Appendix A

Facilities and Processes

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**

Biorefinery Facility

Hugoton, Kansas

Facility Design Assumptions and Engineering Specifications

Production Schedule	Qty	Units	Notes
Nominal Production Schedule	350	days/yr	
Hours per Day of Operation	24	hrs/day	
Hours per Year of Operation	8,400	hr/yr	
Maximum Production Schedule - Permit	365	days/yr	
Hours per Day of Operation	24	hrs/day	
Hours per Year of Operation	8,760	hr/yr	

Production Rate	Qty	Units	Notes
Nominal Biomass Anhydrous ETOH Production	16	MMgpy	The proposed biorefinery will have a nominal production capacity of 16 million gallons of anhydrous ethanol annually, comprised of 16 million gallons of ethanol produced from cellulosic feedstocks on a 350 day annual production schedule. The targeted
Enzymatic Hydrolysis Plant	45,714	gal/day	
	1,905	gal/hr	
Maximum Biomass Anhydrous ETOH Production - Permit	18	MMgpy	For permitting purposes, the biomass ethanol production is based on a 10% increase in plant efficiency and a production schedule of 365 days per year results in a maximum annual anhydrous ethanol production of 18 MMgpy (rounded).
Enzymatic Hydrolysis Plant	49,320	gal/day	
	2,055	gal/hr	
TOTAL Maximum Denatured Ethanol Production - Permit	18.9	MMgpy	
	51,737	gal/day	
	2,156	gal/hr	
Anhydrous Ethanol Density	6.58	lb/gal	
Ethanol (Denatured) Density	6.56	lb/gal	
Ethanol (Denatured) Weight	61,987	ton/yr	
Ethanol Yield - Permit	2.65	gal/bu	
Ethanol HAPs			
Acetaldehyde	200	ppm	HAP emission rate based on engineering estimate.
Methanol	200	ppm	
Acrolein	20	ppm	
Formaldehyde	100	ppm	

Facility Design Assumptions and Engineering Specifications

Denaturant Usage	Qty	Units	Notes
Denaturant (Gasoline) % of Total	4.9%		
Nominal Denaturant (Gasoline) Usage	0.80	MMgpy	
	2240	gal/day	
	93	gal/hr	
Maximum Denaturant (Gasoline) Usage - Permit	0.90	MMgpy	
	2417	gal/day	
	101	gal/hr	
Denaturant (Gasoline) Density	6.17	lb/gal	
Denaturant (Gasoline) Weight	2,952	ton/yr	

Off-Spec Product	Qty	Units	Notes
% Off-Spec Produced per Year	5%		
Max. Off-Spec Produced	0.90	MMgpy	

Facility Design Assumptions and Engineering Specifications

Biomass Usage	Qty	Units	Notes
Biomass Weight	0.080	dT/m^3	Typical density for corn stover.
	5	lb/ft^3	
Wheat Weight	60	lb/bu	
Conversion Factor	2,204.6	lb/dT	
Biomass Feed Rate	104.2	ton/hr	Biomass feed rate based on maximum equipment design rate.
	208,400	lb/hr	
Maximum Biomass Onsite Delivery Rate	2,268	dT/day	Biomass receiving and short term intermediate bale storage based on maximum equipment design rate.
	2,500	ton/day	
	5,000,000	lb/day	
	156	ton/hr	
Maximum Enzymatic Hydrolysis Process Usage	610	dT/day	
	222,650	dT/yr	
	672	ton/day	
	245,427	ton/yr	
	490,854,190	lb/yr	
	1,344,806	lb/day	
	56,034	lb/hr	
Maximum Enzymatic Hydrolysis Residuals	368	dT/day	EH residuals consist of a wet lignin-rich stillage cake and a distiller's biomass thin stillage syrup. Wet lignin-rich stillage may be sent offsite for lignin recovery and returned to the facility as a lignin-lean solid fuel. "Worst Case Scenario" for EH residuals combustion assumes lignin-rich stillage cake combusted.
	134,320	dT/yr	
	406	ton/day	
	148,061	ton/yr	
	296,121,872	lb/yr	
	811,293	lb/day	
	33,804	lb/hr	
Maximum Gasification Process Usage	0	dT/day	The gasification process has been removed from the proposed facility activities.
	0	dT/yr	
	0	ton/day	
	0	ton/yr	
	0	lb/yr	
	0	lb/day	
	0	lb/hr	
Maximum Mixed Fuel-Fired Boiler Usage	2,026	dT/day	1658 dT/day raw biomass plus the additional lignin-rich or lignin-lean stillage cake and distiller's biomass thin stillage syrup. The maximum mixed fuel-fired boiler usage value is based on lignin-rich stillage cake.
	739,485	dT/yr	
	2,233	ton/day	
	815,134	ton/yr	
	1,630,267,682	lb/yr	
	4,466,487	lb/day	
	186,104	lb/hr	
TOTAL Maximum Biomass Usage Rate	2,268	dT/day	
	827,815	dT/yr	
	2,500	ton/day	
	912,500	ton/yr	
	1,825,000,000	lb/yr	
	5,000,000	lb/day	
	208,333	lb/hr	

Facility Design Assumptions and Engineering Specifications

Lignin-Rich/Lean Stillage and Syrup Production	Qty	Units	Notes
Maximum Lignin-Rich Stillage Production	302	dT/day	Lignin makes up approximately 14.6%wt dry of the lignin-rich stream. Lignin-lean stillage would return to the biorefinery wet, at approximately 65%wt moisture. Moisture of the lignin-rich and lignin-lean stillage was assumed equivalent; therefore the difference in weight is due to the removal of lignin.
	110,230	dT/yr	
	333	ton/day	
	121,507	ton/yr	
	733,899	lb/yr	
	665,789	lb/day	
	27,741	lb/hr	
Maximum Lignin-Lean Stillage Production	258	dT/day	
	94,136	dT/yr	
	284	ton/day	
	103,767	ton/yr	
	626,750	lb/yr	
	568,584	lb/day	
	23,691	lb/hr	
Distiller's Biomass Thin Stillage Syrup Production	66	dT/day	
	24,090	dT/yr	
	73	ton/day	
	26,554	ton/yr	
	53,108,814	lb/yr	
	160,389	lb/day	
	6,683	lb/hr	

Lignin-Rich Storage Data	Qty	Units	Notes
Lignin-Rich Stillage Density	65	lb/ft^3	
Storage Capacity Desired	3.0	days	
	1,997,368	lb	
	30,729	ft^3	
Storage Width	30	ft	
Height of Wall	10	ft	
Distance from Back Wall to Spout Discharge	55	ft	
Angle of Repose	15	deg	
Angle (Radians)	0.2618		
Pile Height Above Wall	4.02	ft	= tangent of angle of repose x (0.5 x pile width)
Peak Pile Height	14.02	ft	
Total Length	60	ft	
Calculated Storage	21,163	ft^3	
	1,375,615	lb	

Biomass Storage Data	Qty	Units	Notes
Biomass Storage Capacity	3.70	days	
Total Laydown Biomass Storage	8,400	dT	
Number of Bins	3	Bins	
Total Size Required	136	dT/Bin	
	150	ton/Bin	
	60,000	ft^3/Bin	
Bin Diameter	30	ft	
Bin Height	100	ft	

