	--	0.0014	1.39E-04	1.80E-04	0.0014	1.39E-04	1.80E-04	0.0014	1.39E-04	1.80E-04	8.84E-05	4.15E-05	--	--	--	0.0052
Nitrophenol, 4-	--	--	4.05E-06	4.62E-07	6.00E-07	4.05E-06	4.62E-07	6.00E-07	4.05E-06	4.62E-07	6.00E-07	--	--	--	--	--	1.53E-05
Pentachlorophenol	--	--	3.75E-05	2.14E-07	2.78E-07	3.75E-05	2.14E-07	2.78E-07	3.75E-05	2.14E-07	2.78E-07	--	--	--	--	--	1.14E-04
Perchloroethylene	--	--	0.028	1.60E-04	2.07E-04	0.028	1.60E-04	2.07E-04	0.028	1.60E-04	2.07E-04	--	--	--	--	--	0.085
Phenol	--	--	0.87	0.081	2.78E-04	0.71	0.081	2.78E-04	0.71	0.081	2.78E-04	0.51	0.26	--	--	--	3.30
Phosphorus metal, yellow or white	--	--	9.93E-04	1.13E-04	1.47E-04	9.93E-04	1.13E-04	1.47E-04	9.93E-04	1.13E-04	1.47E-04	--	--	--	--	--	0.0038
Polychlorinated biphenyls	--	--	3.00E-07	3.42E-08	4.44E-08	3.00E-07	3.42E-08	4.44E-08	3.00E-07	3.42E-08	4.44E-08	--	--	--	--	--	1.14E-06
Propionaldehyde	--	--	0.30	0.029	3.32E-04	0.26	0.029	3.32E-04	0.26	0.029	3.32E-04	0.52	0.26	--	--	--	1.67
Selenium compounds	--	--	1.05E-04	1.18E-05	1.53E-05	1.05E-04	1.18E-05	1.53E-05	1.05E-04	1.18E-05	1.53E-05	1.01E-06	4.74E-07	--	--	--	3.97E-04
Styrene	--	--	0.070	--	--	0.070	--	--	0.070	--	--	--	--	--	--	--	0.21
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	--	--	3.16E-10	3.61E-11	4.69E-11	3.16E-10	3.61E-11	4.69E-11	3.16E-10	3.61E-11	4.69E-11	--	--	--	--	--	1.20E-09
Toluene	--	--	0.0013	--	--	0.0013	--	--	0.0011	--	--	1.43E-04	6.72E-05	3.07E-04	9.38E-05	--	0.0044
Total PAH (POM)	--	--	0.095	5.25E-04	6.81E-04	0.095	5.25E-04	6.81E-04	0.095	5.25E-04	6.81E-04	1.72E-03	8.06E-04	2.32E-04	3.85E-05	1.75E-04	0.29
Trichloroethane, 1,1,1-	--	--	0.023	1.30E-04	1.69E-04	0.023	1.30E-04	1.69E-04	0.023	1.30E-04	1.69E-04	--	--	--	--	--	0.069
Trichloroethylene	--	--	0.0011	1.26E-04	1.64E-04	0.0011	1.26E-04	1.64E-04	0.0011	1.26E-04	1.64E-04	--	--	--	--	--	0.0042
Trichlorophenol, 2,4,6-	--	--	8.09E-07	9.24E-08	1.20E-07	8.09E-07	9.24E-08	1.20E-07	8.09E-07	9.24E-08	1.20E-07	--	--	--	--	--	3.07E-06
Vinyl chloride	--	--	6.62E-04	7.56E-05	9.81E-05	6.62E-04	7.56E-05	9.81E-05	6.62E-04	7.56E-05	9.81E-05	--	--	--	--	--	0.0025
Xylene	--	--	9.20E-04	--	--	9.20E-04	--	--	9.20E-04	--	--	--	--	2.11E-04	6.53E-05	--	0.0030
Total HAP Emissions[4] (tpy)	**0.44**	**0.27**	**9.37**	**0.50**	**0.17**	**6.33**	**0.50**	**0.17**	**6.33**	**0.50**	**0.17**	**7.64**	**3.82**	**0.0017**	**8.88E-04**	**0.010**	**36.2**
Maximum Individual HAP	**Methanol**	**Methanol**	**Methanol**	**Acetaldehyde**	**Hydrochloric acid**	**Hydrochloric acid**	**Acetaldehyde**	**Hydrochloric acid**	**Hydrochloric acid**	**Acetaldehyde**	**Hydrochloric acid**	**Methanol**	**Methanol**	**Benzene**	**Formaldehyde**	**Formaldehyde**	**Methanol**
Maximum Individual HAP Emissions (tpy)	**0.44**	**0.27**	**2.41**	**0.10**	**0.10**	**1.40**	**0.10**	**0.10**	**1.40**	**0.10**	**0.10**	**4.37**	**2.18**	**8.48E-04**	**2.71E-04**	**0.0066**	**11.5**

Notes:

[1]- Includes emissions at outlet of the RTO stack as well as emissions resulting from combustion of propane or natural gas by the RTO burners. Emissions from the Green Hammermills will be routed through the Dryer Line 1 WESP and RTO. If Dryer Line 1 is not operational, the Green Hammermill exhaust will be routed to the WESP/RTO on Dryer Line 2. For purposes of potential emissions, emissions from the Green Hammermills are shown under Dryer Line 1 only to avoid double-counting.

[2]- Includes emissions at outlet of the RCO-1 (AA-018) stack as well as emissions resulting from combustion of propane or natural gas by the RCO-1 burners. RCO-1 will control emissions from thirty-two (32) dry hammermills, sixteen (16) pellet mills, and eight (8) pellet coolers.

[3]- Includes emissions at outlet of the RCO-2 (AA-017) stack as well as emissions resulting from combustion of propane or natural gas by the RCO-2 burners. RCO-2 will control emissions from sixteen (16) dry hammermills, eight (8) pellet mills, and four (4) pellet coolers.

[4]- Because benzo(a)pyrene and naphthalene emissions were presented individually and as components of total PAH emissions, the total HAP emissions presented here do not match the sum of all pollutant emissions to avoid double counting benzo(a)pyrene and naphthalene emissions.

Abbreviations:

HAP - hazardous air pollutant
IA - insignificant activity
RCO - regenerative catalytic oxidizer
RTO - regenerative thermal oxidizer
tpy - tons per year
WESP - wet electrostatic precipitator

Table 4
Potential Emissions from Debarking
AA-001
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput[1]	238 ton/hr
Annual Throughput[1]	2,085,714 ton/yr

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor[2] (lb/ton)	Potential Emissions	
		(lb/hr)	(tpy)
TSP	0.020	4.76	20.9
PM_{10}	0.011	2.62	11.5

Notes:

1. Debarker throughput provided by Kai Simonsen (Enviva) via email on June 25, 2018.
2. Particulate matter emission factors from the USEPA document titled *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants.* Source Classification Code 3-07-008-01 (Log Debarking). All PM is assumed to be larger than 2.5 microns in diameter.

Abbreviations:

hr - hour
lb - pound
ODT - oven dried tons
tpy - tons per year
yr - year

Reference:

EPA. 1990. AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants. Source Classification Code 3-07-008-01 (Log Debarking).

Table 5
Log Chipping Potential Emissions
AA-002
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput[1]	200 ton/hr, wet
	100 ODT/hr
Annual Throughput	876,000 ODT/yr

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor[2]	Potential Emissions	
		(lb/hr)	(tpy)
VOC as propane	5.00E-03 lb/ODT	0.50	2.19
Methanol	1.00E-03 lb/ODT	0.10	0.44

Notes:

1. Chipper throughput provided by Kai Simonsen (Enviva) via email on June 25, 2018. The chipper is located inside of a building. As such, there are no quantifiable particulate emissions.
2. Emission factor obtained from available emissions factors for chippers in AP-42 Section 10.6.3, Medium Density Fiberboard, 08/02, Table 7 and Section 10.6.4, Hardboard and Fiberboard, 10/02, Table 9.

Abbreviations:

hr - hour
lb - pound
ODT - oven dried tons
THC - total hydrocarbon
tpy - tons per year
yr - year

References:

EPA. AP-42, Section 10.6.3 - Medium Density Fiberboard, (08/02).
EPA. AP-42, Section 10.6.4 - Hardboard and Fiberboard, (10/02).

Table 6
Bark Hog Potential Emissions
AA-003
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput[1]	113 ton/hr, wet
	62 ODT/hr
Annual Throughput	544,893 ODT/yr
	990,714 ton/yr, wet
Approx. Moisture Content[1]	45% of total weight

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor	Potential Emissions	
		(lb/hr)	(tpy)
VOC as propane[2,3]	5.00E-03 lb/ODT	0.31	1.36
Methanol[2]	1.00E-03 lb/ODT	0.062	0.27
TSP[3]	2.00E-02 lb/ton	2.26	9.91
PM_{10}[3]	1.10E-02 lb/ton	1.24	5.45

Notes:

1. Bark hog throughput and approximate moisture content provided by Kai Simonsen (Enviva) via email on June 25, 2018.
2. Emission factor obtained from available emissions factors for chippers in AP-42 Section 10.6.3, Medium Density Fiberboard, 08/02, Table 7 and Section 10.6.4, Hardboard and Fiberboard, 10/02, Table 9.
3. Particulate matter emission factors from the USEPA document titled *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants. Source Classification Code 3-07-008-01 (Log Debarking)*. All PM is assumed to be larger than 2.5 microns.

Abbreviations:

hr - hour
lb - pound
ODT - oven dried tons
THC - total hydrocarbon
tpy - tons per year
yr - year

References:

EPA. AP-42, Section 10.6.3 - Medium Density Fiberboard, (08/02).
EPA. AP-42, Section 10.6.4 - Hardboard and Fiberboard, (10/02).
EPA. 1990. AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants. Source Classification Code 3-07-008-01 (Log Debarking).

Table 7
Green Wood, Bark, and Dry Shavings Material Handling
AA-004, AA-021, and Bark Handling IA
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Emission Point ID	Source Description	Transfer Activity	Number of Drop Points	Material Moisture Content[1]	PM Emission Factor[2]	PM_{10} Emission Factor[2]	$PM_{2.5}$ Emission Factor[2]	Potential Throughput		Potential PM Emissions		Potential PM_{10} Emissions		Potential $PM_{2.5}$ Emissions	
				(%)	(lb/ton)	(lb/ton)	(lb/ton)	(tph)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
AA-004	Greenwood Handling Operations	Chips to Pile via Conveyor	1	50%	4.06E-05	1.92E-05	2.91E-06	620	5,431,200	0.025	0.11	0.012	0.052	0.0018	0.0079
		Chip Truck Dump to Hoppers	3	50%	4.06E-05	1.92E-05	2.91E-06	140	1,226,400	0.017	0.075	0.0081	0.035	0.0012	0.0054
									Total Green Wood Handling Emissions:	**0.042**	**0.19**	**0.020**	**0.088**	**0.0030**	**0.013**
IA[3]	Bark Handling Operations	Bark Truck Dump to Hopper	1	45%	4.71E-05	2.23E-05	3.37E-06	75	657,000	0.0035	0.015	0.0017	0.0073	0.00025	0.0011
		Bark to Pile via Conveyor	1	45%	4.71E-05	2.23E-05	3.37E-06	113	990,714	0.0053	0.023	0.0025	0.011	0.00038	0.0017
									Total Bark Handling Emissions:	**0.0089**	**0.039**	**0.0042**	**0.018**	**6.34E-04**	**0.0028**
AA-021	Dry Shavings Handling	Dry Shavings Truck Dump to Hopper	1	8%	5.29E-04	2.50E-04	3.79E-05	72	630,720	0.038	0.17	0.018	0.079	0.0027	0.012
									Total Dry Shavings Handling Emissions:	**0.038**	**0.17**	**0.018**	**0.079**	**0.0027**	**0.012**

Notes:

[1] Moisture content provided by Enviva.

[2] Emission factor calculation based on formula from AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, Equation 13.2.1, (11/06).

where:
E = emission factor (lb/ton)
k = particle size multiplier (dimensionless) for PM 0.74
k = particle size multiplier (dimensionless) for PM_{10} 0.35
k = particle size multiplier (dimensionless) for $PM_{2.5}$ 0.053
U = mean wind speed (mph) 7.02 Average wind speed from the Mobile/Bates Field NWS station (KMOB) for 2013-2017

[3] Bark storage and handling are considered an insignificant activity per 11 Miss. Admin. Code Pt. 2 Ch. 1 R. 6.7.B(13).

Abbreviations:

hr - hour
IA - Insignificant Activity
lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
yr - year

References:

EPA. AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, (11/06).

Table 8
Green Screen
AA-005
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput	159 ODT/hr
Annual Throughput	1,390,475 ODT/yr

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor	Potential Emissions[1]	
		(lb/hr)	(tpy)
$PM/PM_{10}/PM_{2.5}$	0.0038 lb/ODT	0.60	2.64

Notes:

1. Emission factor from NCASI Technical Bulletin No. 1020 Table 9.1 for chip screening converted from units of bone dry tons (BDT) to ODT based on a moisture content of 50%.

Abbreviations:

hr - hour
lb - pound
ODT - oven dried tons
THC - total hydrocarbon
tpy - tons per year
yr - year

References:

National Council for Air and Stream Improvement, Inc. (NCASI). 2013. *Compilation of criteria air pollutant emissions data for sources at pulp and paper mills including boilers – an update to Technical Bulletin No. 884.* Technical Bulletin No. 1020. Research Triangle Park, NC: National Council for Air and Stream Improvement, Inc.

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Table 9
Storage Pile Wind Erosion
AA-006 and Bark Storage IA
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Source	Description	PM Emission Factor[1]		VOC Emission Factor[2]		Pile Diameter	Pile Height	Exposed Surface Area of Pile[3]	Potential PM Emissions		Potential PM_{10} Emissions		Potential $PM_{2.5}$ Emissions		Potential VOC Emissions as propane[4]	
		(lb/day /acre)	($lb/hr/ft^2$)	(lb/day /acre)	($lb/hr/ft^2$)	(ft)	(ft)	(ft^2)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
AA-006	Green Wood Storage Pile	9.70	9.3E-06	3.60	3.4E-06	334	72	95,412	0.88	3.88	0.44	1.94	0.066	0.29	0.40	1.76
IA[5]	Bark Storage Pile	9.70	9.3E-06	3.60	3.4E-06	228	50	44,583	0.41	1.81	0.21	0.91	0.031	0.14	0.19	0.82
								Total Emissions:	**1.30**	**5.69**	**0.65**	**2.84**	**0.097**	**0.43**	**0.59**	**2.58**

Notes:

[1] PM emission factor based on U.S. EPA Control of Open Fugitive Dust Sources. Research Triangle Park, North Carolina, EPA-450/3-88-008. September 1988, Page 4-17.

$$E = 1.7\left(\frac{s}{1.5}\right)\left(\frac{(365-p)}{235}\right)\left(\frac{f}{15}\right) \text{lb/day/acre}$$

where:

s, silt content of wood chips (%):	8.4	s - silt content (%) for lumber sawmills (mean) from AP-42, Section 13.2.2 - Unpaved Roads, 11/06, Table 13.2.2-1
p, number of days with rainfall greater than 0.01 inch:	110	Based on AP-42, Section 13.2.2 - Unpaved Roads, 11/06, Figure 13.2.1-2.
f (time that wind exceeds 5.36 m/s - 12 mph) (%):	14.1	Based on meteorological data for 2013-2017 from the Mobile/Bates Field NWS station (KMOB).
PM_{10}/TSP ratio:	50%	PM_{10} is assumed to equal 50% of TSP based on U.S. EPA Control of Open Fugitive Dust Sources, Research Triangle Park, North Carolina, EPA-450/3-88-008. September 1988.
$PM_{2.5}$/TSP ratio:	7.5%	$PM_{2.5}$ is assumed to equal 7.5 % of TSP U.S. EPA Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors. November 2006.

[2] VOC emission factor obtained from NCASI document provided by the South Carolina Department of Health and Environmental Control (DHEC) for the calculation of fugitive VOC emissions from Douglas Fir wood storage piles. Emission factors ranged from 1.6 to 3.6 lb C/acre-day. The maximum emission factor has conservatively been selected.

[3] The exposed surface area of the pile is conservatively calculated as the lateral surface area of a cone [$\pi * r * (h^2 + r^2)^{0.5}$].

[4] Emission factor converted from as carbon to as propane by multiplying by 1.22.

[5] Bark storage and handling are considered an insignificant activity per 11 Miss. Admin. Code Pt. 2 Ch. 1 R. 6.7.B(13).

Abbreviations:

EPA - Environmental Protection Agency
ft - feet
ft^2 - square feet
IA - Insignificant Activity
lb - pound
mph - miles per hour
NCASI - National Council for Air and Stream Improvement, Inc.
NWS - National Weather Service
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
TSP - Total Suspended Particulate
yr - year
VOC - volatile organic compound

References:

AP-42, Section 13.2.2 - Unpaved Roads, 11/06.
U.S. EPA Control of Open Fugitive Dust Sources, Research Triangle Park, North Carolina, EPA-450/3-88-008. September 1988.
U.S. EPA Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors. November 2006.

Table 10a
Potential Emissions at Outlet of Dryer Line 1 RTO Stack
AA-007
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput (per Dyer line)	42	ODT/hr
Annual Throughput (per Dryer line)	367,920	ODT/yr
Hourly Heat Input Capacity (per furnace)	168	MMBtu/hr
Annual Heat Input Capacity (per furnace)	1,471,680	MMBtu/yr
Hourly Throughput (Total GHM)[1]	159	ODT/hr
Annual Throughput (Total GHM)[1]	1,390,475	ODT/yr
Hours of Operation	8,760	hr/yr
Number of RTO Burners (per RTO)	2	burners
RTO Burner Rating	8	MMBtu/hr
Dryer Double Duct System - Num. of Burners[2]	2	burners
Double Duct System Burner Rating[2]	1	MMBtu/hr
Propane Heating Value[3]	91.5	MMBtu/Mgal
Natural Gas Heating Value[4]	1,020	Btu/scf
Hourly Fuel Consumption (total)[5]	0.022	Mgal/hr propane
	0.0020	MMscf/hr natural gas
RTO Control Efficiency[6]	95%	

Potential Criteria Pollutant and Greenhouse Gas Emissions - Dryer and Green Hammermills

Pollutant	Controlled Emission Factor	Units	Potential Emissions from Dryer and Green Hammermills[7]	
			(lb/hr)	(tpy)
CO	14.2	lb/hr[8]	14.2	62.2
NO_X	17.0	lb/hr[9]	17.0	74.5
SO_2	0.025	lb/MMBtu[10]	4.20	18.4
VOC as Propane	11.4	lb/hr[8]	11.4	50.1
$PM/PM_{10}/PM_{2.5}$ (Filterable)	4.69	lb/hr[11]	4.69	20.5
$PM/PM_{10}/PM_{2.5}$ (Condensable)	0.017	lb/MMBtu[12]	2.86	12.5
$PM/PM_{10}/PM_{2.5}$ (Condensable - Nat. Gas)	0.00056	lb/MMBtu[13]	0.0089	0.039
CO_2	780	lb/ODT[14]	32,760	143,489

Notes:

1. Emissions from the Green Hammermills will be routed through the Dryer Line 1 WESP and RTO. If Dryer Line 1 is not operational, the Green Hammermill exhaust will be routed to the WESP/RTO on Dryer Line 2. For purposes of potential emissions, emissions from the Green Hammermills are shown under Dryer Line 1 (AA-007) only to avoid double-counting emissions.
2. Each dryer system will include two (2) ducts (i.e., double ducts) that will each be heated by a 1 MMBtu/hr burner. There will be a total of six (6) burners, two (2) per dryer line. The burners will fire natural gas, with propane as a back-up, and will be low-NO_X burners.
3. Propane heat content from AP-42 Section 1.5 - Liquefied Petroleum Gas Production, 7/08.
4. Natural gas heating value from AP-42 Section 1.4 - Natural Gas Combustion, 07/98.
5. Total hourly fuel consumption for both burners. The burners will fire natural gas, with propane as a back-up.
6. Control efficiency based on RTO vendor guarantee.
7. Exhaust from the dryers are routed to a WESP and then RTO for control of VOC, HAP, and particulates. Each of the three (3) dryer lines will have a dedicated WESP and RTO.
8. CO and VOC emission rates based on vendor data and stack testing at similar Enviva plants.
9. NO_x emission factor based on stack testing at similar Enviva plants.
10. No emission factor is provided in AP-42, Section 10.6.2 for SO_2 for rotary dryers. Enviva has conservatively calculated SO_2 emissions based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
11. Filterable particulate emission rate based on RTO vendor data.
12. Condensable particulate emission factor for biomass combustion obtained from AP-42 Section 1.6.
13. Natural gas combustion by the RTO burners will also result in emissions of condensable PM. Emission factor obtained from AP-42, Section 1.4 - Natural Gas Combustion, 07/98.
14. Emission factor for CO_2 from AP-42, Section 10.6.1 for rotary dryer with RTO control device. Enviva has conservatively calculated the CO_2 emissions using the hardwood emission factor because the dryers at the Lucedale plant will use a combination of hardwood and softwood and the hardwood emission factor is greater than the softwood emission factor.