Facility Design Assumptions and Engineering Specifications

Misc Chemical / Supply Usage	Qty	Units	Notes
Sulfuric Acid (94%) Usage	843	lb/hr	
	20,241	lb/day	Includes 12% overdesign for EH Plant and is based on 365 days per year.
	7,387,834	lb/yr	
Delivery Capacity (By Rail Car)	180,000	lb	
Sodium Hydroxide (50%) Usage	340	lb/hr	
	8,172	lb/day	Includes 12% overdesign for EH Plant and is based on 365 days per year.
	2,982,605	lb/yr	
Delivery Capacity (By Truck)	49,500	lb	
Aqueous Ammonia (<20%) Usage	1,590	lb/hr	
	38,154	lb/day	Includes 12% overdesign for EH Plant and is based on 365 days per year.
	13,926,298	lb/yr	
Delivery Capacity (By Truck)	49,500	lb	
Magnesium Hydroxide (50%) Usage	29	lb/hr	
	699	lb/day	Includes 12% overdesign for EH Plant and is based on 365 days per year.
	255,091	lb/yr	
Delivery Capacity (By Truck)	49,500	lb	
Diamonium Phosphate Usage	1.1	lb/hr	
	27	lb/day	Includes 12% overdesign for EH Plant and is based on 365 days per year.
	9,811	lb/yr	
Delivery Capacity (By Truck)	49,500	lb	
Calcium Hydroxide (Lime) Usage	1,601	lb/day	
	38,415	lb/day	Based on 365 days per year.
	14,021,391	lb/yr	
Delivery Capacity (By Rail Car)	180,000	lb	
Limestone Usage	1,753	lb/day	
	42,070	lb/day	Based on 365 days per year.
	15,355,606	lb/yr	
Delivery Capacity (By Rail Car)	180,000	lb	
Diesel Usage	1,508	lb/hr	
	36,198	lb/day	Based on 365 days per year.
	13,212,409	lb/yr	
Delivery Capacity (By Truck)	53,175	lb	
Corn Syrup	3,021	lb/hr	
	72,495	lb/day	Includes 12% overdesign for EH Plant and is based on 365 days per year.
	26,460,806	lb/yr	
Delivery Capacity (By Truck)	49,500	lb	
Cellulase Usage	3,532	lb/hr	
	84,780	lb/day	Includes 12% overdesign for EH Plant and is based on 365 days per year.
	30,944,525	lb/yr	
Delivery Capacity (By Truck)	49,500	lb	
Urea Usage	892	lb/hr	
	21,396	lb/day	Includes 12% overdesign for EH Plant and is based on 365 days per year.
	7,809,715	lb/yr	
Delivery Capacity (By Truck)	49,500	lb	
Fluidized Based Sand Usage	166	lb/hr	
	3,988	lb/day	Boiler vendor data based on 365 days per year.
	60,646	lb/yr	
Delivery Capacity (By Truck)	22,000	lb	
Boiler Ash Waste	18,969	lb/hr	
Used Fluidized Bed Sand Accounted For In Ash	455,260	lb/day	Boiler vendor data based on 365 days per year.
	166,169,900	lb/yr	
Delivery Capacity (By Truck)	22,000	lb	

Facility Design Assumptions and Engineering Specifications

Misc Chemical / Supply Usage	Qty	Units	Notes
Dirt/Fines Waste From Baghouses	8,000	lb/hr	
	192,000	lb/day	Includes approximately 4% losses in grinders and is based on 365 days per year.
	70,080,000	lb/yr	
Delivery Capacity (By Truck)	22,000	lb	
Hazardous & Municipal Wastes	22	lb/hr	
	526	lb/day	
	192,146	lb/yr	
Delivery Capacity (By Truck)	22,000	lb	
Total Annual Chemical / Supply Usage	368,868,783	lb/yr	
	184,434	ton/yr	

EH Denatured Ethanol Storage Tank	Qty	Units	Notes
Tank ID	T-2101		
Conversion Factor	7.48	gal/ft^3	
Storage Capacity	460,000	gal	
	61,497	ft^3	
Throughput	18.88	MMgal/yr	
	51,736.68	gal/day	
	2,155.70	gal/hr	
Storage Capacity	9.33	days	
	223.87	hours	
Turnovers	41.05	times/yr	
Tank Diameter	45	ft	
Area of Deck	1,590	ft^2	
Tank Height	39	ft	

EH Denaturant (Gasoline) Storage Tank	Qty	Units	Notes
Tank ID	T-2120		
Conversion Factor	7.48	gal/ft^3	
Storage Capacity	22,500	gal	
	3,008	ft^3	
Throughput	0.88	MMgal/yr	
	2,416.68	gal/day	
	100.70	gal/hr	
Storage Capacity	9.31	days	
	223.45	hours	
Turnovers	39.20	times/yr	
Tank Diameter	16	ft	
Area of Deck	201	ft^2	
Tank Height	15	ft	

Facility Design Assumptions and Engineering Specifications

EH Shift Storage Tank	Qty	Units	Notes
Tank ID	T-2100A		
Conversion Factor	7.48	gal/ft^3	
Storage Capacity	60,000	gal	Tank storage based on 32 hours nominal production capacity.
	8,021	ft^3	
Throughput	9.00	MMgal/yr	
Storage Capacity	1.22	days	
	29.20	hours	
Turnovers	150	times/yr	
Tank Diameter	20	ft	
Area of Deck	314	ft^2	
Tank Height	26	ft	

EH Shift Storage Tank	Qty	Units	Notes
Tank ID	T-2100B		
Conversion Factor	7.48	gal/ft^3	
Storage Capacity	60,000	gal	Tank storage based on 32 hours nominal production capacity.
	8,021	ft^3	
Throughput	9.00	MMgal/yr	
Storage Capacity	300.00	days	
	7,200.00	hours	
Turnovers	150	times/yr	
Tank Diameter	20	ft	
Area of Deck	314	ft^2	
Tank Height	26	ft	

EH Off-Spec Storage Tank	Qty	Units	Notes
Tank ID	T-2100C		
Conversion Factor	7.48	gal/ft^3	
Storage Capacity	60,000	gal	In the event of off-spec product being stored in the tank, the off-spec product will be metered back into the distillation process. Tank storage based on 32 hours nominal production capacity.
	8,021	ft^3	
Throughput	0.90	MMgal/yr	
Storage Capacity	1.22	days	
	29.20	hours	
Turnovers	15	times/yr	
Tank Diameter	20	ft	
Area of Deck	314	ft^2	
Tank Height	26	ft	

Receiving and Product Loadout by Truck	Qty	Units	Notes
Received by Truck			
Biomass	100%		
Denaturant (Gasoline)	100%		
Chemicals/Supplies	100%		
Shipped by Truck			
Lignin-Rich Stillage / Lignin-Lean Stillage	100%		
Ethanol (Denatured)	50%		
Received by Rail			
Biomass	0%		
Shipped by Rail			"Worst Case Scenario" assumes 50% Ethanol (Denatured) shipped by truck.
Ethanol (Denatured)	50%		
Truck Fluid Capacity (Ethanol/Denaturant/Chemicals)	7,500	gal/truck	
	50,000	lbs/truck	
Truck Dry Capacity	50,000	lbs/truck	
Truck Dry Capacity (Biomass)	42,000	lb/truck	
Empty Truck	30,000	lbs/truck	

Shipping and Receiving Schedule	Qty	Units	Notes
Daily	16	hr/day	"Worst Case Scenario" for hourly and daily haul road emissions assumes shipping and receiving will occur 5:00 AM to 9:00 PM only.
Annual	330	days	
Total Shipping and Receiving Hours	5,280	hr/yr	
All Receiving and Shipping Roads	PAVED		

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Emission Calculation Assumptions Summary

Emission Point No.	Emission Unit(s)	Emission Factor Source	Other Source/Assumptions
HAUL ROADS			
EP-1000 (Fugitive)	Paved Plant Roads	AP-42 Section 13.2.2 Unpaved Haul Roads, Final Section, November 2006.	95% Control Efficiency with Paved Road Surface with Sweeping and Watering
EP-1050 (Fugitive)	Biomass Laydown Roads	AP-42 Section 13.2.2 Unpaved Haul Roads, Final Section, November 2006.	70% Control Efficiency with Chemical Suppressant and Watering
ENZYMATIC HYDROLYSIS PLANT			
EP-11025	Gasification Metering Bin #1 (GMB1) DC-11139	AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-11026	Gasification Metering Bin #2 (GMB2) DC-11239	AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-11027	EH Metering Bin #1 (EMB1) DC-11339	AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-11028	EH Metering Bin #2 (EMB2) DC-11439	AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-11030	Gasification Day Bin #1 (GB1) Rotary Valve Vent	AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-11033	Gasification Day Bin #2 (GB2) Rotary Valve Vent	AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-11037	Gasification Day Bin #1 (GB1) DC-11172	AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-11039	Gasification Day Bin #2 (GB2) DC-11272	AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-11041	EH Day Bin (EDB1) Rotary Valve Vent	AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-11044	EH Day Bin (EDB1) DC-11372	AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-11071	Biomass Grinding Line DC #1	AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-11072	Biomass Grinding Line DC #2	AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-11080	Floor Sweep System DC-11234	AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-11000 (Fugitive)	Biomass Receiving, Handling and Grinding	AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.	95% Capture Efficiency
EP-18185	EH CO2 Scrubber	ASPEN simulation used to project emissions from this emission unit. Preliminary emissions from the CO2 scrubber (EP-18185) were estimated using ASPEN and were predicted at 2.51 lb/hr VOCs from the scrubber stack. As the final design has not been completed, a factor of safety of 2 was applied.	99% Efficiency of VOC removal based on engineering information.
EP-13150	EH Vent Scrubber	ASPEN simulation used to project emissions from this emission unit. Preliminary emissions from the vent scrubber (EP-13150) were estimated using ASPEN model, EM0902MM-21, which predicts 0.48 lb/hr of furfural. This scrubber controls all non-distillation or fermentation vents including those from A19000 (evaporator), conditioning (A14000), and non-condensibles from pretreatment (A12000).	95% Efficiency of VOC removal based on engineering information. Enzymatic hydrolysis vent stream to be vented to the Mixed Fuel-Fired Boiler system for additional heat input..
EP-18180	EH Distillation Vent Scrubber	Uncontrolled VOM emissions were assumed equivalent to the a starch ethanol plant, scaled to 18 MMgal/yr, plus a factor of safety of 2.	99% Efficiency of VOC removal based on engineering information.
EP-19005	Biomass Stillage Preheater Vent Condenser	Stream composition assumed equivalent to the enzymatic hydrolysis CO2 scrubber, EP-18185.	98% Efficiency of VOC removal based on Vendor information. Enzymatic hydrolysis vent streams to be vented to the Mixed Fuel-Fired Boiler system for additional heat input.
EP-19010	Biomass Process Evaporator Vent Condenser	Stream composition assumed equivalent to the enzymatic hydrolysis CO2 scrubber, EP-18185.	98% Efficiency of VOC removal based on Vendor information. Enzymatic hydrolysis vent streams to be vented to the Mixed Fuel-Fired Boiler system for additional heat input.
EP-19001FUG (Fugitive)	Lignin-Rich Stillage Storage and Loadout	Emissions calculated for lignin-rich stillage storage and loadout assumed equivalent to WDGS emission rates.	November 2004 stack test at the Diversified Energy Co. (DENCO) ethanol facility located in Morris, Minnesota.