Table 10a
Potential Emissions at Outlet of Dryer Line 1 RTO Stack
AA-007
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential Criteria Pollutant and Greenhouse Gas Emissions - Dryer System Double Duct Burners[1]

Pollutant	Natural Gas Emission Factor[2,3] (lb/MMscf)	Potential Emissions - Natural Gas Combustion		Propane Emission Factor[4,5,6] (lb/Mgal)	Potential Emissions - Propane Combustion	
		(lb/hr)	(tpy)		(lb/hr)	(tpy)
CO	84.0	0.16	0.72	7.50	0.16	0.72
NO_X	50.0	0.10	0.43	6.50	0.14	0.62
SO_2	0.60	0.0012	0.0052	0.054	0.0012	0.0052
VOC	5.50	5.39E-04	0.0024	1.00	0.0011	0.0048
$PM/PM_{10}/PM_{2.5}$ Condensable	5.70	5.59E-04	0.0024	0.50	5.46E-04	0.0024
$PM/PM_{10}/PM_{2.5}$ Filterable	1.90	1.86E-04	8.16E-04	0.20	2.19E-04	0.0010
Total $PM/PM_{10}/PM_{2.5}$	--	7.45E-04	0.0033	--	7.65E-04	0.0034
CO_2	120,000	235	1,031	12,500	273	1,197
CH_4	2.30	0.0045	0.020	0.20	0.0044	0.019
N_2O^2	0.64	0.0013	0.0055	0.90	0.020	0.0862
CO_2e	--	236	1,033	--	279	1,223

Notes:

1. Two (2) low-NOx burners will be used to heat the dryer system ducts to prevent condensation of wood tar from occurring and thus reduce the fire risk. The burners will combust natural gas. Emissions from the burners will be routed to the WESP and RTO on each dryer line; therefore, a 95% control efficiency was applied to VOC and $PM/PM_{10}/PM_{2.5}$.
2. Emission factors for natural gas combustion from AP-42 Section 1.4 - Natural Gas Combustion, 07/98. Natural gas heating value of 1,020 Btu/scf assumed per AP-42.
3. Emission factors for NO_X and N_2O assume burners are low NO_X burners, per email from Kai Simonsen (Enviva) on August 8, 2018.
4. Emission factors for propane combustion obtained from AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08.
5. AP-42 Section 1.5 does not include an emission factor for low NO_X burners. Per AP-42 Section 1.4, low NO_X burners reduce NO_X emissions by accomplishing combustion in stages, reducing NO_X emissions 40 to 85% relative to uncontrolled emission levels. A conservative control efficiency of 50% was applied to the uncontrolled NO_X emission factor from AP-42 Section 1.5. This reduction is consistent with the magnitude of reduction between the uncontrolled and low NO_X emission factors in AP-42 Section 1.4.
6. SO_2 emissions are based on an assumed fuel sulfur content of 0.54 grains/100 ft^3 per *A National Methodology and Emission Inventory for Residential Fuel Combustion*.

Table 10a
Potential Emissions at Outlet of Dryer Line 1 RTO Stack
AA-007
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions

Pollutant	VOC	Emission Factor	Units	Footnote	Potential Emissions	
					(lb/hr)	(tpy)
Furnace - Biomass Combustion						
Acetaldehyde	Y	4.88E-03	lb/ODT	1	0.20	0.90
Acrolein	Y	2.43E-03	lb/ODT	1	0.10	0.45
Formaldehyde	Y	2.84E-03	lb/ODT	1	0.12	0.52
Methanol	Y	4.24E-03	lb/ODT	1	0.18	0.78
Phenol	Y	3.84E-03	lb/ODT	1	0.16	0.71
Propionaldehyde	Y	1.39E-03	lb/ODT	1	0.058	0.26
Acetophenone	Y	3.20E-09	lb/MMBtu	1	2.69E-08	1.18E-07
Antimony and compounds	N	7.90E-06	lb/MMBtu	2,4	6.64E-05	2.91E-04
Arsenic and compounds	N	2.20E-05	lb/MMBtu	2,4	1.85E-04	8.09E-04
Benzene	Y	4.20E-03	lb/MMBtu	2,3	0.035	0.15
Benzo(a)pyrene	Y	2.60E-06	lb/MMBtu	2,3	2.18E-05	9.57E-05
Beryllium metal	N	1.10E-06	lb/MMBtu	2,4	9.24E-06	4.05E-05
Cadmium metal	N	4.10E-06	lb/MMBtu	2,4	3.44E-05	1.51E-04
Carbon tetrachloride	Y	4.50E-05	lb/MMBtu	2,3	3.78E-04	1.66E-03
Chlorine	N	7.90E-04	lb/MMBtu	2	0.13	0.58
Chlorobenzene	Y	3.30E-05	lb/MMBtu	2,3	2.77E-04	1.21E-03
Chloroform	Y	2.80E-05	lb/MMBtu	2,3	2.35E-04	1.03E-03
Chromium-Other compounds	N	1.75E-05	lb/MMBtu	2,4	1.47E-04	6.44E-04
Cobalt compounds	N	6.50E-06	lb/MMBtu	2,4	5.46E-05	2.39E-04
Dichloroethane, 1,2-	Y	2.90E-05	lb/MMBtu	2,3	2.44E-04	1.07E-03
Dichloropropane, 1,2-	Y	3.30E-05	lb/MMBtu	2,3	2.77E-04	1.21E-03
Dinitrophenol, 2,4-	Y	1.80E-07	lb/MMBtu	2,3	1.51E-06	6.62E-06
Di(2-ethylhexyl)phthalate	Y	4.70E-08	lb/MMBtu	2,3	3.95E-07	1.73E-06
Ethyl benzene	Y	3.10E-05	lb/MMBtu	2,3	2.60E-04	1.14E-03
Hydrochloric acid	N	1.90E-02	lb/MMBtu	2,5	0.32	1.40
Lead and lead compounds	N	4.80E-05	lb/MMBtu	2,4	4.03E-04	0.0018
Manganese and compounds	N	1.60E-03	lb/MMBtu	2,4	0.013	0.059
Mercury	N	3.50E-06	lb/MMBtu	2,4	2.94E-05	1.29E-04
Methyl bromide	Y	1.50E-05	lb/MMBtu	2,3	1.26E-04	5.52E-04
Methyl chloride	Y	2.30E-05	lb/MMBtu	2,3	1.93E-04	8.46E-04
Methylene chloride	Y	2.90E-04	lb/MMBtu	2,3	0.0024	0.011
Naphthalene	Y	9.70E-05	lb/MMBtu	2,3	8.15E-04	0.0036
Nickel metal	N	3.30E-05	lb/MMBtu	2,4	2.77E-04	0.0012
Nitrophenol, 4-	Y	1.10E-07	lb/MMBtu	2,3	9.24E-07	4.05E-06
Pentachlorophenol	N	5.10E-08	lb/MMBtu	2	8.57E-06	3.75E-05
Perchloroethylene	N	3.80E-05	lb/MMBtu	2	0.0064	0.028
Phosphorus metal, yellow or white	N	2.70E-05	lb/MMBtu	2,4	2.27E-04	9.93E-04
Polychlorinated biphenyls	Y	8.15E-09	lb/MMBtu	2,3	6.85E-08	3.00E-07
Polycyclic Organic Matter	N	1.25E-04	lb/MMBtu	2	0.021	0.092
Selenium compounds	N	2.80E-06	lb/MMBtu	2,4	2.35E-05	1.03E-04
Styrene	Y	1.90E-03	lb/MMBtu	2,3	0.016	0.070
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	8.60E-12	lb/MMBtu	2,3	7.22E-11	3.16E-10
Toluene	Y	3.00E-05	lb/MMBtu	2,3	2.52E-04	0.0011
Trichloroethane, 1,1,1-	N	3.10E-05	lb/MMBtu	2	0.0052	0.023
Trichloroethylene	Y	3.00E-05	lb/MMBtu	2,3	2.52E-04	0.0011
Trichlorophenol, 2,4,6-	Y	2.20E-08	lb/MMBtu	2,3	1.85E-07	8.09E-07
Vinyl chloride	Y	1.80E-05	lb/MMBtu	2,3	1.51E-04	6.62E-04
Xylene	Y	2.50E-05	lb/MMBtu	2,3	2.10E-04	9.20E-04
Total HAP Emissions (biomass combustion)					**1.38**	**6.05**

Table 10a
Potential Emissions at Outlet of Dryer Line 1 RTO Stack
AA-007
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Pollutant	VOC	Emission Factor[1]	Units	Potential Emissions	
				(lb/hr)	(tpy)
Green Hammermills[6]					
Acetaldehyde	Y	8.40E-04	lb/ODT	0.13	0.58
Acrolein	Y	7.80E-04	lb/ODT	0.12	0.54
Formaldehyde	Y	1.20E-04	lb/ODT	0.019	0.083
Methanol	Y	2.34E-03	lb/ODT	0.37	1.63
Phenol	Y	2.40E-04	lb/ODT	0.038	0.17
Propionaldehyde	Y	6.00E-05	lb/ODT	0.0095	0.042
Total HAP Emissions (Green Hammermills)				**0.70**	**3.05**

Potential HAP Emissions - RTO Burners and Dryer System Double Duct Burners

Pollutant	VOC	Emission Factor[7]	Units	RTO Burners Potential Emissions		Double Duct Burners Potential Emissions[3,4]	
				(lb/hr)	(tpy)	(lb/hr)	(tpy)
Natural Gas Combustion							
2-Methylnaphthalene	Y	2.40E-05	lb/MMscf	3.76E-07	1.65E-06	2.35E-09	1.03E-08
3-Methylchloranthrene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
7,12-Dimethylbenz(a)anthracene	Y	1.60E-05	lb/MMscf	2.51E-07	1.10E-06	1.57E-09	6.87E-09
Acenaphthene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Acenaphthylene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Anthracene	Y	2.40E-06	lb/MMscf	3.76E-08	1.65E-07	2.35E-10	1.03E-09
Arsenic and compounds	N	2.00E-04	lb/MMscf	3.14E-06	1.37E-05	1.96E-08	8.59E-08
Benz(a)anthracene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Benzene	Y	2.10E-03	lb/MMscf	3.29E-05	1.44E-04	2.06E-07	9.02E-07
Benzo(a)pyrene	Y	1.20E-06	lb/MMscf	1.88E-08	8.24E-08	1.18E-10	5.15E-10
Benzo(b)fluoranthene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Benzo(g,h,i)perylene	Y	1.20E-06	lb/MMscf	1.88E-08	8.24E-08	1.18E-10	5.15E-10
Benzo(k)fluoranthene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Beryllium metal	N	1.20E-05	lb/MMscf	1.88E-07	8.24E-07	1.18E-09	5.15E-09
Cadmium metal	N	1.10E-03	lb/MMscf	1.73E-05	7.56E-05	1.08E-07	4.72E-07
Chromium VI	N	1.40E-03	lb/MMscf	2.20E-05	9.62E-05	1.37E-07	6.01E-07
Chrysene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Cobalt compounds	N	8.40E-05	lb/MMscf	1.32E-06	5.77E-06	8.24E-09	3.61E-08
Dibenzo(a,h)anthracene	Y	1.20E-06	lb/MMscf	1.88E-08	8.24E-08	1.18E-10	5.15E-10
Dichlorobenzene	Y	1.20E-03	lb/MMscf	1.88E-05	8.24E-05	1.18E-07	5.15E-07
Fluoranthene	Y	3.00E-06	lb/MMscf	4.71E-08	2.06E-07	2.94E-10	1.29E-09
Fluorene	Y	2.80E-06	lb/MMscf	4.39E-08	1.92E-07	2.75E-10	1.20E-09
Formaldehyde	Y	0.075	lb/MMscf	0.0012	0.0052	7.35E-06	3.22E-05
Hexane	Y	1.80	lb/MMscf	0.028	0.12	1.76E-04	7.73E-04
Indeno(1,2,3-cd)pyrene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Lead and lead compounds	N	5.00E-04	lb/MMscf	7.84E-06	3.44E-05	4.90E-08	2.15E-07
Manganese and compounds	N	3.80E-04	lb/MMscf	5.96E-06	2.61E-05	3.73E-08	1.63E-07
Mercury	N	2.60E-04	lb/MMscf	4.08E-06	1.79E-05	2.55E-08	1.12E-07
Naphthalene	Y	6.10E-04	lb/MMscf	9.57E-06	4.19E-05	5.98E-08	2.62E-07
Nickel metal	N	2.10E-03	lb/MMscf	3.29E-05	1.44E-04	2.06E-07	9.02E-07
Phenanthrene	Y	1.70E-05	lb/MMscf	2.67E-07	1.17E-06	1.67E-09	7.30E-09
Pyrene	Y	5.00E-06	lb/MMscf	7.84E-08	3.44E-07	4.90E-10	2.15E-09
Selenium compounds	N	2.40E-05	lb/MMscf	3.76E-07	1.65E-06	2.35E-09	1.03E-08
Toluene	Y	3.40E-03	lb/MMscf	5.33E-05	2.34E-04	3.33E-07	1.46E-06
Total HAP Emissions (Natural Gas Combustion)[8]				**0.030**	**0.13**	**1.85E-04**	**8.11E-04**

Table 10a
Potential Emissions at Outlet of Dryer Line 1 RTO Stack
AA-007
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions - RTO Burners and Dryer System Double Duct Burners

Pollutant	VOC	Emission Factor[9]	Units	RTO Burners Potential Emissions		Double Duct Burners Potential Emissions[3,4]	
				(lb/hr)	(tpy)	(lb/hr)	(tpy)
Propane Combustion							
Benzene	Y	7.10E-04	lb/MMBtu	0.011	0.050	7.10E-05	3.11E-05
Formaldehyde	Y	1.51E-03	lb/MMBtu	0.024	0.11	1.51E-04	6.61E-05
PAHs	N	4.00E-05	lb/MMBtu	6.40E-04	0.0028	8.00E-05	7.01E-04
Total HAP Emissions (Propane Combustion)[9]				**0.036**	**0.16**	**3.02E-04**	**7.98E-04**

Notes:

1. Emission factor derived based on stack testing data from comparable Enviva facilities.
2. Emission factors for wood combustion in a stoker boiler from AP-42 Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
3. A control efficiency of 95% for the RTOs is applied to all organic HAP for those emission factors that are not derived from Enviva stack test data.
4. A 95% control efficiency for the wet electrostatic precipitator (WESP) is applied to all metal HAP.
5. The WESP will employ a caustic solution in its operation in which hydrochloric acid will have high water solubility. This caustic solution will neutralize the acid and effectively control it by 90%, per conversation on October 18, 2011 with Steven A. Jaasund, P.E. of Lundberg Associates, a manufacturer of WESPs.
6. Emissions from the Green Hammermills will be routed through the Dryer Line 1 WESP and RTO. If Dryer Line 1 is not operational, the Green Hammermill exhaust will be routed to the WESP/RTO on Dryer Line 2. For purposes of potential emissions, emissions from the Green Hammermills are shown under Dryer Line 1 (AA-007) only to avoid double-counting.
7. Emission factors for natural gas combustion from AP-42 Section 1.4 - Natural Gas Combustion, 07/98. Natural gas heating value of 1,020 Btu/scf assumed per AP-42.
8. The RTO burners and burners for the dryer system double ducts will fire natural gas with propane as a back-up; however, propane is worst-case for HAP emissions.
9. Emission factors for propane combustion from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.

Abbreviations:

CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
GHM - Green Hammermill
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

References:

AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03
AP-42, Section 1.4 - Natural Gas Combustion, 07/98
South Coast Air Quality Management District. AER Reporting tool. Emission factors available in the Help and Support Manual at: http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting

Table 10b
Potential Emissions - Dryer 1 Bypass (Full Capacity)[1]
AA-008
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput	42 ODT/hr
Hourly Heat Input Capacity	168 MMBtu/hr
Annual Heat Input Capacity	8,400 MMBtu/yr
Hours of Operation[1]	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions - Dryer Bypass Full Capacity

Pollutant	Controlled Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	21.4	lb/hr[2]	21.4	0.54
NO_x	26.3	lb/hr[2]	26.3	0.66
SO_2	0.025	lb/MMBtu[3]	4.20	0.11
VOC	14.0	lb/hr[2]	14.0	0.35
$PM/PM_{10}/PM_{2.5}$ Condensable	0.017	lb/MMBtu[4]	2.86	0.071
$PM/PM_{10}/PM_{2.5}$ Filterable	0.33	lb/MMBtu[5]	55.4	1.39
Total $PM/PM_{10}/PM_{2.5}$			58.3	1.46
CO_2	93.8	kg/MMBtu[6]	34,741	869
CH_4	0.0072	kg/MMBtu[6]	2.67	0.067
N_2O	0.0036	kg/MMBtu[6]	1.33	0.033
CO_2e			35,205	880

Notes:

1. During startup and shutdown (for temperature control) or malfunction, emissions will be vented out either the dryer bypass stacks or the furnace bypass stacks. Use of each bypass stack at full capacity will not exceed 50 hours per 12-month rolling period for each dryer line.
2. CO, NO_x, and VOC emission rates based on vendor data.
3. No emission factor is provided in AP-42, Section 10.6.2 for SO_2 for rotary dryers. Enviva has conservatively calculated SO_2 emissions based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
4. Emission factor for condensable PM based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
5. Uncontrolled filterable PM emission factor is based on testing at a comparable Enviva facility.
6. Emission factors for biomass combustion (dryer) from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.