Emission Calculation Assumptions Summary			
Emission Point No.	**Emission Unit(s)**	**Emission Factor Source**	**Other Source/Assumptions**
ETHANOL STORAGE AND PIPING			
EP-2000 (Fugitive)	Fugitive Leaks	Leak Rates and VOC control from: Protocol for Leak Emission Rates, EPA-453/R-95-017, November 1995.	Leak Rate (SOCMI average) multiplied by number of components.
T-2100A	T-2100A Shift Tank	TANKS, version 4.09D, October 2005.	Internal pontoon floating roof with fixed tank roof.
T-2100B	T-2100B Shift Tank	TANKS, version 4.09D, October 2005.	Internal pontoon floating roof with fixed tank roof.
T-2100C	T-2100C EH Off-Spec Tank	TANKS, version 4.09D, October 2005.	Internal pontoon floating roof with fixed tank roof.
T-2101	T-2101 Denatured Ethanol	TANKS, version 4.09D, October 2005.	Internal pontoon floating roof with fixed tank roof.
T-2120	T-2120 Denaturant	TANKS, version 4.09D, October 2005.	Internal pontoon floating roof with fixed tank roof.
EP-2150	Vapor Recovery System	AP-42 Section 5.2 Transportation and Marketing of Petroleum Liquids, Final Section, January 1995.	90% Collection Efficiency and 98% Destruction Efficiency
EP-2150FUG (Fugitive)	Loading Losses	AP-42 Section 5.2 Transportation and Marketing of Petroleum Liquids, Final Section, January 1995.	90% Collection Efficiency
UTILITIES			
EP-4001	EH Cooling Tower	AP-42, Section 13.4 Wet Cooling Towers, Final Section, January 1995.	0.0005% Drift Rate, 2625 ppm TDS, and 14850 gpm Circulation Rate
EP-22001	Go-Gen Air Condenser #1	AP-42, Section 13.4 Wet Cooling Towers, Final Section, January 1995.	0.0005% Drift Rate, 6678 ppm TDS, and 40845 gpm Circulation Rate
EP-22002	Go-Gen Air Condenser #2	AP-42, Section 13.4 Wet Cooling Towers, Final Section, January 1995.	0.0005% Drift Rate, 6678 ppm TDS, and 40845 gpm Circulation Rate
EP-5201	Mixed Fuel-Fired Boiler #1 (MFFB1)	AP-42 Section 1.6 Wood Residue Combustion in Boilers, Final Section, September 2003. Biomass solids are assumed similar to wood residue in composition and HHV. Wood residue has a heating value that ranges from about 4,500 Btu/lb wet, as-fired basis to 8,000 Btu/lb dry wood. The moisture contents can vary from 5 to 75 wt% depending of residue type and storage operations.	Sodium Sulfate (Na2SO4) is not included in the sulfur emission calculations as it will form Na2S and be collected in ash.
EP-5202	Mixed Fuel-Fired Boiler #2 (MFFB2)	AP-42 Section 1.6 Wood Residue Combustion in Boilers, Final Section, September 2003. Biomass solids are assumed similar to wood residue in composition and HHV. Wood residue has a heating value that ranges from about 4,500 Btu/lb wet, as-fired basis to 8,000 Btu/lb dry wood. The moisture contents can vary from 5 to 75 wt% depending of residue type and storage operations.	Sodium Sulfate (Na2SO4) is not included in the sulfur emission calculations as it will form Na2S and be collected in ash.
EP-20501	Boiler Ash Handling Dust Collector #1	BACT emission factor used to calculate emissions from vents associated with ash, sand and calcium hydroxide handling.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-20502	Boiler Ash Handling Dust Collector #2	BACT emission factor used to calculate emissions from vents associated with ash, sand and calcium hydroxide handling.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-20511	Sand Handling Dust Collector #1	BACT emission factor used to calculate emissions from vents associated with ash, sand and calcium hydroxide handling.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-20512	Sand Handling Dust Collector #2	BACT emission factor used to calculate emissions from vents associated with ash, sand and calcium hydroxide handling.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-1901	Lime Storage Silo #1 Dust Collector	BACT emission factor used to calculate emissions from vents associated with ash, sand and calcium hydroxide handling.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-1902	Lime Storage Silo #2 Dust Collector	BACT emission factor used to calculate emissions from vents associated with ash, sand and calcium hydroxide handling.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-1903	Lime Day Silo Dust Collector	BACT emission factor used to calculate emissions from vents associated with ash, sand and calcium hydroxide handling.	100% Capture Efficiency and 0.004 gr/dscf BACT Emission Factor
EP-9001 (SSM)	Biogas Flare	AP-42 Section 1.4 Natural Gas Combustion, Final Section, July 1998. AP-42 Section 13.5 Industrial Flares, Final Section, September 1991.	SSM Equipment
EP-6001 (Emergency)	Firewater Pump Engine	AP-42 Section 3.3 Gasoline and Diesel Industrial Engines, Final Section, October 1996.	Equipment for emergency purposes only.
EP-6051 (Emergency)	Power Back-up Generator	AP-42 Section 3.4 Large Stationary Diesel and All Stationary Dual-fuel Engines, Final Section, October 1996.	Equipment for emergency purposes only.

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Operations Data

Plant Capacity:	***Denatured Ethanol:***	*18.90*	*MMgal/yr*	***Biomass:***	*912,500*	*ton/yr*
	Anhydrous Ethanol:	*18.00*	*MMgal/yr*			

Plant Operations:	*365*	*day/yr*
	8,760	*hr/yr*

UNCONTROLLED Potential to Emit Summary (TPY)

Emission Point No.	Emission Unit(s)	PM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Single HAP	Total HAPs	Direct CO_2 + CO_2e
HAUL ROADS											
EP-1000 (Fugitive)	Paved Plant Roads	233.23	59.44	5.94							
EP-1050 (Fugitive)	Biomass Laydown Roads	8.83	2.25	0.23							
ENZYMATIC HYDROLYSIS PLANT											
EP-11025	Gasification Metering Bin #1 (GMB1) DC-11139										
EP-11026	Gasification Metering Bin #2 (GMB2) DC-11239										
EP-11027	EH Metering Bin #1 (EMB1) DC-11339										
EP-11028	EH Metering Bin #2 (EMB2) DC-11439										
EP-11030	Gasification Day Bin #1 (GB1) Rotary Valve Vent										
EP-11033	Gasification Day Bin #2 (GB2) Rotary Valve Vent										
EP-11037	Gasification Day Bin #1 (GB1) DC-11172										
EP-11039	Gasification Day Bin #2 (GB2) DC-11272										
EP-11041	EH Day Bin (EDB1) Rotary Valve Vent										
EP-11044	EH Day Bin (EDB1) DC-11372										
EP-11071	Biomass Grinding Line DC #1										
EP-11072	Biomass Grinding Line DC #2										
EP-11080	Floor Sweep System DC-11234										
EP-11081	Dirt Load-Out Silo DC-11190										
EP-11082	Dirt Load-Out Silo Spout DC-11168										
EP-11000 (Fugitive)	Biomass Receiving, Handling and Grinding	411.54	127.43	21.40							
EP-13150	EH Vent Scrubber	1.10	1.10	1.10				42.05			See EP-18185
EP-18185	EH CO2 Scrubber							2,198.76			56,616
EP-18180	EH Distillation Vent Scrubber							344.60	3.93	12.96	See EP-18185
EP-19005	Biomass Stillage Preheater Vent Condenser							26.28			
EP-19010	Biomass Process Evaporator Vent Condenser							26.28			
EP-19001FUG (Fugitive)	Lignin-Rich Stillage Storage and Loadout							0.50	0.0135	0.024	
ETHANOL STORAGE AND PIPING											
EP-2000 (Fugitive)	Fugitive Leaks							8.30	1.66E-03	0.00	
T-2100A	T-2100A Shift Tank							0.12	2.40E-05	0.00006	
T-2100B	T-2100B Shift Tank							0.12	2.40E-05	0.00006	
T-2100C	T-2100C EH Off-Spec Tank							0.07	1.50E-05	0.00004	
T-2101	T-2101 Denatured Ethanol							0.21	5.26E-05	0.00020	
T-2120	T-2120 Denaturant							1.61	8.06E-03	0.0132	
EP-2150	Vapor Recovery System										
EP-2150FUG (Fugitive)	Loading Losses							7.35	0.01	0.03	