Table 10b
Potential Emissions - Dryer 1 Bypass (Full Capacity)[1]
AA-008
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions - Dryer Bypass Full Capacity

Pollutant	Emission Factor	Units	Footnote	Potential Emissions[1]	
				(lb/hr)	(tpy)
Acetaldehyde	0.10	lb/ODT	2	4.10	0.10
Acrolein	0.049	lb/ODT	2	2.04	0.051
Formaldehyde	0.057	lb/ODT	2	2.39	0.060
Methanol	0.085	lb/ODT	2	3.56	0.089
Phenol	0.077	lb/ODT	2	3.23	0.081
Propionaldehyde	0.028	lb/ODT	2	1.16	0.029
Acetophenone	3.20E-09	lb/MMBtu	3	5.38E-07	1.34E-08
Antimony and compounds	7.90E-06	lb/MMBtu	3	1.33E-03	3.32E-05
Arsenic and compounds	2.20E-05	lb/MMBtu	3	3.70E-03	9.24E-05
Benzo(a)pyrene	2.60E-06	lb/MMBtu	3	4.37E-04	1.09E-05
Beryllium metal	1.10E-06	lb/MMBtu	3	1.85E-04	4.62E-06
Cadmium metal	4.10E-06	lb/MMBtu	3	6.89E-04	1.72E-05
Carbon tetrachloride	4.50E-05	lb/MMBtu	3	7.56E-03	1.89E-04
Chlorine	7.90E-04	lb/MMBtu	3	0.13	0.0033
Chlorobenzene	3.30E-05	lb/MMBtu	3	5.54E-03	1.39E-04
Chromium–Other compounds	1.75E-05	lb/MMBtu	3	2.94E-03	7.35E-05
Cobalt compounds	6.50E-06	lb/MMBtu	3	1.09E-03	2.73E-05
Dinitrophenol, 2,4-	1.80E-07	lb/MMBtu	3	3.02E-05	7.56E-07
Di(2-ethylhexyl)phthalate	4.70E-08	lb/MMBtu	3	7.90E-06	1.97E-07
Ethyl benzene	3.10E-05	lb/MMBtu	3	5.21E-03	1.30E-04
Dichloroethane, 1,2-	2.90E-05	lb/MMBtu	3	4.87E-03	1.22E-04
Hydrochloric acid	1.90E-02	lb/MMBtu	3	3.19	0.080
Lead and lead compounds	4.80E-05	lb/MMBtu	3	8.06E-03	2.02E-04
Manganese and compounds	1.60E-03	lb/MMBtu	3	0.27	0.0067
Mercury	3.50E-06	lb/MMBtu	3	5.88E-04	1.47E-05
Methyl bromide	1.50E-05	lb/MMBtu	3	2.52E-03	6.30E-05
Methyl chloride	2.30E-05	lb/MMBtu	3	3.86E-03	9.66E-05
Trichloroethane, 1,1,1-	3.10E-05	lb/MMBtu	3	5.21E-03	1.30E-04
Naphthalene	9.70E-05	lb/MMBtu	3	0.016	4.07E-04
Nickel metal	3.30E-05	lb/MMBtu	3	5.54E-03	1.39E-04
Nitrophenol, 4-	1.10E-07	lb/MMBtu	3	1.85E-05	4.62E-07
Pentachlorophenol	5.10E-08	lb/MMBtu	3	8.57E-06	2.14E-07
Perchloroethylene	3.80E-05	lb/MMBtu	3	6.38E-03	1.60E-04
Phosphorus metal, yellow or white	2.70E-05	lb/MMBtu	3	4.54E-03	1.13E-04
Polychlorinated biphenyls	8.15E-09	lb/MMBtu	3	1.37E-06	3.42E-08
Total PAH (POM)	1.25E-04	lb/MMBtu	3	0.021	5.25E-04
Dichloropropane, 1,2-	3.30E-05	lb/MMBtu	3	5.54E-03	1.39E-04
Selenium compounds	2.80E-06	lb/MMBtu	3	4.70E-04	1.18E-05
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.60E-12	lb/MMBtu	3	1.44E-09	3.61E-11
Trichloroethylene	3.00E-05	lb/MMBtu	3	5.04E-03	1.26E-04
Trichlorophenol, 2,4,6-	2.20E-08	lb/MMBtu	3	3.70E-06	9.24E-08
Vinyl chloride	1.80E-05	lb/MMBtu	3	3.02E-03	7.56E-05
			Total HAP Emissions	**20.2**	**0.50**

Notes:

1. During dryer bypass emissions are not controlled by the WESP and RTO; however, combustion in the furnace still results in a reduction in organic HAP emission rates.
2. Organic HAP emissions rates were derived based on stack testing data from Cottondale and other similar Enviva plants.
3. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Table 10b
Potential Emissions - Dryer 1 Bypass (Full Capacity)[1]
AA-008
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Abbreviations:

CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

Reference:

AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 10c
Potential Emissions - Furnace 1 Bypass (Full Capacity)[1]
AA-009
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput	42 ODT/hr
Hourly Heat Input Capacity	168 MMBtu/hr
Annual Heat Input Capacity	8,400 MMBtu/yr
Hours of Operation[1]	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions - Furnace Bypass Full Capacity

Pollutant	Controlled Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	0.60	lb/MMBtu[2]	101	2.52
NO_x	0.22	lb/MMBtu[2]	37.0	0.92
SO_2	0.025	lb/MMBtu[2]	4.20	0.11
VOC	0.017	lb/MMBtu[2]	2.86	0.071
Total $PM/PM_{10}/PM_{2.5}$	0.56	lb/MMBtu[3]	94.1	2.35
CO_2	93.8	lb/MMBtu[4]	34,741	869
CH_4	0.0072	lb/MMBtu[4]	2.67	0.067
N_2O	0.0036	lb/MMBtu[4]	1.33	0.033
CO_2e			35,205	880

Notes:

1. During startup and shutdown (for temperature control) or malfunction, emissions will be vented out either the dryer bypass stacks or the furnace bypass stacks. Use of each bypass stack at full capacity will not exceed 50 hours per 12-month rolling period for each dryer line.
2. CO, NO_x, SO_2, and VOC emission rates based on AP-42, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. VOC emission factor excludes formaldehyde.
3. Emission factor based on vendor data.
4. Emission factors for biomass combustion from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.

Table 10c
Potential Emissions - Furnace 1 Bypass (Full Capacity)[1]
AA-009
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions - Furnace Bypass Full Capacity

Pollutant	Emission Factor[1]	Units	Potential Emissions	
			(lb/hr)	(tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	1.39E-01	3.49E-03
Acrolein	4.00E-03	lb/MMBtu	6.72E-01	1.68E-02
Formaldehyde	4.40E-03	lb/MMBtu	7.39E-01	1.85E-02
Phenol	5.10E-05	lb/MMBtu	8.57E-03	2.14E-04
Propionaldehyde	6.10E-05	lb/MMBtu	1.02E-02	2.56E-04
Acetophenone	3.20E-09	lb/MMBtu	5.38E-07	1.34E-08
Antimony and compounds	7.90E-06	lb/MMBtu	1.33E-03	3.32E-05
Arsenic and compounds	2.20E-05	lb/MMBtu	3.70E-03	9.24E-05
Benzo(a)pyrene	2.60E-06	lb/MMBtu	4.37E-04	1.09E-05
Beryllium metal	1.10E-06	lb/MMBtu	1.85E-04	4.62E-06
Cadmium metal	4.10E-06	lb/MMBtu	6.89E-04	1.72E-05
Carbon tetrachloride	4.50E-05	lb/MMBtu	7.56E-03	1.89E-04
Chlorine	7.90E-04	lb/MMBtu	1.33E-01	3.32E-03
Chlorobenzene	3.30E-05	lb/MMBtu	5.54E-03	1.39E-04
Chromium-Other compounds	1.75E-05	lb/MMBtu	2.94E-03	7.35E-05
Cobalt compounds	6.50E-06	lb/MMBtu	1.09E-03	2.73E-05
Dinitrophenol, 2,4-	1.80E-07	lb/MMBtu	3.02E-05	7.56E-07
Di(2-ethylhexyl)phthalate	4.70E-08	lb/MMBtu	7.90E-06	1.97E-07
Ethyl benzene	3.10E-05	lb/MMBtu	5.21E-03	1.30E-04
Dichloroethane, 1,2-	2.90E-05	lb/MMBtu	4.87E-03	1.22E-04
Hydrochloric acid	1.90E-02	lb/MMBtu	3.19E+00	7.98E-02
Lead and lead compounds	4.80E-05	lb/MMBtu	8.06E-03	2.02E-04
Manganese and compounds	1.60E-03	lb/MMBtu	2.69E-01	6.72E-03
Mercury	3.50E-06	lb/MMBtu	5.88E-04	1.47E-05
Methyl bromide	1.50E-05	lb/MMBtu	2.52E-03	6.30E-05
Methyl chloride	2.30E-05	lb/MMBtu	3.86E-03	9.66E-05
Trichloroethane, 1,1,1-	3.10E-05	lb/MMBtu	5.21E-03	1.30E-04
Naphthalene	9.70E-05	lb/MMBtu	1.63E-02	4.07E-04
Nickel metal	3.30E-05	lb/MMBtu	5.54E-03	1.39E-04
Nitrophenol, 4-	1.10E-07	lb/MMBtu	1.85E-05	4.62E-07
Pentachlorophenol	5.10E-08	lb/MMBtu	8.57E-06	2.14E-07
Perchloroethylene	3.80E-05	lb/MMBtu	6.38E-03	1.60E-04
Phosphorus metal, yellow or white	2.70E-05	lb/MMBtu	4.54E-03	1.13E-04
Polychlorinated biphenyls	8.15E-09	lb/MMBtu	1.37E-06	3.42E-08
Total PAH (POM)	1.25E-04	lb/MMBtu	2.10E-02	5.25E-04
Dichloropropane, 1,2-	3.30E-05	lb/MMBtu	5.54E-03	1.39E-04
Selenium compounds	2.80E-06	lb/MMBtu	4.70E-04	1.18E-05
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.60E-12	lb/MMBtu	1.44E-09	3.61E-11
Trichloroethylene	3.00E-05	lb/MMBtu	5.04E-03	1.26E-04
Trichlorophenol, 2,4,6-	2.20E-08	lb/MMBtu	3.70E-06	9.24E-08
Vinyl chloride	1.80E-05	lb/MMBtu	3.02E-03	7.56E-05
Total HAP Emissions (Biomass Combustion)			**5.28**	**0.13**

Notes:
[1] Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
lb - pound
MMBtu - Million British thermal units
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:
AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 10d
Potential Emissions - Furnace 1 Bypass (Idle Mode)[1]
AA-009
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput	42 ODT/hr
Hourly Heat Input Capacity	5 MMBtu/hr
Annual Heat Input Capacity	2,500 MMBtu/yr
Hours of Operation[1]	500 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions - Furnace Bypass "Idle Mode"

Pollutant	Controlled Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	0.60	lb/MMBtu[2]	3.00	0.75
NO_x	0.22	lb/MMBtu[2]	1.10	0.28
SO_2	0.025	lb/MMBtu[2]	0.13	0.031
VOC	0.017	lb/MMBtu[2]	0.085	0.021
Total PM	0.56	lb/MMBtu[3]	2.80	0.70
Total PM_{10}	0.52	lb/MMBtu[2]	2.59	0.65
Total $PM_{2.5}$	0.45	lb/MMBtu[2]	2.24	0.56
CO_2	93.8	kg/MMBtu[4]	1,034	258
CH_4	0.0072	kg/MMBtu[4]	0.079	0.020
N_2O	0.0036	kg/MMBtu[4]	0.040	0.010
CO_2e			1,048	262

Notes:

1. Idle mode is defined as operation at up to a maximum heat input rate of 5 MMBtu/hr.
2. CO, NO_x, SO_2, PM_{10}, $PM_{2.5}$, and VOC emission rates based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. PM_{10} and $PM_{2.5}$ factors equal to the sum of the filterable and condensable factors from Table 1.6-1. VOC emission factor excludes formaldehyde.
3. Emission factor based on vendor data.
4. Emission factors for biomass combustion from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.

Table 10d
Potential Emissions - Furnace 1 Bypass (Idle Mode)[1]
AA-009
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions - Furnace Bypass "Idle Mode"

Pollutant	Emission Factor[1]	Units	Potential Emissions	
			(lb/hr)	(tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	4.15E-03	1.04E-03
Acrolein	4.00E-03	lb/MMBtu	2.00E-02	5.00E-03
Formaldehyde	4.40E-03	lb/MMBtu	2.20E-02	5.50E-03
Phenol	5.10E-05	lb/MMBtu	2.55E-04	6.38E-05
Propionaldehyde	6.10E-05	lb/MMBtu	3.05E-04	7.63E-05
Acetophenone	3.2E-09	lb/MMBtu	1.60E-08	4.00E-09
Antimony and compounds	7.9E-06	lb/MMBtu	3.95E-05	9.88E-06
Arsenic and compounds	2.2E-05	lb/MMBtu	1.10E-04	2.75E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	1.30E-05	3.25E-06
Beryllium metal	1.1E-06	lb/MMBtu	5.50E-06	1.38E-06
Cadmium metal	4.1E-06	lb/MMBtu	2.05E-05	5.13E-06
Carbon tetrachloride	4.5E-05	lb/MMBtu	2.25E-04	5.63E-05
Chlorine	7.9E-04	lb/MMBtu	3.95E-03	9.88E-04
Chlorobenzene	3.3E-05	lb/MMBtu	1.65E-04	4.13E-05
Chromium-Other compounds	2.1E-05	lb/MMBtu	1.05E-04	2.63E-05
Cobalt compounds	6.5E-06	lb/MMBtu	3.25E-05	8.13E-06
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	9.00E-07	2.25E-07
Di(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	2.35E-07	5.88E-08
Ethyl benzene	3.1E-05	lb/MMBtu	1.55E-04	3.88E-05
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	1.45E-04	3.63E-05
Hydrochloric acid	1.9E-02	lb/MMBtu	9.50E-02	2.38E-02
Lead and lead compounds	4.8E-05	lb/MMBtu	2.40E-04	6.00E-05
Manganese and compounds	1.6E-03	lb/MMBtu	8.00E-03	2.00E-03
Mercury	3.5E-06	lb/MMBtu	1.75E-05	4.38E-06
Methyl bromide	1.5E-05	lb/MMBtu	7.50E-05	1.88E-05
Methyl chloride	2.3E-05	lb/MMBtu	1.15E-04	2.88E-05
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	1.55E-04	3.88E-05
Naphthalene	9.7E-05	lb/MMBtu	4.85E-04	1.21E-04
Nickel metal	3.3E-05	lb/MMBtu	1.65E-04	4.13E-05
Nitrophenol, 4-	1.1E-07	lb/MMBtu	5.50E-07	1.38E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	2.55E-07	6.38E-08
Perchloroethylene	3.8E-05	lb/MMBtu	1.90E-04	4.75E-05
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	1.35E-04	3.38E-05
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	4.08E-08	1.02E-08
Total PAH (POM)	1.3E-04	lb/MMBtu	6.25E-04	1.56E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	1.65E-04	4.13E-05
Selenium compounds	2.8E-06	lb/MMBtu	1.40E-05	3.50E-06
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	4.30E-11	1.08E-11
Trichloroethylene	3.0E-05	lb/MMBtu	1.50E-04	3.75E-05
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	1.10E-07	2.75E-08
Vinyl chloride	1.8E-05	lb/MMBtu	9.00E-05	2.25E-05
Total HAP Emissions (Biomass Combustion)			**0.16**	**0.039**

Notes:
1. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:
AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 11a
Potential Emissions at Outlet of Dryer Line 2 RTO Stack[1]
AA-010
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput (per line)	42	ODT/hr
Annual Throughput (per line)	367,920	ODT/yr
Hourly Heat Input Capacity (per furnace)	168	MMBtu/hr
Annual Heat Input Capacity (per furnace)	1,471,680	MMBtu/yr
Hours of Operation	8,760	hr/yr
Number of RTO Burners (per RTO)	2	burners
RTO Burner Rating	8	MMBtu/hr
Dryer Double Duct System - Num. of Burners[2]	2	burners
Double Duct System Burner Rating[2]	1	MMBtu/hr
Propane Heating Value[3]	91.5	MMBtu/Mgal
Natural Gas Heating Value[4]	1,020	Btu/scf
Hourly Fuel Consumption (total)[5]	0.022	Mgal/hr propane
	0.0020	MMscf/hr natural gas
RTO Control Efficiency[6]	95%	

Potential Criteria Pollutant and Greenhouse Gas Emissions

Pollutant	Controlled Emission Factor	Units	Potential Emissions from Dryer[7]	
			(lb/hr)	(tpy)
CO	14.2	lb/hr[8]	14.2	62.2
NO_X	17.0	lb/hr[9]	17.0	74.5
SO_2	0.025	lb/MMBtu[10]	4.20	18.4
VOC as Propane	8.75	lb/hr[8]	8.75	38.3
$PM/PM_{10}/PM_{2.5}$ (Filterable)	4.69	lb/hr[11]	4.69	20.5
$PM/PM_{10}/PM_{2.5}$ (Condensable)	0.017	lb/MMBtu[12]	2.86	12.5
$PM/PM_{10}/PM_{2.5}$ (Condensable - Nat. Gas)	0.00056	lb/MMBtu[13]	0.0089	0.039
CO_2	780	lb/ODT[14]	32,760	143,489

Notes:

1. Emissions from the Green Hammermills will be routed through the Dryer Line 1 WESP and RTO. If Dryer Line 1 is not operational, the Green Hammermill exhaust will be routed to the WESP/RTO on Dryer Line 2. For purposes of potential emissions, emissions from the Green Hammermills are shown under Dryer Line 1 (AA-007) only to avoid double-counting emissions.
2. Each dryer system will include two (2) ducts (i.e., double ducts) that will each be heated by a 1 MMBtu/hr burner. There will be a total of six (6) burners, two (2) per dryer line. The burners will fire natural gas, with propane as a back-up, and will be low-NO_x burners.
3. Propane heat content from AP-42 Section 1.5 - Liquefied Petroleum Gas Production, 7/08.
4. Natural gas heating value from AP-42 Section 1.4 - Natural Gas Combustion, 07/98.
5. Total hourly fuel consumption for both burners. The burners will fire natural gas, with propane as a back-up.
6. Control efficiency based on RTO vendor guarantee.
7. Exhaust from the dryers are routed to a WESP and then RTO for control of VOC, HAP, and particulates. Each of the three (3) dryer lines will have a dedicated WESP and RTO. Emissions for Dryer Lines 1 and 3 are calculated separately.
8. CO and VOC emission rates based on vendor data.
9. NO_x emission factor based on stack testing at similar Enviva plants.
10. No emission factor is provided in AP-42, Section 10.6.2 for SO_2 for rotary dryers. Enviva has conservatively calculated SO_2 emissions based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
11. Filterable particulate emission rate based on RTO vendor data.
12. Condensable particulate emission factor for biomass combustion obtained from AP-42 Section 1.6.
13. Natural gas combustion by the RTO burners will also result in emissions of condensable PM. Emission factor obtained from AP-42, Section 1.4 - Natural Gas Combustion, 07/98.
14. Emission factor for CO_2 from AP-42, Section 10.6.1 for rotary dryer with RTO control device. Enviva has conservatively calculated the CO_2 emissions using the hardwood emission factor because the dryers at the Lucedale plant will use a combination of hardwood and softwood and the hardwood emission factor is greater than the softwood emission factor.

Table 11a
Potential Emissions at Outlet of Dryer Line 2 RTO Stack[1]
AA-010
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential Criteria Pollutant and Greenhouse Gas Emissions - Dryer System Double Duct Burners[1]

Pollutant	Natural Gas Emission Factor[2,3] (lb/MMscf)	Potential Emissions - Natural Gas Combustion		Propane Emission Factor[4,5,6] (lb/Mgal)	Potential Emissions - Propane Combustion	
		(lb/hr)	(tpy)		(lb/hr)	(tpy)
CO	84.0	0.16	0.72	7.50	0.16	0.72
NO_x	50.0	0.10	0.43	6.50	0.14	0.62
SO_2	0.60	0.0012	0.0052	0.054	0.0012	0.0052
VOC	5.50	5.39E-04	0.0024	1.00	0.0011	0.0048
$PM/PM_{10}/PM_{2.5}$ Condensable	5.70	5.59E-04	0.0024	0.50	5.46E-04	0.0024
$PM/PM_{10}/PM_{2.5}$ Filterable	1.90	1.86E-04	8.16E-04	0.20	2.19E-04	0.0010
Total $PM/PM_{10}/PM_{2.5}$	--	7.45E-04	0.0033	--	7.65E-04	0.0034
CO_2	120,000	235	1,031	12,500	273	1,197
CH_4	2.30	0.0045	0.020	0.20	0.0044	0.019
N_2O^2	0.64	0.0013	0.0055	0.90	0.020	0.0862
CO_2e	--	236	1,033	--	279	1,223

Notes:

1. Two (2) low-NOx burners will be used to heat the dryer system ducts to prevent condensation of wood tar from occurring and thus reduce the fire risk. The burners will combust natural gas. Emissions from the burners will be routed to the WESP and RTO on each dryer line; therefore, a 95% control efficiency was applied to VOC and $PM/PM_{10}/PM_{2.5}$.
2. Emission factors for natural gas combustion from AP-42 Section 1.4 - Natural Gas Combustion, 07/98. Natural gas heating value of 1,020 Btu/scf assumed per AP-42.
3. Emission factors for NO_x and N_2O assume burners are low NO_x burners, per email from Kai Simonsen (Enviva) on August 8, 2018.
4. Emission factors for propane combustion obtained from AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08.
5. AP-42 Section 1.5 does not include an emission factor for low NO_x burners. Per AP-42 Section 1.4, low NO_x burners reduce NO_x emissions by accomplishing combustion in stages, reducing NO_x emissions 40 to 85% relative to uncontrolled emission levels. A conservative control efficiency of 50% was applied to the uncontrolled NO_x emission factor from AP-42 Section 1.5. This reduction is consistent with the magnitude of reduction between the uncontrolled and low NO_x emission factors in AP-42 Section 1.4.
6. SO_2 emissions are based on an assumed fuel sulfur content of 0.54 grains/100 ft^3 per *A National Methodology and Emission Inventory for Residential Fuel Combustion*.