UNCONTROLLED Potential to Emit Summary (TPY)

Emission Point No.	Emission Unit(s)	PM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Single HAP	Total HAPs	Direct $CO_2 + CO_2e$
UTILITIES											
EP-4001	EH Cooling Tower	0.27	0.27	0.27							
EP-22001	Go-Gen Air Condenser #1	1.57	1.57	1.57							
EP-22002	Go-Gen Air Condenser #2	1.57	1.57	1.57							
EP-5201	Mixed Fuel-Fired Boiler #1 (MFFB1)	2,081.20	1,864.78	1,612.30	991.91	828.45	531.60	61.32	926.98	997.86	798,399
EP-5202	Mixed Fuel-Fired Boiler #2 (MFFB2)	2,081.20	1,864.78	1,612.30	991.91	828.45	531.60	61.32	926.98	997.86	798,399
EP-20501	Boiler Ash Handling Dust Collector #1										
EP-20502	Boiler Ash Handling Dust Collector #2										
EP-20511	Sand Handling Dust Collector #1										
EP-20512	Sand Handling Dust Collector #2										
EP-1901	Lime Storage Silo #1 Dust Collector										
EP-1902	Lime Storage Silo #2 Dust Collector										
EP-1903	Lime Day Silo Dust Collector										
EP-9001 (SSM)	Biogas Flare	0.003	0.003	0.003	0.36	0.29	1.78	0.002	0.0008	0.0008	716.81
EP-6001 (Emergency)	Firewater Pump Engine	0.008	0.008	0.008	0.15	0.05	0.13	0.15	0.0004	0.0010	190.16
EP-6051 (Emergency)	Power Back-up Generator	0.025	0.025	0.025	0.79	0.03	0.43	0.79	0.2086	0.3104	618.01
Total Plantwide		**4,820.53**	**3,923.22**	**3,256.70**	**1,985.11**	**1,657.27**	**1,065.54**	**2,779.83**	**1,853.96**	**2,009.07**	**1,654,938**

Basis:

1. The following major source threshold levels apply to the facility:

	Major Source Threshold	Synthetic Minor Source Threshold	Construction Permit Threshold	Proposed Major Source Thresholds
VOC:	100 ton/yr	50 ton/yr	40 ton/yr	250 ton/yr
NO_x:	100 ton/yr	50 ton/yr	40 ton/yr	250 ton/yr
SO_2:	100 ton/yr	50 ton/yr	40 ton/yr	250 ton/yr
CO:	100 ton/yr	50 ton/yr	50 ton/yr	250 ton/yr
PM/PM_{10}:	100 ton/yr	50 ton/yr	15 ton/yr	250 ton/yr
HAPs:	10/25 ton/yr	5/12.5 ton/yr	2.5/10 ton/yr	10/25 ton/yr

2. Fugitive emissions are required to be included in the potential to emit calculations since the State of Kansas has not delisted ethanol plants; and therefore, an ethanol plant is still included in the source category, "chemical process plant", under KSA 28-19-300.
3. All biomass handling operations, including grinding and hammermilling, will be performed at the proposed project.
4. All plant haul roads will be paved.

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

Operations Data

Plant Capacity:	***Denatured Ethanol:***	*18.90*	*MMgal/yr*	***Biomass:***	*912,500*	*ton/yr*
	Anhydrous Ethanol:	*18.00*	*MMgal/yr*			

Plant Operations:	*365*	*day/yr*
	8,760	*hr/yr*

CONTROLLED Potential to Emit Summary (TPY)

Emission Point No.	Emission Unit(s)	PM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Single HAP	Total HAPs	Direct $CO_2 + CO_2e$
HAUL ROADS											
EP-1000 (Fugitive)	Paved Plant Roads	11.66	2.97	0.30							
EP-1050 (Fugitive)	Biomass Laydown Roads	2.65	0.68	0.07							
ENZYMATIC HYDROLYSIS PLANT											
EP-11025	Gasification Metering Bin #1 (GMB1) DC-11139	1.61	1.61	1.61							
EP-11026	Gasification Metering Bin #2 (GMB2) DC-11239	1.61	1.61	1.61							
EP-11027	EH Metering Bin #1 (EMB1) DC-11339	1.61	1.61	1.61							
EP-11028	EH Metering Bin #2 (EMB2) DC-11439	1.61	1.61	1.61							
EP-11030	Gasification Day Bin #1 (GB1) Rotary Valve Vent	0.04	0.04	0.04							
EP-11033	Gasification Day Bin #2 (GB2) Rotary Valve Vent	0.04	0.04	0.04							
EP-11037	Gasification Day Bin #1 (GB1) DC-11172	0.97	0.97	0.97							
EP-11039	Gasification Day Bin #2 (GB2) DC-11272	0.97	0.97	0.97							
EP-11041	EH Day Bin (EDB1) Rotary Valve Vent	0.04	0.04	0.04							
EP-11044	EH Day Bin (EDB1) DC-11372	0.97	0.97	0.97							
EP-11071	Biomass Grinding Line DC #1	14.58	14.58	14.58							
EP-11072	Biomass Grinding Line DC #2	14.58	14.58	14.58							
EP-11080	Floor Sweep System DC-11234	0.99	0.99	0.99							
EP-11081	Dirt Load-Out Silo DC-11190	0.08	0.08	0.08							
EP-11082	Dirt Load-Out Silo Spout DC-11168	0.19	0.19	0.19							
EP-11000 (Fugitive)	Biomass Receiving, Handling and Grinding	4.11	1.35	0.23							
EP-13150	EH Vent Scrubber	1.10	1.10	1.10				2.10			See EP-18185
EP-18185	EH CO2 Scrubber							21.99			56,616
EP-18180	EH Distillation Vent Scrubber							3.45	6.40E-01	0.74	See EP-18185
EP-19005	Biomass Stillage Preheater Vent Condenser							0.53			
EP-19010	Biomass Process Evaporator Vent Condenser							0.00			
EP-19001FUG (Fugitive)	Lignin-Rich Stillage Storage and Loadout							0.50	0.0135	0.024	
ETHANOL STORAGE AND PIPING											
EP-2000 (Fugitive)	Fugitive Leaks							1.84	9.54E-04	0.0010	
T-2100A	T-2100A Shift Tank							0.12	2.40E-05	0.0001	
T-2100B	T-2100B Shift Tank							0.12	2.40E-05	0.00006	
T-2100C	T-2100C EH Off-Spec Tank							0.07	1.50E-05	0.00004	
T-2101	T-2101 Denatured Ethanol							0.21	5.26E-05	0.00020	
T-2120	T-2120 Denaturant							1.61	8.06E-03	0.0132	
EP-2150	Vapor Recovery System							0.87	0.0017	0.0031	
EP-2150FUG (Fugitive)	Loading Losses							0.73	0.0015	0.003	

CONTROLLED Potential to Emit Summary (TPY)

Emission Point No.	Emission Unit(s)	PM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Single HAP	Total HAPs	Direct $CO_2 + CO_2e$
UTILITIES											
EP-4001	EH Cooling Tower	0.27	0.27	0.27							
EP-22001	Go-Gen Air Condenser #1	1.57	1.57	1.57							
EP-22002	Go-Gen Air Condenser #2	1.57	1.57	1.57							
EP-5201	Mixed Fuel-Fired Boiler #1 (MFFB1)	81.52	79.35	76.83	495.95	82.85	531.60	61.32	9.27	15.64	798,399
EP-5202	Mixed Fuel-Fired Boiler #2 (MFFB2)	81.52	79.35	76.83	495.95	82.85	531.60	61.32	9.27	15.64	798,399
EP-20501	Boiler Ash Handling Dust Collector #1	1.50	1.50	1.50							
EP-20502	Boiler Ash Handling Dust Collector #2	1.50	1.50	1.50							
EP-20511	Sand Handling Dust Collector #1	1.81	1.81	1.81							
EP-20512	Sand Handling Dust Collector #2	1.81	1.81	1.81							
EP-1901	Lime Storage Silo #1 Dust Collector	0.14	0.14	0.14							
EP-1902	Lime Storage Silo #2 Dust Collector	0.14	0.14	0.14							
EP-1903	Lime Day Silo Dust Collector	0.14	0.14	0.14							
EP-9001 (SSM)	Biogas Flare	0.003	0.003	0.003	0.36	0.2905	1.78	0.002	0.0008	0.0008	716.81
EP-6001 (Emergency)	Firewater Pump Engine	0.008	0.008	0.008	0.15	0.05	0.13	0.15	0.0004	0.0010	190.16
EP-6051 (Emergency)	Power Back-up Generator	0.025	0.025	0.02	0.79	0.03	0.43	0.79	0.2086	0.3104	618.01
Total Plantwide		**232.88**	**215.13**	**205.68**	**993.21**	**166.06**	**1065.54**	**157.72**	**18.54**	**32.37**	**1,654,938**

Basis:

1. The following major source threshold levels apply to the facility:

	Major Source Threshold	Synthetic Minor Source Threshold	Construction Permit Threshold	Proposed Major Source Thresholds
VOC:	100 ton/yr	50 ton/yr	40 ton/yr	250 ton/yr
NO_x:	100 ton/yr	50 ton/yr	40 ton/yr	250 ton/yr
SO_2:	100 ton/yr	50 ton/yr	40 ton/yr	250 ton/yr
CO:	100 ton/yr	50 ton/yr	50 ton/yr	250 ton/yr
PM/PM_{10}:	100 ton/yr	50 ton/yr	15 ton/yr	250 ton/yr
HAPs:	10/25 ton/yr	5/12.5 ton/yr	2.5/10 ton/yr	10/25 ton/yr

2. Fugitive emissions are required to be included in the potential to emit calculations since the State of Kansas has not delisted ethanol plants; and therefore, an ethanol plant is still included in the source category, "chemical process plant", under KSA 28-19-300.
3. All biomass handling operations, including grinding and hammermilling, will be performed at the proposed project.
4. All plant haul roads will be paved.

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UNCONTROLLED HAPs Summary (TPY)

CAS No.	HAP Chemicals	EP-18180 EH Distillation Vent Scrubber	EP-2000 (Fugitive) Fugitive Leaks	T-2100A T-2100A Shift Tank	T-2100B T-2100B Shift Tank	T-2100C T-2100C EH Off-Spec Tank	T-2101 T-2101 Denatured Ethanol	T-2120 T-2120 Denaturant	EP-2150 Vapor Recovery System
75-07-0	Acetaldehyde	2.96E+00	1.66E-03	2.40E-05	2.40E-05	1.50E-05	4.29E-05		--
107-02-8	Acrolein	3.93E+00	1.66E-04	2.40E-06	2.40E-06	1.50E-06	4.29E-06		--
71-43-2	Benzene						2.63E-05	4.03E-03	--
7782-50-5	Chlorine								
75-15-0	Carbon disulfide						2.10E-07	6.45E-05	--
9882-8	Cumene						1.05E-06	1.61E-04	--
95-50-1	Dichlorobenzene								
75-09-2	Dichloromethane								
100-41-4	Ethylbenzene						5.26E-07	8.06E-05	--
206-44-0	Fluoranthene								
86-73-7	Fluorene								
50-00-0	Formaldehyde	3.93E+00	8.30E-04	1.20E-05	1.20E-05	7.48E-06	2.15E-05		--
110-54-3	Hexane								
7647-01-0	Hydrogen chloride								
67-56-1	Methanol	2.14E+00	1.66E-03	2.40E-05	2.40E-05	1.50E-05	4.29E-05		--
91-20-3	Naphthalene								
85-01-8	Phenanathrene								
115-07-1	Propylene								
129-00-0	Pyrene								
100-42-5	Styrene								
108-88-3	Toluene						5.26E-05	8.06E-03	--
1330-20-7	Xylene						5.26E-06	8.06E-04	--
7440-36-0	Antimony								
7440-38-2	Arsenic								
7440-41-7	Beryllium								
7440-43-9	Cadmium								
7440-47-3	Chromium								
7440-48-4	Cobalt								
7439-92-1	Lead								
7439-96-5	Manganese								
7439-97-6	Mercury								
7440-02-0	Nickel								
7782-49-2	Selenium								
	Other HAPs								
Total HAPs Per Unit		**12.96**	**0.00431**	**0.00006**	**0.00006**	**0.00004**	**0.00020**	**0.0132**	**0**

UNCONTROLLED HAPs Summary (TPY)

CAS No.	HAP Chemicals	EP-2150FUG (Fugitive) Loading Losses	EP-5201 Mixed Fuel-Fired Boiler #1 (MFFB1)	EP-5202 Mixed Fuel-Fired Boiler #2 (MFFB2)	EP-9001 (SSM) Biogas Flare	EP-19001FUG (Fugitive) Lignin-Rich Stillage Storage and Loadout	EP-6001 (Emergency) Firewater Pump Engine	EP-6051 (Emergency) Power Back-up Generator	Maximum Single HAP
75-07-0	Acetaldehyde	9.35E-04	2.99	2.99		6.74E-03	1.23E-04	1.88E-03	**8.96**
107-02-8	Acrolein	9.35E-05	14.43	14.43		1.01E-03			**32.79**
71-43-2	Benzene	7.26E-03	15.15	15.15	9.20E-07		1.50E-04	5.80E-02	**30.37**
7782-50-5	Chlorine		2.85	2.85					**5.7**
75-15-0	Carbon disulfide	5.81E-05							**0.0001**
9882-8	Cumene	2.90E-04							**0.**
95-50-1	Dichlorobenzene				5.26E-07				**0.**
75-09-2	Dichloromethane		1.05	1.05					**2.09**
100-41-4	Ethylbenzene	1.45E-04	0.11	0.11					**0.22**
206-44-0	Fluoranthene		5.77E-03	5.77E-03	1.31E-09				**0.01**
86-73-7	Fluorene		1.23E-02	1.23E-02	1.23E-09				**0.02**
50-00-0	Formaldehyde	4.68E-04	15.87	15.87	3.29E-05	1.35E-02	1.90E-04	5.90E-03	**35.69**
110-54-3	Hexane				7.88E-04				**0.**
7647-01-0	Hydrogen chloride		926.98	926.98					**1,853.96**
67-56-1	Methanol	9.35E-04				2.70E-03			**2.14**
91-20-3	Naphthalene		0.35	0.35	2.67E-07		1.37E-05	5.89E-04	**0.7**
85-01-8	Phenanathrene		2.52E-02	2.52E-02	7.45E-09				**0.05**
115-07-1	Propylene						4.15E-04	2.09E-01	**0.21**
129-00-0	Pyrene		1.33E-02	1.33E-02	2.19E-09				**0.03**
100-42-5	Styrene		6.85	6.85	1.49E-06		6.58E-05	2.10E-02	**13.73**
108-88-3	Toluene	1.45E-02	3.32	3.32					**6.66**
1330-20-7	Xylene	1.45E-03	0.09	0.09			4.59E-05	1.44E-02	**0.2**
7440-36-0	Antimony		2.85E-02	2.85E-02					**0.06**
7440-38-2	Arsenic		7.94E-02	7.94E-02	8.76E-08				**0.16**
7440-41-7	Beryllium		3.97E-03	3.97E-03					**0.01**
7440-43-9	Cadmium		1.48E-02	1.48E-02	4.82E-07				**0.03**
7440-47-3	Chromium		7.57E-02	0.08	6.13E-07				**0.15**
7440-48-4	Cobalt		2.34E-02	2.34E-02	3.68E-08				**0.05**
7439-92-1	Lead		9.93E-06	9.93E-06	2.19E-07				**0.**
7439-96-5	Manganese		5.77	5.77	1.66E-07				**11.54**
7439-97-6	Mercury		0.01	1.26E-02	1.14E-07				**0.03**
7440-02-0	Nickel		0.12	1.19E-01	9.20E-07				**0.24**
7782-49-2	Selenium		0.01	1.01E-02					**0.02**
	Other HAPs		1.63	1.63	1.05E-08				**3.26**
Total HAPs Per Unit		**0.03**	**997.86**	**997.86**	**0.00083**	**0.024**	**0.00100**	**0.31**	**1,853.96**
Total Plantwide HAPs									**2,009.07**

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CONTROLLED HAPs Summary (TPY)