Table 11a
Potential Emissions at Outlet of Dryer Line 2 RTO Stack[1]
AA-010
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions

Pollutant	VOC	Emission Factor	Units	Footnote	Potential Emissions	
					(lb/hr)	(tpy)
Furnace - Biomass Combustion						
Acetaldehyde	Y	4.88E-03	lb/ODT	1	0.20	0.90
Acrolein	Y	2.43E-03	lb/ODT	1	0.10	0.45
Formaldehyde	Y	2.84E-03	lb/ODT	1	0.12	0.52
Methanol	Y	4.24E-03	lb/ODT	1	0.18	0.78
Phenol	Y	3.84E-03	lb/ODT	1	0.16	0.71
Propionaldehyde	Y	1.39E-03	lb/ODT	1	0.058	0.26
Acetophenone	Y	3.20E-09	lb/MMBtu	1	2.69E-08	1.18E-07
Antimony and compounds	N	7.90E-06	lb/MMBtu	2,4	6.64E-05	2.91E-04
Arsenic and compounds	N	2.20E-05	lb/MMBtu	2,4	1.85E-04	8.09E-04
Benzene	Y	4.20E-03	lb/MMBtu	2,3	0.035	0.15
Benzo(a)pyrene	Y	2.60E-06	lb/MMBtu	2,3	2.18E-05	9.57E-05
Beryllium metal	N	1.10E-06	lb/MMBtu	2,4	9.24E-06	4.05E-05
Cadmium metal	N	4.10E-06	lb/MMBtu	2,4	3.44E-05	1.51E-04
Carbon tetrachloride	Y	4.50E-05	lb/MMBtu	2,3	3.78E-04	1.66E-03
Chlorine	N	7.90E-04	lb/MMBtu	2	0.13	0.58
Chlorobenzene	Y	3.30E-05	lb/MMBtu	2,3	2.77E-04	1.21E-03
Chloroform	Y	2.80E-05	lb/MMBtu	2,3	2.35E-04	1.03E-03
Chromium-Other compounds	N	1.75E-05	lb/MMBtu	2,4	1.47E-04	6.44E-04
Cobalt compounds	N	6.50E-06	lb/MMBtu	2,4	5.46E-05	2.39E-04
Dichloroethane, 1,2-	Y	2.90E-05	lb/MMBtu	2,3	2.44E-04	1.07E-03
Dichloropropane, 1,2-	Y	3.30E-05	lb/MMBtu	2,3	2.77E-04	1.21E-03
Dinitrophenol, 2,4-	Y	1.80E-07	lb/MMBtu	2,3	1.51E-06	6.62E-06
Di(2-ethylhexyl)phthalate	Y	4.70E-08	lb/MMBtu	2,3	3.95E-07	1.73E-06
Ethyl benzene	Y	3.10E-05	lb/MMBtu	2,3	2.60E-04	1.14E-03
Hydrochloric acid	N	1.90E-02	lb/MMBtu	2,5	0.32	1.40
Lead and lead compounds	N	4.80E-05	lb/MMBtu	2,4	4.03E-04	1.77E-03
Manganese and compounds	N	1.60E-03	lb/MMBtu	2,4	0.013	0.059
Mercury	N	3.50E-06	lb/MMBtu	2,4	2.94E-05	1.29E-04
Methyl bromide	Y	1.50E-05	lb/MMBtu	2,3	1.26E-04	5.52E-04
Methyl chloride	Y	2.30E-05	lb/MMBtu	2,3	1.93E-04	8.46E-04
Methylene chloride	Y	2.90E-04	lb/MMBtu	2,3	0.0024	0.011
Naphthalene	Y	9.70E-05	lb/MMBtu	2,3	8.15E-04	0.0036
Nickel metal	N	3.30E-05	lb/MMBtu	2,4	2.77E-04	1.21E-03
Nitrophenol, 4-	Y	1.10E-07	lb/MMBtu	2,3	9.24E-07	4.05E-06
Pentachlorophenol	N	5.10E-08	lb/MMBtu	2	8.57E-06	3.75E-05
Perchloroethylene	N	3.80E-05	lb/MMBtu	2	0.0064	0.028
Phosphorus metal, yellow or white	N	2.70E-05	lb/MMBtu	2,4	2.27E-04	9.93E-04
Polychlorinated biphenyls	Y	8.15E-09	lb/MMBtu	2,3	6.85E-08	3.00E-07
Polycyclic Organic Matter	N	1.25E-04	lb/MMBtu	2	0.021	0.092
Selenium compounds	N	2.80E-06	lb/MMBtu	2,4	2.35E-05	1.03E-04
Styrene	Y	1.90E-03	lb/MMBtu	2,3	0.016	0.070
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	8.60E-12	lb/MMBtu	2,3	7.22E-11	3.16E-10
Toluene	Y	3.00E-05	lb/MMBtu	2,3	2.52E-04	1.10E-03
Trichloroethane, 1,1,1-	N	3.10E-05	lb/MMBtu	2	5.21E-03	2.28E-02
Trichloroethylene	Y	3.00E-05	lb/MMBtu	2,3	2.52E-04	1.10E-03
Trichlorophenol, 2,4,6-	Y	2.20E-08	lb/MMBtu	2,3	1.85E-07	8.09E-07
Vinyl chloride	Y	1.80E-05	lb/MMBtu	2,3	1.51E-04	6.62E-04
Xylene	Y	2.50E-05	lb/MMBtu	2,3	2.10E-04	9.20E-04
Total HAP Emissions (biomass combustion)					**1.38**	**6.05**

Table 11a
Potential Emissions at Outlet of Dryer Line 2 RTO Stack[1]
AA-010
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions

Pollutant	VOC	Emission Factor[6]	Units	RTO Burners Potential Emissions		Double Duct Burners Potential Emissions[3,4]	
				(lb/hr)	(tpy)	(lb/hr)	(tpy)
RTO Burners and Dryer System Double Duct Burners - Natural Gas Combustion							
2-Methylnaphthalene	Y	2.40E-05	lb/MMscf	3.76E-07	1.65E-06	2.35E-09	1.03E-08
3-Methylchloranthrene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
7,12-Dimethylbenz(a)anthracene	Y	1.60E-05	lb/MMscf	2.51E-07	1.10E-06	1.57E-09	6.87E-09
Acenaphthene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Acenaphthylene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Anthracene	Y	2.40E-06	lb/MMscf	3.76E-08	1.65E-07	2.35E-10	1.03E-09
Arsenic and compounds	N	2.00E-04	lb/MMscf	3.14E-06	1.37E-05	1.96E-08	8.59E-08
Benz(a)anthracene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Benzene	Y	2.10E-03	lb/MMscf	3.29E-05	1.44E-04	2.06E-07	9.02E-07
Benzo(a)pyrene	Y	1.20E-06	lb/MMscf	1.88E-08	8.24E-08	1.18E-10	5.15E-10
Benzo(b)fluoranthene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Benzo(g,h,i)perylene	Y	1.20E-06	lb/MMscf	1.88E-08	8.24E-08	1.18E-10	5.15E-10
Benzo(k)fluoranthene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Beryllium metal	N	1.20E-05	lb/MMscf	1.88E-07	8.24E-07	1.18E-09	5.15E-09
Cadmium metal	N	1.10E-03	lb/MMscf	1.73E-05	7.56E-05	1.08E-07	4.72E-07
Chromium VI	N	1.40E-03	lb/MMscf	2.20E-05	9.62E-05	1.37E-07	6.01E-07
Chrysene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Cobalt compounds	N	8.40E-05	lb/MMscf	1.32E-06	5.77E-06	8.24E-09	3.61E-08
Dibenzo(a,h)anthracene	Y	1.20E-06	lb/MMscf	1.88E-08	8.24E-08	1.18E-10	5.15E-10
Dichlorobenzene	Y	1.20E-03	lb/MMscf	1.88E-05	8.24E-05	1.18E-07	5.15E-07
Fluoranthene	Y	3.00E-06	lb/MMscf	4.71E-08	2.06E-07	2.94E-10	1.29E-09
Fluorene	Y	2.80E-06	lb/MMscf	4.39E-08	1.92E-07	2.75E-10	1.20E-09
Formaldehyde	Y	0.075	lb/MMscf	0.0012	0.0052	7.35E-06	3.22E-05
Hexane	Y	1.80	lb/MMscf	0.028	0.12	1.76E-04	7.73E-04
Indeno(1,2,3-cd)pyrene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Lead and lead compounds	N	5.00E-04	lb/MMscf	7.84E-06	3.44E-05	4.90E-08	2.15E-07
Manganese and compounds	N	3.80E-04	lb/MMscf	5.96E-06	2.61E-05	3.73E-08	1.63E-07
Mercury	N	2.60E-04	lb/MMscf	4.08E-06	1.79E-05	2.55E-08	1.12E-07
Naphthalene	Y	6.10E-04	lb/MMscf	9.57E-06	4.19E-05	5.98E-08	2.62E-07
Nickel metal	N	2.10E-03	lb/MMscf	3.29E-05	1.44E-04	2.06E-07	9.02E-07
Phenanthrene	Y	1.70E-05	lb/MMscf	2.67E-07	1.17E-06	1.67E-09	7.30E-09
Pyrene	Y	5.00E-06	lb/MMscf	7.84E-08	3.44E-07	4.90E-10	2.15E-09
Selenium compounds	N	2.40E-05	lb/MMscf	3.76E-07	1.65E-06	2.35E-09	1.03E-08
Toluene	Y	3.40E-03	lb/MMscf	5.33E-05	2.34E-04	3.33E-07	1.46E-06
Total HAP Emissions (Natural Gas Combustion)[7]				**0.030**	**0.13**	**1.85E-04**	**8.10E-04**

Table 11a
Potential Emissions at Outlet of Dryer Line 2 RTO Stack[1]
AA-010
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions

Pollutant	VOC	Emission Factor[8]	Units	RTO Burners Potential Emissions		Double Duct Burners Potential Emissions[3,4]	
				(lb/hr)	(tpy)	(lb/hr)	(tpy)
RTO Burners - Propane Combustion							
Benzene	Y	7.10E-04	lb/MMBtu	0.011	0.050	7.10E-05	3.11E-05
Formaldehyde	Y	1.51E-03	lb/MMBtu	0.024	0.11	1.51E-04	6.61E-05
PAHs	N	4.00E-05	lb/MMBtu	6.40E-04	0.0028	8.00E-05	7.01E-04
Total HAP Emissions (Propane Combustion)[7]				**0.036**	**0.16**	**3.02E-04**	**7.98E-04**

Notes:

1. Emission factor derived based on stack testing data from comparable Enviva facilities.
2. Emission factors for wood combustion in a stoker boiler from AP-42 Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
3. A control efficiency of 95% for the RTOs is applied to all organic HAP for those emission factors that are not derived from Enviva stack test data.
4. A 95% control efficiency for the wet electrostatic precipitator (WESP) is applied to all metal HAP.
5. The WESP will employ a caustic solution in its operation in which hydrochloric acid will have high water solubility. This caustic solution will neutralize the acid and effectively control it by 90%, per conversation on October 18, 2011 with Steven A. Jaasund, P.E. of Lundberg Associates, a manufacturer of WESPs.
6. Emission factors for natural gas combustion from AP-42 Section 1.4 - Natural Gas Combustion, 07/98. Natural gas heating value of 1,020 Btu/scf assumed per AP-42.
7. The RTO burners and burners for the dryer system double ducts will fire natural gas with propane as a back-up; however, propane is worst-case for HAP emissions.
8. Emission factors for propane combustion from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.

Abbreviations:

CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

References:

AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03
AP-42, Section 1.4 - Natural Gas Combustion, 07/98
South Coast Air Quality Management District. AER Reporting tool. Emission factors available in the Help and Support Manual at: http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting

Table 11b
Potential Emissions - Dryer 2 Bypass (Full Capacity)[1]
AA-011
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput	42 ODT/hr
Hourly Heat Input Capacity	168 MMBtu/hr
Annual Heat Input Capacity	8,400 MMBtu/yr
Hours of Operation[1]	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions - Dryer Bypass Full Capacity

Pollutant	Controlled Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	21.4	lb/hr[2]	21.4	0.54
NO_X	26.3	lb/hr[2]	26.3	0.66
SO_2	0.025	lb/MMBtu[3]	4.20	0.11
VOC	14.0	lb/hr[2]	14.0	0.35
$PM/PM_{10}/PM_{2.5}$ Condensable	0.017	lb/MMBtu[4]	2.86	0.071
$PM/PM_{10}/PM_{2.5}$ Filterable	0.33	lb/MMBtu[5]	55.4	1.39
Total $PM/PM_{10}/PM_{2.5}$			58.3	1.46
CO_2	93.8	kg/MMBtu[6]	34,741	869
CH_4	0.0072	kg/MMBtu[6]	2.67	0.067
N_2O	0.0036	kg/MMBtu[6]	1.33	0.033
CO_2e			35,205	880

Notes:

1. During startup and shutdown (for temperature control) or malfunction, emissions will be vented out either the dryer bypass stacks or the furnace bypass stacks. Use of each bypass stack at full capacity will not exceed 50 hours per 12-month rolling period for each dryer line.
2. CO, NOX, and VOC emission rates based on vendor data.
3. No emission factor is provided in AP-42, Section 10.6.2 for SO_2 for rotary dryers. Enviva has conservatively calculated SO_2 emissions based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
4. Emission factor for condensable PM based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
5. Uncontrolled filterable PM emission factor is based on testing at a comparable Enviva facility.
6. Emission factors for biomass combustion (dryer) from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.

Table 11b
Potential Emissions - Dryer 2 Bypass (Full Capacity)[1]
AA-011
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions - Dryer Bypass Full Capacity

Pollutant	Emission Factor	Units	Footnote	Potential Emissions[1]	
				(lb/hr)	(tpy)
Acetaldehyde	0.10	lb/ODT	2	4.10	0.10
Acrolein	0.049	lb/ODT	2	2.04	0.051
Formaldehyde	0.057	lb/ODT	2	2.39	0.060
Methanol	0.085	lb/ODT	2	3.56	0.089
Phenol	0.077	lb/ODT	2	3.23	0.081
Propionaldehyde	0.028	lb/ODT	2	1.16	0.029
Acetophenone	3.20E-09	lb/MMBtu	3	5.38E-07	1.34E-08
Antimony and compounds	7.90E-06	lb/MMBtu	3	1.33E-03	3.32E-05
Arsenic and compounds	2.20E-05	lb/MMBtu	3	3.70E-03	9.24E-05
Benzo(a)pyrene	2.60E-06	lb/MMBtu	3	4.37E-04	1.09E-05
Beryllium metal	1.10E-06	lb/MMBtu	3	1.85E-04	4.62E-06
Cadmium metal	4.10E-06	lb/MMBtu	3	6.89E-04	1.72E-05
Carbon tetrachloride	4.50E-05	lb/MMBtu	3	7.56E-03	1.89E-04
Chlorine	7.90E-04	lb/MMBtu	3	0.13	0.0033
Chlorobenzene	3.30E-05	lb/MMBtu	3	5.54E-03	1.39E-04
Chromium-Other compounds	1.75E-05	lb/MMBtu	3	2.94E-03	7.35E-05
Cobalt compounds	6.50E-06	lb/MMBtu	3	1.09E-03	2.73E-05
Dinitrophenol, 2,4-	1.80E-07	lb/MMBtu	3	3.02E-05	7.56E-07
Di(2-ethylhexyl)phthalate	4.70E-08	lb/MMBtu	3	7.90E-06	1.97E-07
Ethyl benzene	3.10E-05	lb/MMBtu	3	5.21E-03	1.30E-04
Dichloroethane, 1,2-	2.90E-05	lb/MMBtu	3	4.87E-03	1.22E-04
Hydrochloric acid	1.90E-02	lb/MMBtu	3	3.19	0.080
Lead and lead compounds	4.80E-05	lb/MMBtu	3	8.06E-03	2.02E-04
Manganese and compounds	1.60E-03	lb/MMBtu	3	0.27	6.72E-03
Mercury	3.50E-06	lb/MMBtu	3	5.88E-04	1.47E-05
Methyl bromide	1.50E-05	lb/MMBtu	3	2.52E-03	6.30E-05
Methyl chloride	2.30E-05	lb/MMBtu	3	3.86E-03	9.66E-05
Trichloroethane, 1,1,1-	3.10E-05	lb/MMBtu	3	5.21E-03	1.30E-04
Naphthalene	9.70E-05	lb/MMBtu	3	0.016	4.07E-04
Nickel metal	3.30E-05	lb/MMBtu	3	5.54E-03	1.39E-04
Nitrophenol, 4-	1.10E-07	lb/MMBtu	3	1.85E-05	4.62E-07
Pentachlorophenol	5.10E-08	lb/MMBtu	3	8.57E-06	2.14E-07
Perchloroethylene	3.80E-05	lb/MMBtu	3	6.38E-03	1.60E-04
Phosphorus metal, yellow or white	2.70E-05	lb/MMBtu	3	4.54E-03	1.13E-04
Polychlorinated biphenyls	8.15E-09	lb/MMBtu	3	1.37E-06	3.42E-08
Total PAH (POM)	1.25E-04	lb/MMBtu	3	0.021	5.25E-04
Dichloropropane, 1,2-	3.30E-05	lb/MMBtu	3	5.54E-03	1.39E-04
Selenium compounds	2.80E-06	lb/MMBtu	3	4.70E-04	1.18E-05
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.60E-12	lb/MMBtu	3	1.44E-09	3.61E-11
Trichloroethylene	3.00E-05	lb/MMBtu	3	5.04E-03	1.26E-04
Trichlorophenol, 2,4,6-	2.20E-08	lb/MMBtu	3	3.70E-06	9.24E-08
Vinyl chloride	1.80E-05	lb/MMBtu	3	3.02E-03	7.56E-05
			Total HAP Emissions	**20.2**	**0.50**

Notes:

1. During dryer bypass emissions are not controlled by the WESP and RTO; however, combustion in the furnace still results in a reduction in organic HAP emission rates.
2. Organic HAP emissions rates were derived based on stack testing data from Cottondale and other similar Enviva plants.
3. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Table 11b
Potential Emissions - Dryer 2 Bypass (Full Capacity)[1]
AA-011
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Abbreviations:

CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

Reference:

AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 11c
Potential Emissions - Furnace 2 Bypass (Full Capacity)[1]
AA-012
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput	42 ODT/hr
Hourly Heat Input Capacity	168 MMBtu/hr
Annual Heat Input Capacity	8,400 MMBtu/yr
Hours of Operation[1]	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions - Furnace Bypass Full Capacity

Pollutant	Controlled Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	0.60	lb/MMBtu[2]	101	2.52
NO_x	0.22	lb/MMBtu[2]	37.0	0.92
SO_2	0.025	lb/MMBtu[2]	4.20	0.11
VOC	0.017	lb/MMBtu[2]	2.86	0.071
Total $PM/PM_{10}/PM_{2.5}$	0.56	lb/MMBtu[3]	94.1	2.35
CO_2	93.8	lb/MMBtu[4]	34,741	869
CH_4	0.0072	lb/MMBtu[4]	2.67	0.067
N_2O	0.0036	lb/MMBtu[4]	1.33	0.033
CO_2e			35,205	880

Notes:

1. During startup and shutdown (for temperature control) or malfunction, emissions will be vented out either the dryer bypass stacks or the furnace bypass stacks. Use of each bypass stack at full capacity will not exceed 50 hours per 12-month rolling period for each dryer line.
2. CO, NO_x, SO_2, and VOC emission rates based on AP-42, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. VOC emission factor excludes formaldehyde.
3. Emission factor based on vendor data.
4. Emission factors for biomass combustion from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.