CAS No.	HAP Chemicals	EP-18180 EH Distillation Vent Scrubber	EP-2000 (Fugitive) Fugitive Leaks	T-2100A T-2100A Shift Tank	T-2100B T-2100B Shift Tank	T-2100C T-2100C EH Off-Spec Tank	T-2101 T-2101 Denatured Ethanol	T-2120 T-2120 Denaturant	EP-2150 Vapor Recovery System
75-07-0	Acetaldehyde	6.40E-01	3.67E-04	2.40E-05	2.40E-05	1.50E-05	4.29E-05		1.10E-04
107-02-8	Acrolein	4.00E-02	3.67E-05	2.40E-06	2.40E-06	1.50E-06	4.29E-06		1.10E-05
71-43-2	Benzene						2.63E-05	4.03E-03	8.56E-04
7782-50-5	Chlorine								
75-15-0	Carbon disulfide						2.10E-07	6.45E-05	6.85E-06
9882-8	Cumene						1.05E-06	1.61E-04	3.43E-05
95-50-1	Dichlorobenzene								
75-09-2	Dichloromethane								
100-41-4	Ethylbenzene						5.26E-07	8.06E-05	1.71E-05
206-44-0	Fluoranthene								
86-73-7	Fluorene								
50-00-0	Formaldehyde	4.00E-02	1.84E-04	1.20E-05	1.20E-05	7.48E-06	2.15E-05		5.52E-05
110-54-3	Hexane								
7647-01-0	Hydrogen chloride								
67-56-1	Methanol	2.00E-02	3.67E-04	2.40E-05	2.40E-05	1.50E-05	4.29E-05		1.10E-04
91-20-3	Naphthalene								
85-01-8	Phenanathrene								
115-07-1	Propylene								
129-00-0	Pyrene								
100-42-5	Styrene								
108-88-3	Toluene						5.26E-05	8.06E-03	1.71E-03
1330-20-7	Xylene						5.26E-06	8.06E-04	1.71E-04
7440-36-0	Antimony								
7440-38-2	Arsenic								
7440-41-7	Beryllium								
7440-43-9	Cadmium								
7440-47-3	Chromium								
7440-48-4	Cobalt								
7439-92-1	Lead								
7439-96-5	Manganese								
7439-97-6	Mercury								
7440-02-0	Nickel								
7782-49-2	Selenium								
	Other HAPs								
Total HAPs Per Unit		**0.74**	**0.0010**	**0.00006**	**0.00006**	**0.00004**	**0.00020**	**0.01321**	**0.0031**

CONTROLLED HAPs Summary (TPY)

CAS No.	HAP Chemicals	EP-2150FUG (Fugitive) Loading Losses	EP-5201 Mixed Fuel-Fired Boiler #1 (MFFB1)	EP-5202 Mixed Fuel-Fired Boiler #2 (MFFB2)	EP-9001 (SSM) Biogas Flare	EP-19001FUG (Fugitive) Lignin-Rich Stillage Storage and Loadout	EP-6001 (Emergency) Firewater Pump Engine	EP-6051 (Emergency) Power Back-up Generator	Maximum Single HAP
75-07-0	Acetaldehyde	9.35E-05	0.30	0.30		6.74E-03	1.23E-04	1.88E-03	**1.25**
107-02-8	Acrolein	9.35E-06	1.44	1.44		1.01E-03		5.89E-04	**2.93**
71-43-2	Benzene	7.26E-04	1.51	1.51	9.20E-07		1.50E-04	5.80E-02	**3.09**
7782-50-5	Chlorine		0.03	0.03					**0.06**
75-15-0	Carbon disulfide	5.81E-06							**0.0001**
9882-8	Cumene	2.90E-05							**0.**
95-50-1	Dichlorobenzene				5.26E-07				**0.**
75-09-2	Dichloromethane		0.10	0.10					**0.21**
100-41-4	Ethylbenzene	1.45E-05	1.12E-02	1.12E-02					**0.02**
206-44-0	Fluoranthene		5.77E-03	5.77E-03	1.31E-09				**0.01**
86-73-7	Fluorene		1.23E-02	1.23E-02	1.23E-09				**0.02**
50-00-0	Formaldehyde	4.68E-05	1.59	1.59	3.29E-05	1.35E-02	1.90E-04	5.90E-03	**3.23**
110-54-3	Hexane				7.88E-04				**0.**
7647-01-0	Hydrogen chloride		9.27	9.27					**18.54**
67-56-1	Methanol	9.35E-05				2.70E-03			**0.02**
91-20-3	Naphthalene		0.03	0.03	2.67E-07		1.37E-05		**0.07**
85-01-8	Phenanathrene		2.52E-02	2.52E-02	7.45E-09				**0.05**
115-07-1	Propylene						4.15E-04	2.09E-01	**0.21**
129-00-0	Pyrene		1.33E-02	1.33E-02	2.19E-09				**0.03**
100-42-5	Styrene		0.69	0.69					**1.37**
108-88-3	Toluene	1.45E-03	0.33	0.33	1.49E-06		6.58E-05	2.10E-02	**0.7**
1330-20-7	Xylene	1.45E-04	9.02E-03	9.02E-03			4.59E-05	1.44E-02	**0.03**
7440-36-0	Antimony		2.85E-04	2.85E-04					**0.0006**
7440-38-2	Arsenic		7.94E-04	7.94E-04	8.76E-08				**0.002**
7440-41-7	Beryllium		3.97E-05	3.97E-05					**0.0001**
7440-43-9	Cadmium		1.48E-04	1.48E-04	4.82E-07				**0.**
7440-47-3	Chromium		7.57E-04	7.57E-04	6.13E-07				**0.**
7440-48-4	Cobalt		2.34E-04	2.34E-04	3.68E-08				**0.0005**
7439-92-1	Lead		9.93E-06	9.93E-06	2.19E-07				**0.**
7439-96-5	Manganese		5.77E-02	5.77E-02	1.66E-07				**0.12**
7439-97-6	Mercury		1.26E-04	1.26E-04	1.14E-07				**0.**
7440-02-0	Nickel		1.19E-03	1.19E-03	9.20E-07				**0.**
7782-49-2	Selenium		1.01E-04	1.01E-04					**0.0002**
	Other HAPs		0.20	0.20					**0.4**
Total HAPs Per Unit		**0.003**	**15.64**	**15.64**	**0.00083**	**0.024**	**0.0010**	**0.31**	**18.54**
Total Plantwide HAPs									**32.37**

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

Direct GHG Summary (TPY)

Pollutants	EP-18185 EH CO2 Scrubber	EP-13150 EH Vent Scrubber	EP-18180 EH Distillation Vent Scrubber	EP-9001 (SSM) Biogas Flare	EP-5201 Mixed Fuel-Fired Boiler #1 (MFFB1)	EP-5202 Mixed Fuel-Fired Boiler #2 (MFFB2)	EP-6001 Firewater Pump Engine	EP-6051 Power Back-up Generator
CO_2	56,616	0.00	0.00	717	782,699	782,699	189.51	615.91
CH_4				0.0010	255	255	0.0078	0.025
CH_4 => CO_2 Equivalent[1]				0.02	5,344.60	5,344.60	0.16	0.53
N_2O				0.00010	33.40	33.40	0.0016	0.0051
N_2O => CO_2 Equivalent[1]				0.03	10,355.17	10,355.17	0.48	1.57
Total CO_2 + CO_2e	**56,616**	**0**	**0**	**716.81**	**798,399**	**798,399**	**190.16**	**618.01**

(1) To incorporate and evaluate non-CO_2 gases, the mass estimates of these gases were converted to their CO_2 equivalent (CO_2e). To calculate the CO_2 equivalent, the mass of the non-CO_2 gas is multiplied by the non-CO_2 gas's Global Warming Potential (GWP), see note 2 below. The GWPs for CH_4 and N_2O are 21 and 310, respectively, as reported by the Intergovernmental Panel on Climate

(2) Global Warming Potentials (GWPs) were developed by the Intergovernmental Panel on Climate Change (IPCC) to quantify the globally averaged relative radiative forcing effects of a given GHG, using CO_2 as the reference gas. In 1996, the IPCC published a set of GWPs for the most commonly measured greenhouse gases in its Second Assessment Report (SAR). In 2001, the IPCC published its Third Assessment Report (TAR), which adjusted the GWPs to reflect new information on atmospheric lifetimes and an improved calculation of the radiative forcing of CO_2. However, SAR GWPs are still used by international convention and the U.S. to maintain the value of the CO_2 "currency". To maintain consistency with international practice, the California Climate Action Registry requires participants to use GWPs from the SAR when determining de minimis emissions, establishing baselines, and making baseline adjustments.

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

EP-1000
Paved Plant Roads

Basis: AP-42 Section 13.2.2 Unpaved Haul Roads, Final Section, November 2006.

Emission Factor Equation: $E=[k(s/12)^a(W/3)^b]*[(365-P)/365]$ Equation 13.2.2-1a

where:
E = particulate emission factor (pounds per vehicle mile traveled, lb/VMT)
k, a, b = dimensionless constants
s = surface material silt content (%)
W = mean vehicle weight of the vehicles traveling the road (tons)
P = number of "wet" days with at least 0.254 mm (0.01-in) of precipitation during the averaging period

		PM_{30}	PM_{10}	$PM_{2.5}$	Unit	Notes
Particle Size Multipliers for Paved Road Equation	k	4.9	1.5	0.15		Table 13.2.2-2
	a	0.7	0.9	0.9		Table 13.2.2-2
	b	0.45	0.45	0.45		Table 13.2.2-2
Mean Silt Content	s	4.8	4.8	4.8	%	Utah DEQ March 10, 2008 Memo
Average Weight of Vehicles	W	26.26	26.26	26.26	tons	Average weight, see calculation below
Mean Days > 0.01-in precipitation	P	75	75	75	days	1971-2000 Average Annual Precipitation
Paved Road Surface with Sweeping and Watering	CE	95	95	95	%	Utah DEQ March 10, 2008 Memo
Enforced Speed Limit	S	15	15	15	mph	Utah DEQ March 10, 2008 Memo

Emission Factors:

					Uncontrolled Emission Factors			Controlled Emission Factors		
		Daily Ops	Annual Ops		PM_{30}	PM_{10}	$PM_{2.5}$	PM_{30}	PM_{10}	$PM_{2.5}$
ID	Source Description	(hr/day)	(day/yr)	(hrs/yr)	(lb/VMT)	(lb/VMT)	(lb/VMT)	(lb/VMT)	(lb/VMT)	(lb/VMT)
EP-1000	Paved Plant Roads	16	330	5,280	5.441	1.387	0.139	0.272	0.069	0.007

Uncontrolled PM/PM_{10}/$PM_{2.5}$

		PM_{30}			PM_{10}			$PM_{2.5}$		
ID	Source Description	(lb/hr)	(lb/day)	(ton/yr)	(lb/hr)	(lb/day)	(ton/yr)	(lb/hr)	(lb/day)	(ton/yr)
EP-1000	Paved Plant Roads	88.34	1,413.49	233.23	22.52	360.25	59.44	2.25	36.02	5.94
Total		**88.34**		**233.23**	**22.52**		**59.44**	**2.25**		**5.94**

Controlled PM/PM_{10}/$PM_{2.5}$ Emissions:

		PM_{30}			PM_{10}			$PM_{2.5}$		
ID	Source Description	(lb/hr)	(lb/day)	(ton/yr)	(lb/hr)	(lb/day)	(ton/yr)	(lb/hr)	(lb/day)	(ton/yr)
EP-1000	Paved Plant Roads	4.42	70.67	11.66	1.13	18.01	2.97	0.11	1.80	0.30
Total		**4.42**		**11.66**	**1.13**		**2.97**	**0.11**		**0.30**

EP-1000
Paved Plant Roads

Average Weight of Vehicles:

Material Loaded/Unloaded	miles LOADED Per Year	miles EMPTY Per Year	miles TOTAL Per Year	LOADED weight	EMPTY weight		
Ethanol (Denatured)	1,227.69	998.28	2,225.97	40	15	45.02%	percent of total miles LOADED trucks
Denaturant (Gasoline)	95.07	116.92	212.00	40	15	54.98%	percent of total miles EMPTY trucks
Biomass Delivery	23,302.52	29,053.89	52,356.41	36	15		
Lignin-Rich/Lean Stillage	5,806.63	7,049.71	12,856.34	40	15		
Misc. Chemicals & Supplies	8,164.46	9,912.30	18,076.77	30	15		
Facility-wide	**38,596**	**47,131**	**85,727**				

W = (% of Miles LOADED)(LOADED Weight) + (% of Miles EMPTY)(EMPTY Weight)

W = **26.26 tons**

VMT Calculations:	Load Size	Annual Volume	% by Truck	Annual Volume by Truck	Trips / Year	Annual VMT
Ethanol (Denatured)	7,500 gal	61,987 ton/yr	50%	30,993.64 ton/yr	1,260	2,225.97
Denaturant (Gasoline)	7,500 gal	2,952 ton/yr	100%	2,951.78 ton/yr	120	212.00
Biomass Delivery	21 tons	912,500 ton/yr	100%	912,500.00 ton/yr	43,453	52,356.41
Lignin-Rich/Lean Stillage	25 tons	225,273 ton/yr	100%	225,273.10 ton/yr	9,011	12,856.34
Misc. Chemicals & Supplies	14.6 tons	184,434 ton/yr	100%	184,434.39 ton/yr	12,670	18,076.77
Facility-wide		**1,387,147 ton/yr**			**66,514**	**85,727.49**

Supporting Calculations:

Ethanol (Denatured)

** Denatured ethanol will primarily be shipped offsite by rail; however a conservative estimate of 50% shipped by truck is included as a worst-case scenario.

Ethanol (Denatured) Production - Annual	18.90	MMgal/yr
	61,987	ton/yr
Ethanol (Denatured) Shipped - Daily	57,273	gal/day
	188	ton/day
% Shipped by Truck	50%	
Ethanol (Denatured) Density	6.56	lb/gal
Truck Capacity	7,500	gal
	25	tons
Estimated Truck Trips	1,260	trips/yr
	4	trips/day

Truck Travel on Plant Roads	5,145	feet per trip LOADED	1,227.69	miles LOADED
	4,183	feet per trip EMPTY	998.28	miles EMPTY
			2,225.97	**miles TOTAL**

EP-1000
Paved Plant Roads

Denaturant (Gasoline)

Denaturant (Gasoline) Usage - Annual	0.90	MMgal/yr
	2,952	ton/yr
Denaturant (Gasoline) Received - Daily	2,727.27	gal/day
	8	ton/day
% Shipped by Truck	100%	
Denaturant (Gasoline) Density	6.17	lb/gal
Truck Capacity	7,500	gal
	25	tons
Estimated Truck Trips	120	trips/yr
	1	trips/day

Truck Travel on Plant Roads	4,183	feet per trip LOADED	95.07	miles LOADED
	5,145	feet per trip EMPTY	116.92	miles EMPTY
			212.00	**miles TOTAL**

Biomass Delivery

Biomass Receiving - Annual	912,500	ton/yr
Biomass Receiving - Daily	2,500	ton/day
% Received by Truck	100%	
Truck Capacity	21	tons
Estimated Truck Trips	43,453	trips/yr
	120	trips/day
	8	trips/hr
	8	min/truck

Truck Travel on Plant Roads	2,832	feet per trip LOADED	23,302.52	miles LOADED
	3,530	feet per trip EMPTY	29,053.89	miles EMPTY
			52,356.41	**miles TOTAL**

Lignin-Rich/Lean Stillage

Lignin-Rich/Lean Stillage Handling	225,273	ton/yr
Lignin Shipping/Receiving - Daily	617	ton/day
% Shipped by Truck	100%	
Truck Capacity	25	tons
Estimated Truck Trips	9,011	trips/yr
	25	trips/day
	2	trips/hr
	30	min/truck

Truck Travel on Plant Roads	3,402	feet per trip LOADED	5,806.63	miles LOADED
	4,131	feet per trip EMPTY	7,049.71	miles EMPTY
			12,856.34	**miles TOTAL**

EP-1000
Paved Plant Roads

Misc. Chemicals, Enzymes & Supplies

**For the purpose of estimating the weighted vehicle average, the annual usage was divided by the total number of truck trips.

Chemicals Received - Annual	184,434	ton/yr
% Shipped by Truck	100%	
Truck Capacity**	14.6	tons
Estimated Truck Trips	12,670	trips/yr
	1,056	trips/mo
	35	trips/day

Truck Travel on Plant Roads	3,402	feet per trip LOADED	8,164.46	miles LOADED
	4,131	feet per trip EMPTY	9,912.30	miles EMPTY
			18,076.77	**miles TOTAL**

Misc. Chemicals & Enzymes Used	Usage (lb/day)	Usage (lb/yr)	Truck Capacity (lb/truck)	Truck Trips (trips/yr)
Chemicals				
Sulfuric Acid (94%) Usage	20,241	7,387,834	NA	Rail
Sodium Hydroxide (50%) Usage	8,172	2,982,605	49,500	61
Aqueous Ammonia (<20%) Usage	38,154	13,926,298	49,500	282
Magnesium Hydroxide (50%) Usage	699	255,091	49,500	6
Diamonium Phosphate Usage	27	9,811	49,500	1
Calcium Hydroxide (Lime) Usage	38,415	14,021,391	NA	Rail
Limestone Usage	42,070	15,355,606	NA	Rail
Diesel Usage	36,198	13,212,409	53,175	249
Enzymes & Additives				
Corn Syrup	72,495	26,460,806	49,500	535
Cellulase Usage	84,780	30,944,525	49,500	626
Misc. Supplies				
Urea Usage	21,396	7,809,715	49,500	158
Fluidized Based Sand Usage	3,988	60,646	22,000	3
Boiler Ash Waste	455,260	166,169,900	22,000	7,554
Dirt/Fines Waste From Baghouses	192,000	70,080,000	22,000	3,186
Hazardous & Municipal Wastes	526	192,146	22,000	9
Total Annual Lbs		368,868,783		12,670
Total Annual Tons		184,434		

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

EP-1050
Biomass Laydown Roads

Basis: AP-42 Section 13.2.2 Unpaved Haul Roads, Final Section, November 2006.