Table 11c
Potential Emissions - Furnace 2 Bypass (Full Capacity)[1]
AA-012
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions - Furnace Bypass Full Capacity

Pollutant	Emission Factor[1]	Units	Potential Emissions	
			(lb/hr)	(tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	1.39E-01	3.49E-03
Acrolein	4.00E-03	lb/MMBtu	6.72E-01	1.68E-02
Formaldehyde	4.40E-03	lb/MMBtu	7.39E-01	1.85E-02
Phenol	5.10E-05	lb/MMBtu	8.57E-03	2.14E-04
Propionaldehyde	6.10E-05	lb/MMBtu	1.02E-02	2.56E-04
Acetophenone	3.20E-09	lb/MMBtu	5.38E-07	1.34E-08
Antimony and compounds	7.90E-06	lb/MMBtu	1.33E-03	3.32E-05
Arsenic and compounds	2.20E-05	lb/MMBtu	3.70E-03	9.24E-05
Benzo(a)pyrene	2.60E-06	lb/MMBtu	4.37E-04	1.09E-05
Beryllium metal	1.10E-06	lb/MMBtu	1.85E-04	4.62E-06
Cadmium metal	4.10E-06	lb/MMBtu	6.89E-04	1.72E-05
Carbon tetrachloride	4.50E-05	lb/MMBtu	7.56E-03	1.89E-04
Chlorine	7.90E-04	lb/MMBtu	1.33E-01	3.32E-03
Chlorobenzene	3.30E-05	lb/MMBtu	5.54E-03	1.39E-04
Chromium-Other compounds	1.75E-05	lb/MMBtu	2.94E-03	7.35E-05
Cobalt compounds	6.50E-06	lb/MMBtu	1.09E-03	2.73E-05
Dinitrophenol, 2,4-	1.80E-07	lb/MMBtu	3.02E-05	7.56E-07
Di(2-ethylhexyl)phthalate	4.70E-08	lb/MMBtu	7.90E-06	1.97E-07
Ethyl benzene	3.10E-05	lb/MMBtu	5.21E-03	1.30E-04
Dichloroethane, 1,2-	2.90E-05	lb/MMBtu	4.87E-03	1.22E-04
Hydrochloric acid	1.90E-02	lb/MMBtu	3.19E+00	7.98E-02
Lead and lead compounds	4.80E-05	lb/MMBtu	8.06E-03	2.02E-04
Manganese and compounds	1.60E-03	lb/MMBtu	2.69E-01	6.72E-03
Mercury	3.50E-06	lb/MMBtu	5.88E-04	1.47E-05
Methyl bromide	1.50E-05	lb/MMBtu	2.52E-03	6.30E-05
Methyl chloride	2.30E-05	lb/MMBtu	3.86E-03	9.66E-05
Trichloroethane, 1,1,1-	3.10E-05	lb/MMBtu	5.21E-03	1.30E-04
Naphthalene	9.70E-05	lb/MMBtu	1.63E-02	4.07E-04
Nickel metal	3.30E-05	lb/MMBtu	5.54E-03	1.39E-04
Nitrophenol, 4-	1.10E-07	lb/MMBtu	1.85E-05	4.62E-07
Pentachlorophenol	5.10E-08	lb/MMBtu	8.57E-06	2.14E-07
Perchloroethylene	3.80E-05	lb/MMBtu	6.38E-03	1.60E-04
Phosphorus metal, yellow or white	2.70E-05	lb/MMBtu	4.54E-03	1.13E-04
Polychlorinated biphenyls	8.15E-09	lb/MMBtu	1.37E-06	3.42E-08
Total PAH (POM)	1.25E-04	lb/MMBtu	2.10E-02	5.25E-04
Dichloropropane, 1,2-	3.30E-05	lb/MMBtu	5.54E-03	1.39E-04
Selenium compounds	2.80E-06	lb/MMBtu	4.70E-04	1.18E-05
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.60E-12	lb/MMBtu	1.44E-09	3.61E-11
Trichloroethylene	3.00E-05	lb/MMBtu	5.04E-03	1.26E-04
Trichlorophenol, 2,4,6-	2.20E-08	lb/MMBtu	3.70E-06	9.24E-08
Vinyl chloride	1.80E-05	lb/MMBtu	3.02E-03	7.56E-05
Total HAP Emissions (Biomass Combustion)			**5.28**	**0.13**

Notes:
[1] Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
lb - pound
MMBtu - Million British thermal units
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:
AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 11d
Potential Emissions - Furnace 2 Bypass (Idle Mode)[1]
AA-012
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput	42 ODT/hr
Hourly Heat Input Capacity	5 MMBtu/hr
Annual Heat Input Capacity	2,500 MMBtu/yr
Hours of Operation[1]	500 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions - Furnace Bypass "Idle Mode"

Pollutant	Controlled Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	0.60	lb/MMBtu[2]	3.00	0.75
NO_X	0.22	lb/MMBtu[2]	1.10	0.28
SO_2	0.025	lb/MMBtu[2]	0.13	0.031
VOC	0.017	lb/MMBtu[2]	0.085	0.021
Total PM	0.56	lb/MMBtu[3]	2.80	0.70
Total PM_{10}	0.52	lb/MMBtu[2]	2.59	0.65
Total $PM_{2.5}$	0.45	lb/MMBtu[2]	2.24	0.56
CO_2	93.8	kg/MMBtu[4]	1,034	258
CH_4	0.0072	kg/MMBtu[4]	0.079	0.020
N_2O	0.0036	kg/MMBtu[4]	0.040	0.010
CO_2e			1,048	262

Notes:

1. Idle mode is defined as operation at up to a maximum heat input rate of 5 MMBtu/hr.
2. CO, NO_X, SO_2, PM_{10}, $PM_{2.5}$, and VOC emission rates based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. PM_{10} and $PM_{2.5}$ factors equal to the sum of the filterable and condensable factors from Table 1.6-1. VOC emission factor excludes formaldehyde.
3. Emission factor based on vendor data.
4. Emission factors for biomass combustion from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.

Table 11d
Potential Emissions - Furnace 2 Bypass (Idle Mode)[1]
AA-012
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions - Furnace Bypass "Idle Mode"

Pollutant	Emission Factor[1]	Units	Potential Emissions	
			(lb/hr)	(tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	4.15E-03	1.04E-03
Acrolein	4.00E-03	lb/MMBtu	2.00E-02	5.00E-03
Formaldehyde	4.40E-03	lb/MMBtu	2.20E-02	5.50E-03
Phenol	5.10E-05	lb/MMBtu	2.55E-04	6.38E-05
Propionaldehyde	6.10E-05	lb/MMBtu	3.05E-04	7.63E-05
Acetophenone	3.20E-09	lb/MMBtu	1.60E-08	4.00E-09
Antimony and compounds	7.90E-06	lb/MMBtu	3.95E-05	9.88E-06
Arsenic and compounds	2.20E-05	lb/MMBtu	1.10E-04	2.75E-05
Benzo(a)pyrene	2.60E-06	lb/MMBtu	1.30E-05	3.25E-06
Beryllium metal	1.10E-06	lb/MMBtu	5.50E-06	1.38E-06
Cadmium metal	4.10E-06	lb/MMBtu	2.05E-05	5.13E-06
Carbon tetrachloride	4.50E-05	lb/MMBtu	2.25E-04	5.63E-05
Chlorine	7.90E-04	lb/MMBtu	3.95E-03	9.88E-04
Chlorobenzene	3.30E-05	lb/MMBtu	1.65E-04	4.13E-05
Chromium-Other compounds	2.10E-05	lb/MMBtu	1.05E-04	2.63E-05
Cobalt compounds	6.50E-06	lb/MMBtu	3.25E-05	8.13E-06
Dinitrophenol, 2,4-	1.80E-07	lb/MMBtu	9.00E-07	2.25E-07
Di(2-ethylhexyl)phthalate	4.70E-08	lb/MMBtu	2.35E-07	5.88E-08
Ethyl benzene	3.10E-05	lb/MMBtu	1.55E-04	3.88E-05
Dichloroethane, 1,2-	2.90E-05	lb/MMBtu	1.45E-04	3.63E-05
Hydrochloric acid	1.90E-02	lb/MMBtu	9.50E-02	2.38E-02
Lead and lead compounds	4.80E-05	lb/MMBtu	2.40E-04	6.00E-05
Manganese and compounds	1.60E-03	lb/MMBtu	8.00E-03	2.00E-03
Mercury	3.50E-06	lb/MMBtu	1.75E-05	4.38E-06
Methyl bromide	1.50E-05	lb/MMBtu	7.50E-05	1.88E-05
Methyl chloride	2.30E-05	lb/MMBtu	1.15E-04	2.88E-05
Trichloroethane, 1,1,1-	3.10E-05	lb/MMBtu	1.55E-04	3.88E-05
Naphthalene	9.70E-05	lb/MMBtu	4.85E-04	1.21E-04
Nickel metal	3.30E-05	lb/MMBtu	1.65E-04	4.13E-05
Nitrophenol, 4-	1.10E-07	lb/MMBtu	5.50E-07	1.38E-07
Pentachlorophenol	5.10E-08	lb/MMBtu	2.55E-07	6.38E-08
Perchloroethylene	3.80E-05	lb/MMBtu	1.90E-04	4.75E-05
Phosphorus metal, yellow or white	2.70E-05	lb/MMBtu	1.35E-04	3.38E-05
Polychlorinated biphenyls	8.15E-09	lb/MMBtu	4.08E-08	1.02E-08
Total PAH (POM)	1.25E-04	lb/MMBtu	6.25E-04	1.56E-04
Dichloropropane, 1,2-	3.30E-05	lb/MMBtu	1.65E-04	4.13E-05
Selenium compounds	2.80E-06	lb/MMBtu	1.40E-05	3.50E-06
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.60E-12	lb/MMBtu	4.30E-11	1.08E-11
Trichloroethylene	3.00E-05	lb/MMBtu	1.50E-04	3.75E-05
Trichlorophenol, 2,4,6-	2.20E-08	lb/MMBtu	1.10E-07	2.75E-08
Vinyl chloride	1.80E-05	lb/MMBtu	9.00E-05	2.25E-05
Total HAP Emissions (Biomass Combustion)			**0.16**	**0.039**

Notes:
1. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:
AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 12a
Potential Emissions at Outlet of Dryer Line 3 RTO Stack
AA-013
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput (per line)	42	ODT/hr
Annual Throughput (per line)	367,920	ODT/yr
Hourly Heat Input Capacity (per furnace)	168	MMBtu/hr
Annual Heat Input Capacity (per furnace)	1,471,680	MMBtu/yr
Hours of Operation	8,760	hr/yr
Number of RTO Burners (per RTO)	2	burners
RTO Burner Rating	8	MMBtu/hr
Dryer Double Duct System - Num. of Burners[1]	2	burners
Double Duct System Burner Rating[1]	1	MMBtu/hr
Propane Heating Value[2]	91.5	MMBtu/Mgal
Natural Gas Heating Value[3]	1,020	Btu/scf
Hourly Fuel Consumption (total)[4]	0.022	Mgal/hr propane
	0.0020	MMscf/hr natural gas
RTO Control Efficiency[5]	95%	

Potential Criteria Pollutant and Greenhouse Gas Emissions

Pollutant	Controlled Emission Factor	Units	Potential Emissions from Dryer[6]	
			(lb/hr)	(tpy)
CO	14.2	lb/hr[7]	14.2	62.2
NO_x	17.0	lb/hr[8]	17.0	74.5
SO_2	0.025	lb/MMBtu[9]	4.20	18.4
VOC as Propane	8.75	lb/hr[7]	8.75	38.3
$PM/PM_{10}/PM_{2.5}$ (Filterable)	4.69	lb/hr[10]	4.69	20.5
$PM/PM_{10}/PM_{2.5}$ (Condensable)	0.017	lb/MMBtu[11]	2.86	12.5
$PM/PM_{10}/PM_{2.5}$ (Condensable - Nat. Gas)	0.00056	lb/MMBtu[12]	0.0089	0.039
CO_2	780	lb/ODT[13]	32,760	143,489

Notes:

1. Each dryer system will include two (2) ducts (i.e., double ducts) that will each be heated by a 1 MMBtu/hr burner. There will be a total of six (6) burners, two (2) per dryer line. The burners will fire natural gas, with propane as a back-up, and will be low-NO_x burners.
2. Propane heat content from AP-42 Section 1.5 - Liquefied Petroleum Gas Production, 7/08.
3. Natural gas heating value from AP-42 Section 1.4 - Natural Gas Combustion, 07/98.
4. Total hourly fuel consumption for both burners. The burners will fire natural gas, with propane as a back-up.
5. Control efficiency based on RTO vendor guarantee.
6. Exhaust from the dryers are routed to a WESP and then RTO for control of VOC, HAP, and particulates. Each of the three (3) dryer lines will have a dedicated WESP and RTO. Emissions for Dryer Lines 1 and 2 are calculated separately.
7. CO and VOC emission rates based on vendor data.
8. NO_x emission factor based on stack testing at similar Enviva plants.
9. No emission factor is provided in AP-42, Section 10.6.2 for SO_2 for rotary dryers. Enviva has conservatively calculated SO_2 emissions based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
10. Filterable particulate emission rate based on RTO vendor data.
11. Condensable particulate emission factor for biomass combustion obtained from AP-42 Section 1.6.
12. Natural gas combustion by the RTO burners will also result in emissions of condensable PM. Emission factor obtained from AP-42, Section 1.4 - Natural Gas Combustion, 07/98.
13. Emission factor for CO_2 from AP-42, Section 10.6.1 for rotary dryer with RTO control device. Enviva has conservatively calculated the CO_2 emissions using the hardwood emission factor because the dryers at the Lucedale plant will use a combination of hardwood and softwood and the hardwood emission factor is greater than the softwood emission factor.

Table 12a
Potential Emissions at Outlet of Dryer Line 3 RTO Stack
AA-013
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential Criteria Pollutant and Greenhouse Gas Emissions - Dryer System Double Duct Burners[1]

Pollutant	Natural Gas Emission Factor[2,3] (lb/MMscf)	Potential Emissions - Natural Gas Combustion		Propane Emission Factor[4,5,6] (lb/Mgal)	Potential Emissions - Propane Combustion	
		(lb/hr)	(tpy)		(lb/hr)	(tpy)
CO	84.0	0.16	0.72	7.50	0.16	0.72
NO_X	50.0	0.10	0.43	6.50	0.14	0.62
SO_2	0.60	0.0012	0.0052	0.054	0.0012	0.0052
VOC	5.50	5.39E-04	0.0024	1.00	0.0011	0.0048
$PM/PM_{10}/PM_{2.5}$ Condensable	5.70	5.59E-04	0.0024	0.50	5.46E-04	0.0024
$PM/PM_{10}/PM_{2.5}$ Filterable	1.90	1.86E-04	0.0008	0.20	2.19E-04	0.0010
Total $PM/PM_{10}/PM_{2.5}$	--	7.45E-04	0.0033	--	7.65E-04	0.0034
CO_2	120,000	235	1,031	12,500	273	1,197
CH_4	2.30	0.0045	0.020	0.20	0.0044	0.019
N_2O^2	0.64	0.0013	0.0055	0.90	0.020	0.0862
CO_2e	--	236	1,033	--	279	1,223

Notes:

1. Two (2) low-NOx burners will be used to heat the dryer system ducts to prevent condensation of wood tar from occurring and thus reduce the fire risk. The burners will combust natural gas. Emissions from the burners will be routed to the WESP and RTO on each dryer line; therefore, a 95% control efficiency was applied to VOC and $PM/PM_{10}/PM_{2.5}$.
2. Emission factors for natural gas combustion from AP-42 Section 1.4 - Natural Gas Combustion, 07/98. Natural gas heating value of 1,020 Btu/scf assumed per AP-42.
3. Emission factors for NO_X and N_2O assume burners are low NO_X burners, per email from Kai Simonsen (Enviva) on August 8, 2018.
4. Emission factors for propane combustion obtained from AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08.
5. AP-42 Section 1.5 does not include an emission factor for low NO_X burners. Per AP-42 Section 1.4, low NO_X burners reduce NO_X emissions by accomplishing combustion in stages, reducing NO_X emissions 40 to 85% relative to uncontrolled emission levels. A conservative control efficiency of 50% was applied to the uncontrolled NO_X emission factor from AP-42 Section 1.5. This reduction is consistent with the magnitude of reduction between the uncontrolled and low NO_X emission factors in AP-42 Section 1.4.
6. SO_2 emissions are based on an assumed fuel sulfur content of 0.54 grains/100 ft^3 per *A National Methodology and Emission Inventory for Residential Fuel Combustion*.

Table 12a
Potential Emissions at Outlet of Dryer Line 3 RTO Stack
AA-013
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions

Pollutant	VOC	Emission Factor	Units	Footnote	Potential Emissions	
					(lb/hr)	(tpy)
Furnace - Biomass Combustion						
Acetaldehyde	Y	4.88E-03	lb/ODT	1	0.20	0.90
Acrolein	Y	2.43E-03	lb/ODT	1	0.10	0.45
Formaldehyde	Y	2.84E-03	lb/ODT	1	0.12	0.52
Methanol	Y	4.24E-03	lb/ODT	1	0.18	0.78
Phenol	Y	3.84E-03	lb/ODT	1	0.16	0.71
Propionaldehyde	Y	1.39E-03	lb/ODT	1	0.058	0.26
Acetophenone	Y	3.20E-09	lb/MMBtu	1	2.69E-08	1.18E-07
Antimony and compounds	N	7.90E-06	lb/MMBtu	2,4	6.64E-05	2.91E-04
Arsenic and compounds	N	2.20E-05	lb/MMBtu	2,4	1.85E-04	8.09E-04
Benzene	Y	4.20E-03	lb/MMBtu	2,3	0.035	0.15
Benzo(a)pyrene	Y	2.60E-06	lb/MMBtu	2,3	2.18E-05	9.57E-05
Beryllium metal	N	1.10E-06	lb/MMBtu	2,4	9.24E-06	4.05E-05
Cadmium metal	N	4.10E-06	lb/MMBtu	2,4	3.44E-05	1.51E-04
Carbon tetrachloride	Y	4.50E-05	lb/MMBtu	2,3	3.78E-04	1.66E-03
Chlorine	N	7.90E-04	lb/MMBtu	2	0.13	0.58
Chlorobenzene	Y	3.30E-05	lb/MMBtu	2,3	2.77E-04	1.21E-03
Chloroform	Y	2.80E-05	lb/MMBtu	2,3	2.35E-04	1.03E-03
Chromium-Other compounds	N	1.75E-05	lb/MMBtu	2,4	1.47E-04	6.44E-04
Cobalt compounds	N	6.50E-06	lb/MMBtu	2,4	5.46E-05	2.39E-04
Dichloroethane, 1,2-	Y	2.90E-05	lb/MMBtu	2,3	2.44E-04	1.07E-03
Dichloropropane, 1,2-	Y	3.30E-05	lb/MMBtu	2,3	2.77E-04	1.21E-03
Dinitrophenol, 2,4-	Y	1.80E-07	lb/MMBtu	2,3	1.51E-06	6.62E-06
Di(2-ethylhexyl)phthalate	Y	4.70E-08	lb/MMBtu	2,3	3.95E-07	1.73E-06
Ethyl benzene	Y	3.10E-05	lb/MMBtu	2,3	2.60E-04	1.14E-03
Hydrochloric acid	N	1.90E-02	lb/MMBtu	2,5	0.32	1.40
Lead and lead compounds	N	4.80E-05	lb/MMBtu	2,4	4.03E-04	1.77E-03
Manganese and compounds	N	1.60E-03	lb/MMBtu	2,4	0.013	0.059
Mercury	N	3.50E-06	lb/MMBtu	2,4	2.94E-05	1.29E-04
Methyl bromide	Y	1.50E-05	lb/MMBtu	2,3	1.26E-04	5.52E-04
Methyl chloride	Y	2.30E-05	lb/MMBtu	2,3	1.93E-04	8.46E-04
Methylene chloride	Y	2.90E-04	lb/MMBtu	2,3	0.0024	0.011
Naphthalene	Y	9.70E-05	lb/MMBtu	2,3	8.15E-04	0.0036
Nickel metal	N	3.30E-05	lb/MMBtu	2,4	2.77E-04	1.21E-03
Nitrophenol, 4-	Y	1.10E-07	lb/MMBtu	2,3	9.24E-07	4.05E-06
Pentachlorophenol	N	5.10E-08	lb/MMBtu	2	8.57E-06	3.75E-05
Perchloroethylene	N	3.80E-05	lb/MMBtu	2	0.0064	0.028
Phosphorus metal, yellow or white	N	2.70E-05	lb/MMBtu	2,4	2.27E-04	9.93E-04
Polychlorinated biphenyls	Y	8.15E-09	lb/MMBtu	2,3	6.85E-08	3.00E-07
Polycyclic Organic Matter	N	1.25E-04	lb/MMBtu	2	0.021	0.092
Selenium compounds	N	2.80E-06	lb/MMBtu	2,4	2.35E-05	1.03E-04
Styrene	Y	1.90E-03	lb/MMBtu	2,3	0.016	0.070
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	8.60E-12	lb/MMBtu	2,3	7.22E-11	3.16E-10
Toluene	Y	3.00E-05	lb/MMBtu	2,3	2.52E-04	1.10E-03
Trichloroethane, 1,1,1-	N	3.10E-05	lb/MMBtu	2	5.21E-03	0.023
Trichloroethylene	Y	3.00E-05	lb/MMBtu	2,3	2.52E-04	1.10E-03
Trichlorophenol, 2,4,6-	Y	2.20E-08	lb/MMBtu	2,3	1.85E-07	8.09E-07
Vinyl chloride	Y	1.80E-05	lb/MMBtu	2,3	1.51E-04	6.62E-04
Xylene	Y	2.50E-05	lb/MMBtu	2,3	2.10E-04	9.20E-04
Total HAP Emissions (biomass combustion)					**1.38**	**6.05**

Table 12a
Potential Emissions at Outlet of Dryer Line 3 RTO Stack
AA-013
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions

Pollutant	VOC	Emission Factor[6]	Units	RTO Burners Potential Emissions		Double Duct Burners Potential Emissions[3,4]	
				(lb/hr)	(tpy)	(lb/hr)	(tpy)
RTO Burners and Dryer System Double Duct Burners - Natural Gas Combustion							
2-Methylnaphthalene	Y	2.40E-05	lb/MMscf	3.76E-07	1.65E-06	2.35E-09	1.03E-08
3-Methylchloranthrene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
7,12-Dimethylbenz(a)anthracene	Y	1.60E-05	lb/MMscf	2.51E-07	1.10E-06	1.57E-09	6.87E-09
Acenaphthene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Acenaphthylene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Anthracene	Y	2.40E-06	lb/MMscf	3.76E-08	1.65E-07	2.35E-10	1.03E-09
Arsenic and compounds	N	2.00E-04	lb/MMscf	3.14E-06	1.37E-05	1.96E-08	8.59E-08
Benz(a)anthracene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Benzene	Y	2.10E-03	lb/MMscf	3.29E-05	1.44E-04	2.06E-07	9.02E-07
Benzo(a)pyrene	Y	1.20E-06	lb/MMscf	1.88E-08	8.24E-08	1.18E-10	5.15E-10
Benzo(b)fluoranthene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Benzo(g,h,i)perylene	Y	1.20E-06	lb/MMscf	1.88E-08	8.24E-08	1.18E-10	5.15E-10
Benzo(k)fluoranthene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Beryllium metal	N	1.20E-05	lb/MMscf	1.88E-07	8.24E-07	1.18E-09	5.15E-09
Cadmium metal	N	1.10E-03	lb/MMscf	1.73E-05	7.56E-05	1.08E-07	4.72E-07
Chromium VI	N	1.40E-03	lb/MMscf	2.20E-05	9.62E-05	1.37E-07	6.01E-07
Chrysene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Cobalt compounds	N	8.40E-05	lb/MMscf	1.32E-06	5.77E-06	8.24E-09	3.61E-08
Dibenzo(a,h)anthracene	Y	1.20E-06	lb/MMscf	1.88E-08	8.24E-08	1.18E-10	5.15E-10
Dichlorobenzene	Y	1.20E-03	lb/MMscf	1.88E-05	8.24E-05	1.18E-07	5.15E-07
Fluoranthene	Y	3.00E-06	lb/MMscf	4.71E-08	2.06E-07	2.94E-10	1.29E-09
Fluorene	Y	2.80E-06	lb/MMscf	4.39E-08	1.92E-07	2.75E-10	1.20E-09
Formaldehyde	Y	0.075	lb/MMscf	0.0012	0.0052	7.35E-06	3.22E-05
Hexane	Y	1.80	lb/MMscf	0.028	0.12	1.76E-04	7.73E-04
Indeno(1,2,3-cd)pyrene	Y	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	1.76E-10	7.73E-10
Lead and lead compounds	N	5.00E-04	lb/MMscf	7.84E-06	3.44E-05	4.90E-08	2.15E-07
Manganese and compounds	N	3.80E-04	lb/MMscf	5.96E-06	2.61E-05	3.73E-08	1.63E-07
Mercury	N	2.60E-04	lb/MMscf	4.08E-06	1.79E-05	2.55E-08	1.12E-07
Naphthalene	Y	6.10E-04	lb/MMscf	9.57E-06	4.19E-05	5.98E-08	2.62E-07
Nickel metal	N	2.10E-03	lb/MMscf	3.29E-05	1.44E-04	2.06E-07	9.02E-07
Phenanthrene	Y	1.70E-05	lb/MMscf	2.67E-07	1.17E-06	1.67E-09	7.30E-09
Pyrene	Y	5.00E-06	lb/MMscf	7.84E-08	3.44E-07	4.90E-10	2.15E-09
Selenium compounds	N	2.40E-05	lb/MMscf	3.76E-07	1.65E-06	2.35E-09	1.03E-08
Toluene	Y	3.40E-03	lb/MMscf	5.33E-05	2.34E-04	3.33E-07	1.46E-06
Total HAP Emissions (Natural Gas Combustion)[7]				**0.030**	**0.13**	**1.85E-04**	**8.10E-04**

Table 12a
Potential Emissions at Outlet of Dryer Line 3 RTO Stack
AA-013
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions

Pollutant	VOC	Emission Factor[8]	Units	RTO Burners Potential Emissions		Double Duct Burners Potential Emissions[3,4]	
				(lb/hr)	(tpy)	(lb/hr)	(tpy)
RTO Burners - Propane Combustion							
Benzene	Y	7.10E-04	lb/MMBtu	0.011	0.050	7.10E-05	3.11E-05
Formaldehyde	Y	1.51E-03	lb/MMBtu	0.024	0.11	1.51E-04	6.61E-05
PAHs	N	4.00E-05	lb/MMBtu	6.40E-04	0.0028	8.00E-05	7.01E-04
Total HAP Emissions (Propane Combustion)[7]				**0.036**	**0.16**	**3.02E-04**	**7.98E-04**

Notes:

1. Emission factor derived based on stack testing data from comparable Enviva facilities.
2. Emission factors for wood combustion in a stoker boiler from AP-42 Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
3. A control efficiency of 95% for the RTOs is applied to all organic HAP for those emission factors that are not derived from Enviva stack test data.
4. A 95% control efficiency for the wet electrostatic precipitator (WESP) is applied to all metal HAP.
5. The WESP will employ a caustic solution in its operation in which hydrochloric acid will have high water solubility. This caustic solution will neutralize the acid and effectively control it by 90%, per conversation on October 18, 2011 with Steven A. Jaasund, P.E. of Lundberg Associates, a manufacturer of WESPs.
6. Emission factors for natural gas combustion from AP-42 Section 1.4 - Natural Gas Combustion, 07/98. Natural gas heating value of 1,020 Btu/scf assumed per AP-42.
7. The RTO burners and burners for the dryer system double ducts will fire natural gas with propane as a back-up; however, propane is worst-case for HAP emissions.
8. Emission factors for propane combustion from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.

Abbreviations:

CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

References:

AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03
AP-42, Section 1.4 - Natural Gas Combustion, 07/98
South Coast Air Quality Management District. AER Reporting tool. Emission factors available in the Help and Support Manual at: http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting

Table 12b
Potential Emissions - Dryer 3 Bypass (Full Capacity)[1]
AA-014
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput	42 ODT/hr
Hourly Heat Input Capacity	168 MMBtu/hr
Annual Heat Input Capacity	8,400 MMBtu/yr
Hours of Operation[1]	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions - Dryer Bypass Full Capacity

Pollutant	Controlled Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	21.4	lb/hr[2]	21.4	0.54
NO_X	26.3	lb/hr[2]	26.3	0.66
SO_2	0.025	lb/MMBtu[3]	4.20	0.11
VOC	14.0	lb/hr[2]	14.0	0.35
$PM/PM_{10}/PM_{2.5}$ Condensable	0.017	lb/MMBtu[4]	2.86	0.071
$PM/PM_{10}/PM_{2.5}$ Filterable	0.33	lb/MMBtu[5]	55.4	1.39
Total $PM/PM_{10}/PM_{2.5}$			58.3	1.46
CO_2	93.8	kg/MMBtu[6]	34,741	869
CH_4	0.0072	kg/MMBtu[6]	2.67	0.067
N_2O	0.0036	kg/MMBtu[6]	1.33	0.033
CO_2e			35,205	880

Notes:

1. During startup and shutdown (for temperature control) or malfunction, emissions will be vented out either the dryer bypass stacks or the furnace bypass stacks. Use of each bypass stack at full capacity will not exceed 50 hours per 12-month rolling period for each dryer line.
2. CO, NO_X, and VOC emission rates based on vendor data.
3. No emission factor is provided in AP-42, Section 10.6.2 for SO_2 for rotary dryers. Enviva has conservatively calculated SO_2 emissions based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
4. Emission factor for condensable PM based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
5. Uncontrolled filterable PM emission factor is based on testing at a comparable Enviva facility.
6. Emission factors for biomass combustion (dryer) from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.

Table 12b
Potential Emissions - Dryer 3 Bypass (Full Capacity)[1]
AA-014
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions - Dryer Bypass Full Capacity

Pollutant	Emission Factor	Units	Footnote	Potential Emissions[1]	
				(lb/hr)	(tpy)
Acetaldehyde	0.10	lb/ODT	2	4.10	0.10
Acrolein	0.049	lb/ODT	2	2.04	0.051
Formaldehyde	0.057	lb/ODT	2	2.39	0.060
Methanol	0.085	lb/ODT	2	3.56	0.089
Phenol	0.077	lb/ODT	2	3.23	0.081
Propionaldehyde	0.028	lb/ODT	2	1.16	0.029
Acetophenone	3.2E-09	lb/MMBtu	3	5.38E-07	1.34E-08
Antimony and compounds	7.9E-06	lb/MMBtu	3	1.33E-03	3.32E-05
Arsenic and compounds	2.2E-05	lb/MMBtu	3	3.70E-03	9.24E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	3	4.37E-04	1.09E-05
Beryllium metal	1.1E-06	lb/MMBtu	3	1.85E-04	4.62E-06
Cadmium metal	4.1E-06	lb/MMBtu	3	6.89E-04	1.72E-05
Carbon tetrachloride	4.5E-05	lb/MMBtu	3	7.56E-03	1.89E-04
Chlorine	7.9E-04	lb/MMBtu	3	0.13	0.0033
Chlorobenzene	3.3E-05	lb/MMBtu	3	5.54E-03	1.39E-04
Chromium-Other compounds	1.8E-05	lb/MMBtu	3	2.94E-03	7.35E-05
Cobalt compounds	6.5E-06	lb/MMBtu	3	1.09E-03	2.73E-05
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	3	3.02E-05	7.56E-07
Di(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	3	7.90E-06	1.97E-07
Ethyl benzene	3.1E-05	lb/MMBtu	3	5.21E-03	1.30E-04
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	3	4.87E-03	1.22E-04
Hydrochloric acid	1.9E-02	lb/MMBtu	3	3.19	0.080
Lead and lead compounds	4.8E-05	lb/MMBtu	3	8.06E-03	2.02E-04
Manganese and compounds	1.6E-03	lb/MMBtu	3	0.27	0.0067
Mercury	3.5E-06	lb/MMBtu	3	5.88E-04	1.47E-05
Methyl bromide	1.5E-05	lb/MMBtu	3	2.52E-03	6.30E-05
Methyl chloride	2.3E-05	lb/MMBtu	3	3.86E-03	9.66E-05
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	3	5.21E-03	1.30E-04
Naphthalene	9.7E-05	lb/MMBtu	3	0.016	4.07E-04
Nickel metal	3.3E-05	lb/MMBtu	3	5.54E-03	1.39E-04
Nitrophenol, 4-	1.1E-07	lb/MMBtu	3	1.85E-05	4.62E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	3	8.57E-06	2.14E-07
Perchloroethylene	3.8E-05	lb/MMBtu	3	6.38E-03	1.60E-04
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	3	4.54E-03	1.13E-04
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	3	1.37E-06	3.42E-08
Total PAH (POM)	1.3E-04	lb/MMBtu	3	2.10E-02	5.25E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	3	5.54E-03	1.39E-04
Selenium compounds	2.8E-06	lb/MMBtu	3	4.70E-04	1.18E-05
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	3	1.44E-09	3.61E-11
Trichloroethylene	3.0E-05	lb/MMBtu	3	5.04E-03	1.26E-04
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	3	3.70E-06	9.24E-08
Vinyl chloride	1.8E-05	lb/MMBtu	3	3.02E-03	7.56E-05
Total HAP Emissions				**20.2**	**0.50**

Notes:

1. During dryer bypass emissions are not controlled by the WESP and RTO; however, combustion in the furnace still results in a reduction in organic HAP emission rates.
2. Organic HAP emissions rates were derived based on stack testing data from Cottondale and other similar Enviva plants.
3. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Table 12b
Potential Emissions - Dryer 3 Bypass (Full Capacity)[1]
AA-014
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Abbreviations:

CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

Reference:

AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 12c
Potential Emissions - Furnace 3 Bypass (Full Capacity)[1]
AA-015
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput	42 ODT/hr
Hourly Heat Input Capacity	168 MMBtu/hr
Annual Heat Input Capacity	8,400 MMBtu/yr
Hours of Operation[1]	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions - Furnace Bypass Full Capacity

Pollutant	Controlled Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	0.60	lb/MMBtu[2]	100.8	2.52
NO_x	0.22	lb/MMBtu[2]	36.96	0.92
SO_2	0.025	lb/MMBtu[2]	4.20	0.11
VOC	0.017	lb/MMBtu[2]	2.86	0.071
Total $PM/PM_{10}/PM_{2.5}$	0.56	lb/MMBtu[3]	94.1	2.35
CO_2	93.8	lb/MMBtu[4]	34,741	869
CH_4	0.0072	lb/MMBtu[4]	2.67	0.067
N_2O	0.0036	lb/MMBtu[4]	1.33	0.033
CO_2e			35,205	880

Notes:

1. During startup and shutdown (for temperature control) or malfunction, emissions will be vented out either the dryer bypass stacks or the furnace bypass stacks. Use of each bypass stack at full capacity will not exceed 50 hours per 12-month rolling period for each dryer line.
2. CO, NO_x, SO_2, and VOC emission rates based on AP-42, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. VOC emission factor excludes formaldehyde.
3. Emission factor based on vendor data.
4. Emission factors for biomass combustion from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.

Table 12c
Potential Emissions - Furnace 3 Bypass (Full Capacity)[1]
AA-015
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions - Furnace Bypass Full Capacity

Pollutant	Emission Factor[1]	Units	Potential Emissions	
			(lb/hr)	(tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	1.39E-01	3.49E-03
Acrolein	4.00E-03	lb/MMBtu	6.72E-01	1.68E-02
Formaldehyde	4.40E-03	lb/MMBtu	7.39E-01	1.85E-02
Phenol	5.10E-05	lb/MMBtu	8.57E-03	2.14E-04
Propionaldehyde	6.10E-05	lb/MMBtu	1.02E-02	2.56E-04
Acetophenone	3.20E-09	lb/MMBtu	5.38E-07	1.34E-08
Antimony and compounds	7.90E-06	lb/MMBtu	1.33E-03	3.32E-05
Arsenic and compounds	2.20E-05	lb/MMBtu	3.70E-03	9.24E-05
Benzo(a)pyrene	2.60E-06	lb/MMBtu	4.37E-04	1.09E-05
Beryllium metal	1.10E-06	lb/MMBtu	1.85E-04	4.62E-06
Cadmium metal	4.10E-06	lb/MMBtu	6.89E-04	1.72E-05
Carbon tetrachloride	4.50E-05	lb/MMBtu	7.56E-03	1.89E-04
Chlorine	7.90E-04	lb/MMBtu	1.33E-01	3.32E-03
Chlorobenzene	3.30E-05	lb/MMBtu	5.54E-03	1.39E-04
Chromium-Other compounds	1.75E-05	lb/MMBtu	2.94E-03	7.35E-05
Cobalt compounds	6.50E-06	lb/MMBtu	1.09E-03	2.73E-05
Dinitrophenol, 2,4-	1.80E-07	lb/MMBtu	3.02E-05	7.56E-07
Di(2-ethylhexyl)phthalate	4.70E-08	lb/MMBtu	7.90E-06	1.97E-07
Ethyl benzene	3.10E-05	lb/MMBtu	5.21E-03	1.30E-04
Dichloroethane, 1,2-	2.90E-05	lb/MMBtu	4.87E-03	1.22E-04
Hydrochloric acid	1.90E-02	lb/MMBtu	3.19E+00	7.98E-02
Lead and lead compounds	4.80E-05	lb/MMBtu	8.06E-03	2.02E-04
Manganese and compounds	1.60E-03	lb/MMBtu	2.69E-01	6.72E-03
Mercury	3.50E-06	lb/MMBtu	5.88E-04	1.47E-05
Methyl bromide	1.50E-05	lb/MMBtu	2.52E-03	6.30E-05
Methyl chloride	2.30E-05	lb/MMBtu	3.86E-03	9.66E-05
Trichloroethane, 1,1,1-	3.10E-05	lb/MMBtu	5.21E-03	1.30E-04
Naphthalene	9.70E-05	lb/MMBtu	1.63E-02	4.07E-04
Nickel metal	3.30E-05	lb/MMBtu	5.54E-03	1.39E-04
Nitrophenol, 4-	1.10E-07	lb/MMBtu	1.85E-05	4.62E-07
Pentachlorophenol	5.10E-08	lb/MMBtu	8.57E-06	2.14E-07
Perchloroethylene	3.80E-05	lb/MMBtu	6.38E-03	1.60E-04
Phosphorus metal, yellow or white	2.70E-05	lb/MMBtu	4.54E-03	1.13E-04
Polychlorinated biphenyls	8.15E-09	lb/MMBtu	1.37E-06	3.42E-08
Total PAH (POM)	1.25E-04	lb/MMBtu	2.10E-02	5.25E-04
Dichloropropane, 1,2-	3.30E-05	lb/MMBtu	5.54E-03	1.39E-04
Selenium compounds	2.80E-06	lb/MMBtu	4.70E-04	1.18E-05
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.60E-12	lb/MMBtu	1.44E-09	3.61E-11
Trichloroethylene	3.00E-05	lb/MMBtu	5.04E-03	1.26E-04
Trichlorophenol, 2,4,6-	2.20E-08	lb/MMBtu	3.70E-06	9.24E-08
Vinyl chloride	1.80E-05	lb/MMBtu	3.02E-03	7.56E-05
Total HAP Emissions (Biomass Combustion)			**5.28**	**0.13**

Notes:
[1] Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
lb - pound
MMBtu - Million British thermal units
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:
AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 12d
Potential Emissions - Furnace 2 Bypass (Idle Mode)[1]
AA-015
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput	42 ODT/hr
Hourly Heat Input Capacity	5 MMBtu/hr
Annual Heat Input Capacity	2,500 MMBtu/yr
Hours of Operation[1]	500 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions - Furnace Bypass "Idle Mode"

Pollutant	Controlled Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	0.60	lb/MMBtu[2]	3.00	0.75
NO_x	0.22	lb/MMBtu[2]	1.10	0.28
SO_2	0.025	lb/MMBtu[2]	0.13	0.031
VOC	0.017	lb/MMBtu[2]	0.085	0.021
Total PM	0.56	lb/MMBtu[3]	2.80	0.70
Total PM_{10}	0.52	lb/MMBtu[2]	2.59	0.65
Total $PM_{2.5}$	0.45	lb/MMBtu[2]	2.24	0.56
CO_2	93.8	kg/MMBtu[4]	1,034	258
CH_4	0.0072	kg/MMBtu[4]	0.079	0.020
N_2O	0.0036	kg/MMBtu[4]	0.040	0.010
CO_2e			1,048	262

Notes:

1. Idle mode is defined as operation at up to a maximum heat input rate of 5 MMBtu/hr.
2. CO, NO_x, SO_2, PM_{10}, $PM_{2.5}$, and VOC emission rates based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. PM_{10} and $PM_{2.5}$ factors equal to the sum of the filterable and condensable factors from Table 1.6-1. VOC emission factor excludes formaldehyde.
3. Emission factor based on vendor data.
4. Emission factors for biomass combustion from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.