Emission Factor Equation: $E=[k(s/12)^a(W/3)^b]*[(365-P)/365]$ Equation 13.2.2-1a

where:
E = particulate emission factor (pounds per vehicle mile traveled, lb/VMT)
k, a, b = dimensionless constants
s = surface material silt content (%)
W = mean vehicle weight of the vehicles traveling the road (tons)
P = number of "wet" days with at least 0.254 mm (0.01-in) of precipitation during the averaging period

		PM_{30}	PM_{10}	$PM_{2.5}$	Unit	Notes
Particle Size Multipliers for Paved Road Equation	k	4.9	1.5	0.15		Table 13.2.2-2
	a	0.7	0.9	0.9		Table 13.2.2-2
	b	0.45	0.45	0.45		Table 13.2.2-2
Mean Silt Content	s	4.8	4.8	4.8	%	Utah DEQ March 10, 2008 Memo
Average Weight of Vehicles	W	25.50	25.50	25.50	tons	Average weight, see calculation below
Mean Days > 0.01-in precipitation	P	85	85	85	days	1971-2000 Average Annual Precipitation
Chemical Suppressant and Watering	CE	70	70	70	%	Utah DEQ March 10, 2008 Memo

Emission Factors:

					Uncontrolled Emission Factors			Controlled Emission Factors		
		Daily Ops	Annual Ops		PM_{30}	PM_{10}	$PM_{2.5}$	PM_{30}	PM_{10}	$PM_{2.5}$
ID	Source Description	(hr/day)	(day/yr)	(hrs/yr)	(lb/VMT)	(lb/VMT)	(lb/VMT)	(lb/VMT)	(lb/VMT)	(lb/VMT)
EP-1050	Biomass Laydown Roads	16	330	5,280	5.185	1.321	0.132	1.555	0.396	0.040

EP-1050
Biomass Laydown Roads

Uncontrolled PM/PM$_{10}$/PM$_{2.5}$

ID	Source Description	PM_{30} (lb/hr)	PM_{30} (lb/day)	PM_{30} (ton/yr)	PM_{10} (lb/hr)	PM_{10} (lb/day)	PM_{10} (ton/yr)	$PM_{2.5}$ (lb/hr)	$PM_{2.5}$ (lb/day)	$PM_{2.5}$ (ton/yr)
EP-1050	Biomass Laydown Roads	3.35	53.54	8.83	0.85	13.65	2.25	0.09	1.36	0.23
Total		**3.35**		**8.83**	**0.85**		**2.25**	**0.09**		**0.23**

Controlled PM/PM$_{10}$/PM$_{2.5}$ Emissions:

ID	Source Description	PM_{30} (lb/hr)	PM_{30} (lb/day)	PM_{30} (ton/yr)	PM_{10} (lb/hr)	PM_{10} (lb/day)	PM_{10} (ton/yr)	$PM_{2.5}$ (lb/hr)	$PM_{2.5}$ (lb/day)	$PM_{2.5}$ (ton/yr)
EP-1050	Biomass Laydown Roads	1.00	16.06	2.65	0.26	4.09	0.68	0.03	0.41	0.07
Total		**1.00**		**2.65**	**0.26**		**0.68**	**0.03**		**0.07**

Average Weight of Vehicles:

Material Loaded/Unloaded	miles LOADED Per Year	miles EMPTY Per Year	miles TOTAL Per Year	LOADED weight	EMPTY weight		
Biomass Laydown	1,703.86	1,703.86	3,407.73	36	15	50.00%	percent of total miles LOADED trucks
						50.00%	percent of total miles EMPTY trucks
Facility-wide	**1,704**	**1,704**	**3,408**				

W = (% of Miles LOADED)(LOADED Weight) + (% of Miles EMPTY)(EMPTY Weight)

W = **25.50 tons**

VMT Calculations:	Load Size	Annual Volume	% by Truck	Annual Volume by Truck	Trips / Year	Annual VMT
Biomass Laydown	21 tons	111,112 ton/yr	100%	111,111.84 ton/yr	10,584	3,407.73
Facility-wide		**111,112 ton/yr**			**10,584**	**3,407.73**

EP-1050
Biomass Laydown Roads

Supporting Calculations:

Biomass Laydown

**Biomass laydown field assumed to cycle once per month. Biomass bale delivery to laydown field includes only traffic on unpaved laydown haul roads.

Biomass Laydown - Annual	111,112	ton/yr
Biomass Laydown	#REF!	ton/day
% Received by Truck	100%	
Truck Capacity	21	tons
Estimated Truck Trips	10,584	trips/yr
	#REF!	trips/day
	#REF!	trips/hr
	#REF!	min/truck

Truck Travel on Plant Roads	850	feet per trip LOADED	1,703.86	miles LOADED
	850	feet per trip EMPTY	1,703.86	miles EMPTY
			3,407.73	**miles TOTAL**

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

EP-2000
Equipment Leaks

Basis: Leak Rates and VOC control from: *Protocol for Leak Emission Rates,* EPA-453/R-95-017, November 1995.
Leak Rate (SOCMI average) multiplied by number of components.
Component count based on estimate for similar sized ethanol facilities.
HAP composition is the same in all VOC emissions for source identified.
Composition of HAPs is based on an engineering estimate.

Ethanol HAPs:

Acetaldehyde	200 ppm
Methanol	200 ppm
Acrolein	20 ppm
Formaldehyde	100 ppm

Component Count Criteria:
Streams with less than 1% VOC content (by water weight) are assumed negligible and are not counted.
Streams with less than 20% VOC (Vapor Pressure >0.3 kPa at 20 ^{o}C) content (by water weight) are defined as "Heavy Liquids".
Components in vacuum service are not inventoried and not to be inspected due to leak free nature.
All other streams are "Light Liquid" or "Gas/Vapor".

VOC Emissions:

Plant Area:		Fermentation		Distillation					Storage	Total Plant
		Pre-Fermenter	Beer Well	Beer Preheater	Stripper	Rectifier	Molecular Sieve Purge	Molecular Sieve Product	Finished Product	
%VOC in Product at Area:		10%	15%	15%	50%	93%	75%	100%	100%	
Equipment [1] Valves:	Leak Rate (kg/hr/source)									
Gas	0.00597	0.000597	0.0008955	0.0008955	0.002985	0.0055521	0.0044775	0.00597	0.00597	
	Count	3	2	0	3	6	2	5	1	22
	Emissions	0.002	0.002	0	0.009	0.033	0.009	0.030	0.00597	0.091
Light Liquid	0.00403	0.000403	0.0006045	0.0006045	0.002015	0.0037479	0.0030225	0.00403	0.00403	
	Count	0	0	0	6	4	2	6	6	24
	Emissions	0	0	0	0.012	0.015	0.006	0.024	0.024	0.081
Heavy Liquid	0.00023	0.000023	0.0000345	0.0000345	0.000115	0.0002139	0.0001725	0.00023	0.00023	
	Count	14	9	5	0	0	0	0	0	28
	Emissions	0.0003	0.0003	0.0002	0	0	0	0	0	0.001
Pumps:										
Light Liquid	0.0199	0.00199	0.002985	0.002985	0.00995	0.018507	0.014925	0.0199	0.0199	
	Count	0	0	0	1	1	1	1	1	5
	Emissions	0	0	0	0.010	0.019	0.015	0.020	0.020	0.083
Heavy Liquid	0.00862	0.000862	0.001293	0.001293	0.00431	0.0080166	0.006465	0.00862	0.00862	
	Count	2	2	0	0	0	0	0	0	4
	Emissions	0.0017	0.0026	0.0000	0	0	0	0	0	0.004
Other:										
Relief Valves	0.104	0.0104	0.0156	0.0156	0.052	0.09672	0.078	0.104	0.104	
	Count	1	1	1	1	1	1	1	0	7
	Emissions	0.0104	0.0156	0.0156	0.052	0.09672	0.078	0.104	0	0.372
Connectors