Table 12d
Potential Emissions - Furnace 2 Bypass (Idle Mode)[1]
AA-015
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions - Furnace Bypass "Idle Mode"

Pollutant	Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	4.15E-03	1.04E-03
Acrolein	4.00E-03	lb/MMBtu	2.00E-02	5.00E-03
Formaldehyde	4.40E-03	lb/MMBtu	2.20E-02	5.50E-03
Phenol	5.10E-05	lb/MMBtu	2.55E-04	6.38E-05
Propionaldehyde	6.10E-05	lb/MMBtu	3.05E-04	7.63E-05
Acetophenone	3.20E-09	lb/MMBtu	1.60E-08	4.00E-09
Antimony and compounds	7.90E-06	lb/MMBtu	3.95E-05	9.88E-06
Arsenic and compounds	2.20E-05	lb/MMBtu	1.10E-04	2.75E-05
Benzo(a)pyrene	2.60E-06	lb/MMBtu	1.30E-05	3.25E-06
Beryllium metal	1.10E-06	lb/MMBtu	5.50E-06	1.38E-06
Cadmium metal	4.10E-06	lb/MMBtu	2.05E-05	5.13E-06
Carbon tetrachloride	4.50E-05	lb/MMBtu	2.25E-04	5.63E-05
Chlorine	7.90E-04	lb/MMBtu	3.95E-03	9.88E-04
Chlorobenzene	3.30E-05	lb/MMBtu	1.65E-04	4.13E-05
Chromium-Other compounds	2.10E-05	lb/MMBtu	1.05E-04	2.63E-05
Cobalt compounds	6.50E-06	lb/MMBtu	3.25E-05	8.13E-06
Dinitrophenol, 2,4-	1.80E-07	lb/MMBtu	9.00E-07	2.25E-07
Di(2-ethylhexyl)phthalate	4.70E-08	lb/MMBtu	2.35E-07	5.88E-08
Ethyl benzene	3.10E-05	lb/MMBtu	1.55E-04	3.88E-05
Dichloroethane, 1,2-	2.90E-05	lb/MMBtu	1.45E-04	3.63E-05
Hydrochloric acid	1.90E-02	lb/MMBtu	9.50E-02	2.38E-02
Lead and lead compounds	4.80E-05	lb/MMBtu	2.40E-04	6.00E-05
Manganese and compounds	1.60E-03	lb/MMBtu	8.00E-03	2.00E-03
Mercury	3.50E-06	lb/MMBtu	1.75E-05	4.38E-06
Methyl bromide	1.50E-05	lb/MMBtu	7.50E-05	1.88E-05
Methyl chloride	2.30E-05	lb/MMBtu	1.15E-04	2.88E-05
Trichloroethane, 1,1,1-	3.10E-05	lb/MMBtu	1.55E-04	3.88E-05
Naphthalene	9.70E-05	lb/MMBtu	4.85E-04	1.21E-04
Nickel metal	3.30E-05	lb/MMBtu	1.65E-04	4.13E-05
Nitrophenol, 4-	1.10E-07	lb/MMBtu	5.50E-07	1.38E-07
Pentachlorophenol	5.10E-08	lb/MMBtu	2.55E-07	6.38E-08
Perchloroethylene	3.80E-05	lb/MMBtu	1.90E-04	4.75E-05
Phosphorus metal, yellow or white	2.70E-05	lb/MMBtu	1.35E-04	3.38E-05
Polychlorinated biphenyls	8.15E-09	lb/MMBtu	4.08E-08	1.02E-08
Total PAH (POM)	1.25E-04	lb/MMBtu	6.25E-04	1.56E-04
Dichloropropane, 1,2-	3.30E-05	lb/MMBtu	1.65E-04	4.13E-05
Selenium compounds	2.80E-06	lb/MMBtu	1.40E-05	3.50E-06
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.60E-12	lb/MMBtu	4.30E-11	1.08E-11
Trichloroethylene	3.00E-05	lb/MMBtu	1.50E-04	3.75E-05
Trichlorophenol, 2,4,6-	2.20E-08	lb/MMBtu	1.10E-07	2.75E-08
Vinyl chloride	1.80E-05	lb/MMBtu	9.00E-05	2.25E-05
Total HAP Emissions (Biomass Combustion)			**0.16**	**0.039**

Notes:
1. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:
AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 13
Potential VOC and HAP Emissions at Outlet of RCO-1 Stack
AA-016
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput	108 ODT/hr
Annual Throughput	947,026 ODT/yr
Hours of Operation	8,760 hr/yr
Propane Heating Value[1]	91.5 MMBtu/Mgal
Natural Gas Heating Value[2]	1,020 Btu/scf
Number of Burners	1 burners
RCO Burner Rating	9.8 MMBtu/hr
RCO Control Efficiency[3]	96.3%

Pellet Coolers, Pellet Mills, and Dry Hammermills Potential VOC and HAP Emissions

Pollutant	CAS No.	Controlled Emission Factor[4,5]	Units	Emissions at RCO Outlet[6]	
				(lb/hr)	(tpy)
Acetaldehyde	75-07-0	0.00065	lb/ODT	0.070	0.31
Acrolein	107-02-8	0.0023	lb/ODT	0.24	1.07
Formaldehyde	50-00-0	0.0015	lb/ODT	0.16	0.69
Methanol	67-56-1	0.0092	lb/ODT	1.00	4.37
Phenol	108-95-2	0.0011	lb/ODT	0.12	0.51
Propionaldehyde	123-38-6	0.0011	lb/ODT	0.12	0.52
		Total HAP Emissions		**1.70**	**7.47**
Total VOC as propane	--	7.73	lb/hr	7.73	33.9
$PM/PM_{10}/PM_{2.5}$ (Filterable + Condensable)		2.13	lb/hr	2.13	9.34

Notes:

1. Propane heat content from AP-42 Section 1.5 - Liquefied Petroleum Gas Production, 7/08.
2. Natural gas heating value from AP-42 Section 1.4 - Natural Gas Combustion, 07/98.
3. A 96.3% control efficiency for the RCO is applied to VOC and organic HAP emissions per vendor data provided by Kai Simonsen (Enviva) via email on June 26, 2018.
4. HAP emission factors were derived based on stack testing data from comparable Enviva facilities.
5. VOC emissions (as propane) and PM emissions based on vendor data.
6. Includes emissions at outlet of the RCO-1 (AA-010) stack as well as emissions resulting from combustion of natural gas by the RCO-1 (AA-010) burners. RCO-1 (AA-010) will control emissions from thirty-two (32) dry hammermills, sixteen (16) pellet mills, and eight (8) pellet coolers.

Table 13
Potential VOC and HAP Emissions at Outlet of RCO-1 Stack
AA-016
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Thermally Generated Potential Criteria Pollutant Emissions

Maximum high heating value of VOC constituents	0.018 MMBtu/lb
Uncontrolled VOC emissions	915 tons/yr
Heat input of uncontrolled VOC emissions	33,864 MMBtu/yr

Pollutant	Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	0.082	lb/MMBtu[1]	0.32	1.39
NO_X	0.10	lb/MMBtu[1]	0.38	1.66

Potential Criteria Pollutant and Greenhouse Gas Emissions - RCO Burners

Pollutant	Emission Factor[1]	Units	Potential Emissions	
			(lb/hr)	(tpy)
RCO Burners - Natural Gas Combustion				
CO	0.082	lb/MMBtu	0.81	3.53
NO_X[2]	1.00	lb/hr	1.00	4.38
SO_2	5.88E-04	lb/MMBtu	0.0058	0.025
VOC	5.39E-03	lb/MMBtu	0.053	0.23
$PM/PM_{10}/PM_{2.5}$ Filterable	1.86E-03	lb/MMBtu	0.018	0.080
$PM/PM_{10}/PM_{2.5}$ Condensable	5.59E-03	lb/MMBtu	0.055	0.24
Total $PM/PM_{10}/PM_{2.5}$			0.073	0.32
CO_2	66.9	kg/MMBtu	1,445	6,329
CH_4	1.00E-03	kg/MMBtu	0.022	0.095
N_2O	1.00E-04	kg/MMBtu	0.0022	0.0095
CO_2e			1,446	6,334

Pollutant	Emission Factor[3]	Units	Potential Emissions	
			(lb/hr)	(tpy)
RCO Burners - Propane Combustion				
CO	7.50	lb/Mgal	0.80	3.52
NO_X	6.50	lb/Mgal	0.70	3.05
SO_2[4]	0.054	lb/Mgal	0.0058	0.025
VOC	1.00	lb/Mgal	0.11	0.47
$PM/PM_{10}/PM_{2.5}$ Condensable	0.50	lb/Mgal	0.054	0.23
$PM/PM_{10}/PM_{2.5}$ Filterable	0.20	lb/Mgal	0.021	0.094
Total $PM/PM_{10}/PM_{2.5}$			0.075	0.33
CO_2	12,500	lb/Mgal	1,339	5,864
CH_4	0.20	lb/Mgal	0.021	0.094
N_2O	0.90	lb/Mgal	0.10	0.42
CO_2e			1,339	5,864

Notes:

1. Emission factors from AP-42, Section 1.4 - Natural Gas Combustion, 07/98. Emission factors converted from lb/MMscf to lb/MMBtu based on assumed heating value of 1,020 Btu/scf for natural gas per AP-42 Section 1.4.
2. NO_x emissions from combustion of natural gas by the RCO burners are based on vendor data with additional contingency applied for conservatism.
3. Emission factors for propane combustion obtained from AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08.
4. SO_2 emissions are based on an assumed fuel sulfur content of 0.54 grains/100 ft^3 per *A National Methodology and Emission Inventory for Residential Fuel Combustion*.

Table 13
Potential VOC and HAP Emissions at Outlet of RCO-1 Stack
AA-016
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions - RCO Burners

Pollutant	Emission Factor[1]	Units	Potential Emissions	
			(lb/hr)	(tpy)
RCO Burners - Natural Gas Combustion				
2-Methylnaphthalene	2.40E-05	lb/MMscf	2.31E-07	1.01E-06
3-Methylchloranthrene	1.80E-06	lb/MMscf	1.73E-08	7.57E-08
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	1.54E-07	6.73E-07
Acenaphthene	1.80E-06	lb/MMscf	1.73E-08	7.57E-08
Acenaphthylene	1.80E-06	lb/MMscf	1.73E-08	7.57E-08
Acrolein	1.80E-05	lb/MMscf	1.73E-07	7.57E-07
Anthracene	2.40E-06	lb/MMscf	2.31E-08	1.01E-07
Arsenic	2.00E-04	lb/MMscf	1.92E-06	8.42E-06
Benz(a)anthracene	1.80E-06	lb/MMscf	1.73E-08	7.57E-08
Benzene	2.10E-03	lb/MMscf	2.02E-05	8.84E-05
Benzo(a)pyrene	1.20E-06	lb/MMscf	1.15E-08	5.05E-08
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	1.73E-08	7.57E-08
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	1.15E-08	5.05E-08
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	1.73E-08	7.57E-08
Beryllium	1.20E-05	lb/MMscf	1.15E-07	5.05E-07
Cadmium	1.10E-03	lb/MMscf	1.06E-05	4.63E-05
Chromium VI	1.40E-03	lb/MMscf	1.35E-05	5.89E-05
Chrysene	1.80E-06	lb/MMscf	1.73E-08	7.57E-08
Cobalt	8.40E-05	lb/MMscf	8.07E-07	3.53E-06
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	1.15E-08	5.05E-08
Dichlorobenzene	1.20E-03	lb/MMscf	1.15E-05	5.05E-05
Fluoranthene	3.00E-06	lb/MMscf	2.88E-08	1.26E-07
Fluorene	2.80E-06	lb/MMscf	2.69E-08	1.18E-07
Formaldehyde	7.50E-02	lb/MMscf	7.21E-04	3.16E-03
Hexane	1.8	lb/MMscf	0.017	0.076
Indeno(1,2,3-cd)pyrene	1.80E-06	lb/MMscf	1.73E-08	7.57E-08
Lead	5.00E-04	lb/MMscf	4.80E-06	2.10E-05
Manganese	3.80E-04	lb/MMscf	3.65E-06	1.60E-05
Mercury	2.60E-04	lb/MMscf	2.50E-06	1.09E-05
Naphthalene	6.10E-04	lb/MMscf	5.86E-06	2.57E-05
Nickel	2.10E-03	lb/MMscf	2.02E-05	8.84E-05
Phenanathrene	1.70E-05	lb/MMscf	1.63E-07	7.15E-07
Pyrene	5.00E-06	lb/MMscf	4.80E-08	2.10E-07
Selenium	2.40E-05	lb/MMscf	2.31E-07	1.01E-06
Toluene	3.40E-03	lb/MMscf	3.27E-05	1.43E-04
Total HAP Emissions (natural gas combustion)			**0.018**	**0.079**

Table 13
Potential VOC and HAP Emissions at Outlet of RCO-1 Stack
AA-016
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Pollutant	Emission Factor[2]	Units	Potential Emissions	
			(lb/hr)	(tpy)
RCO Burners - Propane Combustion				
Benzene	7.10E-04	lb/MMBtu	6.96E-03	3.05E-02
Formaldehyde	1.51E-03	lb/MMBtu	1.48E-02	6.48E-02
PAHs	4.00E-05	lb/MMBtu	3.92E-04	1.72E-03
Total HAP Emissions (propane combustion)			**0.022**	**0.097**

Notes:

1. Emission factors from AP-42, Section 1.4 - Natural Gas Combustion, 07/98. Emission factors converted from lb/MMscf to lb/MMBtu based on assumed heating value of 1,020 Btu/scf for natural gas per AP-42 Section 1.4.
2. Emission factors for propane combustion from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.

Abbreviations:

CAS - chemical abstract service
HAP - hazardous air pollutant
hr - hour
lb - pound
ODT - oven dried tons
RCO - regenerative catalytic oxidizer
RTO - regenerative thermal oxidizer
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:

A National Methodology and Emission Inventory for Residential Fuel Combustion (2001). Retrieved from https://www3.epa.gov/ttnchie1/conference/ei12/area/haneke.pdf.
AP-42, Section 1.4 - Natural Gas Combustion, 07/98.
AP-42 Chapter 1.5, Liquid Petroleum Gas Combustion, 07/08.
South Coast Air Quality Management District. AER Reporting tool. Emission factors available in the Help and Support Manual at: http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting

Table 14
Potential VOC and HAP Emissions at Outlet of RCO-2 Stack
AA-017
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Hourly Throughput	54 ODT/hr
Annual Throughput	473,513 ODT/yr
Hours of Operation	8,760 hr/yr
Propane Heating Value[1]	91.5 MMBtu/Mgal
Natural Gas Heating Value[2]	1,020 Btu/scf
Number of Burners	1 burners
RCO Burner Rating	4.6 MMBtu/hr
RCO Control Efficiency[3]	96.3%

Pellet Coolers, Pellet Mills, and Dry Hammermills Potential VOC and HAP Emissions

Pollutant	CAS No.	Controlled Emission Factor[4,5]	Units	Emissions at RCO Outlet[6]	
				(lb/hr)	(tpy)
Acetaldehyde	75-07-0	0.00065	lb/ODT	0.035	0.15
Acrolein	107-02-8	0.0023	lb/ODT	0.12	0.54
Formaldehyde	50-00-0	0.0015	lb/ODT	0.078	0.34
Methanol	67-56-1	0.0092	lb/ODT	0.50	2.18
Phenol	108-95-2	0.0011	lb/ODT	0.059	0.26
Propionaldehyde	123-38-6	0.0011	lb/ODT	0.059	0.26
			Total HAP Emissions	**0.85**	**3.73**
Total VOC as propane	--	3.87	lb/hr	3.87	16.9
$PM/PM_{10}/PM_{2.5}$ (Filterable + Condensable)		1.07	lb/hr	1.07	4.67

Notes:

1. Propane heat content from AP-42 Section 1.5 - Liquefied Petroleum Gas Production, 7/08.
2. Natural gas heating value from AP-42 Section 1.4 - Natural Gas Combustion, 07/98.
3. A 96.3% control efficiency for the RCO is applied to VOC and organic HAP emissions per vendor data provided by Kai Simonsen (Enviva) via email on June 26, 2018.
4. HAP emission factors were derived based on stack testing data from comparable Enviva facilities.
5. VOC emissions (as propane) and PM emissions based on vendor data.
6. Includes emissions at outlet of the RCO-2 (AA-011) stack as well as emissions resulting from combustion of natural gas by the RCO-2 (AA-011) burners. RCO-2 (AA-011) will control emissions from sixteen (16) dry hammermills, eight (8) pellet mills, and four (4) pellet coolers.

Table 14
Potential VOC and HAP Emissions at Outlet of RCO-2 Stack
AA-017
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Thermally Generated Potential Criteria Pollutant Emissions

Maximum high heating value of VOC constituents	0.018 MMBtu/lb
Uncontrolled VOC emissions	458 tons/yr
Heat input of uncontrolled VOC emissions	16,932 MMBtu/yr

Pollutant	Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	0.082	lb/MMBtu[1]	0.16	0.70
NO_x	0.10	lb/MMBtu[1]	0.19	0.83

Potential Criteria Pollutant and Greenhouse Gas Emissions - RCO Burners

Pollutant	Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
RCO Burners - Natural Gas Combustion				
CO	0.082	lb/MMBtu[1]	0.38	1.66
NO_x	1.00	lb/hr[2]	1.00	4.38
SO_2	5.9E-04	lb/MMBtu[1]	0.0027	0.012
VOC	5.4E-03	lb/MMBtu[1]	0.025	0.11
$PM/PM_{10}/PM_{2.5}$ Filterable	1.9E-03	lb/MMBtu[1]	0.0086	0.038
$PM/PM_{10}/PM_{2.5}$ Condensable	5.6E-03	lb/MMBtu[1]	0.026	0.11
Total $PM/PM_{10}/PM_{2.5}$			0.034	0.15
CO_2	66.9	kg/MMBtu[3]	678	2,971
CH_4	1.0E-03	kg/MMBtu[3]	0.010	0.044
N_2O	1.0E-04	kg/MMBtu[3]	0.0010	0.0044
CO_2e			679	2,973

Pollutant	Emission Factor[3]	Units	Potential Emissions	
			(lb/hr)	(tpy)
RCO Burners - Propane Combustion				
CO	7.50	lb/Mgal	0.38	1.65
NO_x	6.50	lb/Mgal	0.33	1.43
SO_2[4]	0.054	lb/Mgal	0.0027	0.012
VOC	1.00	lb/Mgal	0.050	0.22
$PM/PM_{10}/PM_{2.5}$ Condensable	0.50	lb/Mgal	0.025	0.11
$PM/PM_{10}/PM_{2.5}$ Filterable	0.20	lb/Mgal	0.010	0.044
Total $PM/PM_{10}/PM_{2.5}$			0.035	0.15
CO_2	12,500	lb/Mgal	628	2,752
CH_4	0.20	lb/Mgal	0.010	0.044
N_2O	0.90	lb/Mgal	0.045	0.20
CO_2e			628	2,752

Notes:

1. Emission factors from AP-42, Section 1.4 - Natural Gas Combustion, 07/98. Emission factors converted from lb/MMscf to lb/MMBtu based on assumed heating value of 1,020 Btu/scf for natural gas per AP-42 Section 1.4.
2. NO_x emissions from combustion of natural gas by the RCO burners are based on vendor data with additional contingency applied for conservatism.
3. Emission factors for propane combustion obtained from AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08.
4. SO_2 emissions are based on an assumed fuel sulfur content of 0.54 grains/100 ft^3 per *A National Methodology and Emission Inventory for Residential Fuel Combustion*.

Table 14
Potential VOC and HAP Emissions at Outlet of RCO-2 Stack
AA-017
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Potential HAP Emissions - RCO Burners

Pollutant	Emission Factor[1]	Units	Potential Emissions	
			(lb/hr)	(tpy)
RCO Burners - Natural Gas Combustion				
2-Methylnaphthalene	2.40E-05	lb/MMscf	1.08E-07	4.74E-07
3-Methylchloranthrene	1.80E-06	lb/MMscf	8.12E-09	3.56E-08
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	7.22E-08	3.16E-07
Acenaphthene	1.80E-06	lb/MMscf	8.12E-09	3.56E-08
Acenaphthylene	1.80E-06	lb/MMscf	8.12E-09	3.56E-08
Acrolein	1.80E-05	lb/MMscf	8.12E-08	3.56E-07
Anthracene	2.40E-06	lb/MMscf	1.08E-08	4.74E-08
Arsenic	2.00E-04	lb/MMscf	9.02E-07	3.95E-06
Benz(a)anthracene	1.80E-06	lb/MMscf	8.12E-09	3.56E-08
Benzene	2.10E-03	lb/MMscf	9.47E-06	4.15E-05
Benzo(a)pyrene	1.20E-06	lb/MMscf	5.41E-09	2.37E-08
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	8.12E-09	3.56E-08
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	5.41E-09	2.37E-08
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	8.12E-09	3.56E-08
Beryllium	1.20E-05	lb/MMscf	5.41E-08	2.37E-07
Cadmium	1.10E-03	lb/MMscf	4.96E-06	2.17E-05
Chromium VI	1.40E-03	lb/MMscf	6.31E-06	2.77E-05
Chrysene	1.80E-06	lb/MMscf	8.12E-09	3.56E-08
Cobalt	8.40E-05	lb/MMscf	3.79E-07	1.66E-06
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	5.41E-09	2.37E-08
Dichlorobenzene	1.20E-03	lb/MMscf	5.41E-06	2.37E-05
Fluoranthene	3.00E-06	lb/MMscf	1.35E-08	5.93E-08
Fluorene	2.80E-06	lb/MMscf	1.26E-08	5.53E-08
Formaldehyde	7.50E-02	lb/MMscf	3.38E-04	1.48E-03
Hexane	1.8	lb/MMscf	0.0081	0.036
Indeno(1,2,3-cd)pyrene	1.80E-06	lb/MMscf	8.12E-09	3.56E-08
Lead	5.00E-04	lb/MMscf	2.25E-06	9.88E-06
Manganese	3.80E-04	lb/MMscf	1.71E-06	7.51E-06
Mercury	2.60E-04	lb/MMscf	1.17E-06	5.14E-06
Naphthalene	6.10E-04	lb/MMscf	2.75E-06	1.20E-05
Nickel	2.10E-03	lb/MMscf	9.47E-06	4.15E-05
Phenanathrene	1.70E-05	lb/MMscf	7.67E-08	3.36E-07
Pyrene	5.00E-06	lb/MMscf	2.25E-08	9.88E-08
Selenium	2.40E-05	lb/MMscf	1.08E-07	4.74E-07
Toluene	3.40E-03	lb/MMscf	1.53E-05	6.72E-05
Total HAP Emissions (natural gas combustion)			**0.0085**	**0.037**

Table 14
Potential VOC and HAP Emissions at Outlet of RCO-2 Stack
AA-017
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Pollutant	Emission Factor[2]	Units	Potential Emissions	
			(lb/hr)	(tpy)
RCO Burners - Propane Combustion				
Benzene	7.10E-04	lb/MMBtu	3.27E-03	1.43E-02
Formaldehyde	1.51E-03	lb/MMBtu	6.95E-03	3.04E-02
PAHs	4.00E-05	lb/MMBtu	1.84E-04	8.06E-04
Total HAP Emissions (propane combustion)			**0.010**	**0.046**

Notes:

1. Emission factors from AP-42, Section 1.4 - Natural Gas Combustion, 07/98. Emission factors converted from lb/MMscf to lb/MMBtu based on assumed heating value of 1,020 Btu/scf for natural gas per AP-42 Section 1.4.
2. Emission factors for propane combustion from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.

Abbreviations:

CAS - chemical abstract service
HAP - hazardous air pollutant
hr - hour
lb - pound
ODT - oven dried tons
RCO - regenerative catalytic oxidizer
RTO - regenerative thermal oxidizer
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:

A National Methodology and Emission Inventory for Residential Fuel Combustion (2001). Retrieved from https://www3.epa.gov/ttnchie1/conference/ei12/area/haneke.pdf.

AP-42, Section 1.4 - Natural Gas Combustion, 07/98.

AP-42 Chapter 1.5, Liquid Petroleum Gas Combustion, 07/08.

South Coast Air Quality Management District. AER Reporting tool. Emission factors available in the Help and Support Manual at: http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting

RAMBOLL

Table 15
Summary of Potential Emissions from Baghouses
AA-018, AA-019, AA-020
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Emission Unit ID	Source Description	Control Device Description	Exhaust Flow Rate[1]	Exit Grain Loading	Particulate Speciation		Potential Emissions					
							PM		PM_{10}		$PM_{2.5}$	
			(cfm)	(gr/cf)	PM_{10} (% of PM)	$PM_{2.5}$ (% of PM)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
AA-018	Finished Product Handling Two (2) Pellet Loadout Bins	One (1) baghouse[2]	3,000	0.004	91%	1.7%	0.10	0.45	0.094	0.41	0.0017	0.0077
AA-019	Additive Handling and Storage	One (1) baghouse[3]	1,000	0.004	100%	100%	0.034	0.15	0.034	0.15	0.034	0.15
AA-020	Dry Shavings Silo	One (1) baghouse[3]	1,000	0.004	100%	100%	0.034	0.15	0.034	0.15	0.034	0.15

Notes:
1. Control device flow rate (cfm) based on data provided by Kai Simonsen (Enviva) on June 25, 2018 and July 3, 2018.
2. Finished product handling particulate speciation based on April 2014 testing conducted at Enviva's Southampton plant.
3. No speciation data is available; therefore, all PM is conservatively assumed to be $PM_{2.5}$.

Abbreviations:
cf - cubic feet
cfm - cubic feet per minute
gr - grain
hr - hour
lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year

Table 16
Emergency Generator Potential Emissions
AA-022
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Engine Output	500 kW
Horsepower Rating	671 brake hp
Diesel Heating Value	19,300 Btu/lb
Hours of Operation	500 hr/yr
Conversion factor	2,545 Btu/hr/hp
Hourly Fuel Consumption	31.9 gal/hr[1]
Energy Input	4.37 MMBtu/hr[2]

Notes:
1. Fuel consumption calculated using a factor of 0.0476 gal/hr-hp. Advanced Environmental Interface, Inc. (1998). General Permits for Emergency Engines. INSIGHTS, 98-2, 3.
2. Energy calculated on a fuel consumption basis, using an energy factor of 0.137 MMBtu/gal.

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor	Units	Potential Emissions[1]	
			(lb/hr)	(tpy)
CO[2]	0.39	g/hp-hr	0.58	0.14
NO_x[2]	6.65	g/hp-hr	9.83	2.46
SO_2[3]	15	ppmw	0.0027	0.00066
VOC[2]	0.01	lb/hp-hr	6.71	1.68
PM[2]	0.021	g/hp-hr	0.031	0.0078
PM_{10}[2]	0.021	g/hp-hr	0.031	0.0078
$PM_{2.5}$[2]	0.021	g/hp-hr	0.031	0.0078
CO_2	74.0	kg/MMBtu[4]	713	178
CH_4	3.0E-03	kg/MMBtu[4]	0.029	0.0072
N_2O	6.0E-04	kg/MMBtu[4]	0.0058	0.0014
CO_2e			715	179

Notes:
1. NSPS allows for only 100 hrs/yr of non-emergency operation of these engines. Potential emissions for the emergency generator are conservatively based on 500 hr/yr.
2. Emission factors for Particulate Matter (TSP/PM_{10}/$PM_{2.5}$), Nitrous Oxide (NO_x), Volatile Organic Matter (VOC), and Carbon Monoxide (CO) obtained from generator's spec sheet. The generator's spec sheet does not include an emission factor for VOC so the hydrocarbon (HC) emission factor was used as a surrogate for VOC.
3. Sulfur content in accordance with Year 2013 standards of 40 CFR 80.510(a) as required by NSPS Subpart IIII.
4. Emission factors from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.

Potential HAP Emissions

Pollutant	CAS No.	VOC	Emission Factor[1]	Potential Emissions[2]	
			(lb/MMBtu)	(lb/hr)	(tpy)
Acetaldehyde	75-07-0	Y	2.52E-05	1.10E-04	2.75E-05
Acrolein	107-02-8	Y	7.88E-06	3.45E-05	8.61E-06
Benzene	71-43-2	Y	7.76E-04	3.39E-03	8.48E-04
Benzo(a)pyrene[3]	50-32-8	Y	2.57E-07	1.12E-06	2.81E-07
Formaldehyde	50-00-0	Y	7.89E-05	3.45E-04	8.62E-05
Naphthalene[3]	91-20-3	Y	1.30E-04	5.68E-04	1.42E-04
Total PAH (POM)	--	Y	2.12E-04	9.27E-04	2.32E-04
Toluene	108-88-3	Y	2.81E-04	1.23E-03	3.07E-04
Xylene	1330-20-7	Y	1.93E-04	8.44E-04	2.11E-04
Total HAP Emissions				**6.88E-03**	**1.72E-03**

Notes:
1. Emission factors obtained from AP-42 Section 3.4 - Large Stationary Diesel and All Stationary Duel-fuel Engines, 10/96, Table 3.4-3 and Table 3.4-4.
2. NSPS allows for only 100 hrs/yr of non-emergency operation of these engines. Potential emissions for the emergency generator are conservatively based on 500 hr/yr.
3. Benzo(a)pyrene and naphthalene are included as HAPs in Total PAH.

Table 16
Emergency Generator Potential Emissions
AA-022
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Abbreviations:

Btu - British thermal unit
CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
g - gram
gal - gallon
HAP - hazardous air pollutant
hp - horsepower
hr - hour
kg - kilogram
kW - kilowatt
lb - pound
MW - megawatt
MMBtu - Million British thermal units
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PAH - polycyclic aromatic hydrocarbon
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
POM - polycyclic organic matter
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

References:

Advanced Environmental Interface, Inc. (1998). General Permits for Emergency Engines. INSIGHTS, 98-2, 3.
AP-42 Chapter 3.3, Stationary Internal Combustion Engines, 10/96.

Table 17
Fire Pump Potential Emissions
AA-023
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Engine Output	0.10 MW
Horsepower Rating	131 hp
Diesel Density[1]	7.1 lb/gal
Hours of Operation	500 hr/yr
Hourly Fuel Consumption	9 gal/hr[1]
Energy Input	1.23 MMBtu/hr[2]

Notes:
1. Diesel density from AP-42 Section 3.4 - Large Stationary Diesel and All Stationary Dual-fuel Engines, 10/96, Table 3.4-1, footnote a.
2. Energy calculated on a fuel consumption basis, using an energy factor of 0.137 MMBtu/gal.

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor	Units	Potential Emissions[1]	
			(lb/hr)	(tpy)
CO[2]	1.3	g/kW-hr	0.28	0.070
NO_x[2]	3.4	g/kW-hr	0.72	0.18
SO_2[3]	15	ppmw	0.0019	4.79E-04
VOC[2]	0.15	g/kW-hr	0.032	0.0081
PM[2]	0.17	g/kW-hr	0.037	0.0092
PM_{10}[2]	0.17	g/kW-hr	0.037	0.0092
$PM_{2.5}$[2]	0.17	g/kW-hr	0.037	0.0092
CO_2	74	kg/MMBtu[4]	201	50.3
CH_4	3.0E-03	kg/MMBtu[4]	0.0082	0.0020
N_2O	6.0E-04	kg/MMBtu[4]	0.0016	4.08E-04
CO_2e			202	50.4

Notes:
1. NSPS allows for only 100 hrs/yr of non-emergency operation. Potential emissions for the fire pump are conservatively based on 500 hr/yr.
2. Emissions factors for PM/PM_{10}/$PM_{2.5}$, NO_x, hydrocarbons, and CO obtained from generator's spec sheet.
3. Sulfur content in accordance with Year 2013 standards of 40 CFR 80.510(a) as required by NSPS Subpart IIII.
4. Emission factors from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.

Potential HAP Emissions

Pollutant	CAS No.	VOC	Emission Factor[1]	Potential Emissions[2]	
			(lb/hp-hr)	(lb/hr)	(tpy)
Acetaldehyde	75-07-0	Y	5.4E-06	7.03E-04	1.76E-04
Acrolein	107-02-8	Y	6.5E-07	8.48E-05	2.12E-05
Benzene	71-43-2	Y	6.5E-06	8.56E-04	2.14E-04
Benzo(a)pyrene	50-32-8	Y	1.3E-09	1.72E-07	4.31E-08
1,3-Butadiene	106-99-0	Y	2.7E-07	3.59E-05	8.96E-06
Formaldehyde	50-00-0	Y	8.3E-06	1.08E-03	2.71E-04
Naphthalene	91-20-3	Y	5.9E-07	7.78E-05	1.95E-05
Total PAH (POM)[3]	--	Y	1.2E-06	1.54E-04	3.85E-05
Toluene	108-88-3	Y	2.9E-06	3.75E-04	9.38E-05
Xylene	1330-20-7	Y	2.0E-06	2.61E-04	6.53E-05
			Total HAP Emissions	**3.55E-03**	**8.88E-04**

Notes:
1. Emission factor obtained from AP-42 Section 3.3 - Stationary Internal Combustion Engines, 10/96, Table 3.3-2.
2. NSPS allows for only 100 hrs/yr of non-emergency operation. Potential emissions for the fire pump are conservatively based on 500 hr/yr.
3. The PAH emission factor includes all the PAH compounds listed in AP-42. Emissions for naphthalene and benzo(a)pyrene are also calculated separately. For the purposes of calculating total HAP emissions, the naphthalene and benzo(a)pyrene are not included separately to avoid double counting these emissions.

Table 17
Fire Pump Potential Emissions
AA-023
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Abbreviations:

Btu - British thermal unit
CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
g - gram
gal - gallon
HAP - hazardous air pollutant
hp - horsepower
hr - hour
kg - kilogram
kW - kilowatt
lb - pound
MW - megawatt
MMBtu - Million British thermal units
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PAH - polycyclic aromatic hydrocarbon
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
POM - polycyclic organic matter
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

References:

Advanced Environmental Interface, Inc. (1998). General Permits for Emergency Engines. INSIGHTS, 98-2, 3.
AP-42 Chapter 3.3, Stationary Internal Combustion Engines, 10/96.

Table 18
Potential Emissions from Paved Roads
AA-024
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Vehicle Activity	Distance Traveled per Roundtrip[1] (ft)	Trips Per Day	Daily VMT	Events Per Year (days)	Empty Truck Weight (lb)	Loaded Truck Weight (lb)	Average Truck Weight (ton)	Annual VMT	PM Emission Factor[2] (lb/VMT)	PM_{10} Emission Factor[2] (lb/VMT)	$PM_{2.5}$ Emission Factor[2] (lb/VMT)	Potential PM Emissions[3] (lb/day)	(tpy)	Potential PM_{10} Emissions[3] (lb/day)	(tpy)	Potential $PM_{2.5}$ Emissions[3] (lb/day)	(tpy)
Logs Delivery to Crane Storage Area	3,600	102	69	365	24,000	80,000	26	25,331	1.92	0.38	0.094	13.3	2.43	2.66	0.49	0.65	0.12
Chip Delivery	4,300	171	140	365	24,000	80,000	26	50,958	1.92	0.38	0.094	26.7	4.88	5.35	0.98	1.31	0.24
Bark Delivery	4,200	28	22	365	24,000	80,000	26	8,088	1.92	0.38	0.094	4.24	0.77	0.85	0.15	0.21	0.038
Dry Shavings Delivery	5,000	16	15	365	24,000	76,000	25	5,583	1.84	0.37	0.090	2.81	0.51	0.56	0.10	0.14	0.025
Pellet Truck Delivery to Pellet Loadout Area (Truck Back-up)	5,000	147	139	10	24,000	80,000	26	1,393	1.92	0.38	0.094	26.7	0.13	5.34	0.03	1.31	0.0065
Employee Car Parking	1,200	55	13	365	4,000	4,000	2	4,563	0.14	0.028	0.0069	0.17	0.032	0.035	0.006	0.0086	0.0016
Additive Delivery	5,000	3	3	213	24,000	64,000	22	605	1.62	0.32	0.079	0.46	0.049	0.092	0.0098	0.023	0.0024
											Total Emissions:	**74.4**	**8.81**	**14.9**	**1.76**	**3.65**	**0.43**

Notes:

1. Distance traveled per round trip and daily trip counts provided by Enviva.
2. Emission factors calculated based on Equation 2 from AP-42 Section 13.2.1 - Paved Roads, 01/11.

where:

E = emission factor (lb/ton)		
k = particle size multiplier (dimensionless) for PM	0.011	
k = particle size multiplier (dimensionless) for PM_{10}	0.0022	
k = particle size multiplier (dimensionless) for $PM_{2.5}$	0.00054	
sL = mean road surface silt loading from AP-42 Table 13.2.1-3 for quarries (g/m^2)	8.2	
P = No. days with rainfall greater than 0.01 inch	110	Per AP-42, Section 13.2.1, Figure 13.2.1-2 (Lucedale, MS).

3. Potential emissions calculated from appropriate emission factor times vehicle miles traveled with control efficiency of 90% for water / dust suppression activities followed by sweeping. Per Table 5 in Chapter 4 of the Air Pollution Engineering Manual, Air and Waste Management Association, page 141. Control efficiency (%) = 96-0.263*V, where V is the number of vehicle passes since application of water.

Abbreviations:

ft - feet
hr - hour
lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
yr - year
VMT - vehicle miles traveled
VOC - volatile organic compound

References:

AP-42, Section 13.2.1 - Paved Roads, 01/11
Air Pollution Engineering Manual, Air and Waste Management Association.

Table 19
Diesel Storage Tanks
IAs
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Source ID[1]	Description	Design Volume[2]	Working Volume[3]	Tank Dimensions		Orientation	Throughput[3]	Turnovers	VOC Emissions[4]	
				Diameter	Length					
		(gal)	(gal)	(ft)	(ft)		(gal/yr)		(lb/hr)	(tpy)
IA	Emergency Generator Fuel Storage Tank	500	450	4.0	6	Horizontal	300	0.67	4.79E-05	2.10E-04
IA	Fire Pump Fuel Storage Tank[5]	185	93	3.3	3.3	Horizontal	4,500	48.6	4.22E-05	1.85E-04
IA	Mobile Fuel Diesel Storage Tank	5,000	2,500	6.0	23.7	Horizontal	200,000	80.0	8.76E-04	3.84E-03
								Total Emissions:	**9.66E-04**	**4.23E-03**

Notes:

1. Storage tanks used exclusively to store diesel are considered an insignificant activity per 11 Miss. Admin. Code Pt. 2 Ch. 1 R. 6.7.B(7).
2. Conservative design specifications.
3. Working volumes and throughputs provided by Kai Simonsen (Enviva) via email June 25, 2018.
4. Emissions calculated using EPA TANKS 4.0 software.
5. The TANKS program has a minimum allowable tank length of 5 feet. As such, emissions for the Fire Pump Fuel Storage tank are based on a length of 5 feet.

Abbreviations:

EPA - Environmental Protection Agency
ft - feet
gal - gallon
IA - Insignificant Activity
lb - pound
yr - year
VOC - volatile organic compound

Table 20
Propane Vaporizer Potential Emissions
IA[1]
Enviva Pellets Lucedale, LLC
Lucedale, George County, Mississippi

Calculation Basis

Propane Heating Value[2]	91.5 MMBtu/Mgal
Hours of Operation	8,760 hr/yr
Maximum Heat Input Rate	1.00 MMBtu/hr
Hourly Fuel Consumption	0.011 Mgal/hr

Notes:
1. The propane vaporizer is considered an insignificant activity per 11 Miss. Admin. Code Pt. 2 Ch. 6 R. 6.7.B(2).
2. Propane heat content from AP-42 Section 1.5 - Liquefied Petroleum Gas Production, 7/08.

Potential Criteria Pollutant and Greenhouse Gas Emissions

Pollutant	Emission Factor[1]	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	7.50	lb/Mgal	0.082	0.36
NO_X	13.0	lb/Mgal	0.14	0.62
SO_2[2]	0.054	lb/Mgal	5.90E-04	0.0026
VOC	1.00	lb/Mgal	0.011	0.048
$PM/PM_{10}/PM_{2.5}$ Condensable	0.50	lb/Mgal	0.0055	0.024
$PM/PM_{10}/PM_{2.5}$ Filterable	0.20	lb/Mgal	0.0022	0.010
Total $PM/PM_{10}/PM_{2.5}$			0.0077	0.034
CO_2	12,500	lb/Mgal	137	598
CH_4	0.20	lb/Mgal	0.0022	0.010
N_2O	0.90	lb/Mgal	0.010	0.043
CO_2e			140	611

Notes:
1. Emission factors obtained from AP-42 1.5- Liquefied Petroleum Gas Combustion, 07/08, Table 1.5-1.
2. SO_2 emissions are based on an assumed fuel sulfur content of 0.54 grains/100 ft^3 per *A National Methodology and Emission Inventory for Residential Fuel Combustion*.

Potential HAP Emissions

Pollutant	CAS No.	VOC	Emission Factor[1]	Potential Emissions	
			(lb/MMBtu)	(lb/hr)	(tpy)
Benzene	71-43-2	Y	7.10E-04	7.10E-04	3.11E-03
Formaldehyde	50-00-0	Y	1.50E-03	1.50E-03	6.57E-03
PAHs	--	N	4.00E-05	4.00E-05	1.75E-04
			Total HAP Emissions	**2.21E-03**	**9.86E-03**

Notes:
1. Emission factors for propane combustion from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.

Abbreviations:

Btu - British thermal unit
CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
gal - gallon
HAP - hazardous air pollutant
hr - hour
lb - pound
LPG - liquified petroleum gas
MMBtu - Million British thermal units
Mgal - Thousand gallons
NO_X - nitrogen oxides
N_2O - nitrous oxide
PAH - polycyclic aromatic hydrocarbon
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

References:

A National Methodology and Emission Inventory for Residential Fuel Combustion (2001). Retrieved from https://www3.epa.gov/ttnchie1/conference/ei12/area/haneke.pdf.
AP-42 Chapter 1.5, Liquid Petroleum Gas Combustion, 07/08.
South Coast Air Quality Management District. AER Reporting tool. Emission factors available in the Help and Support Manual at: http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting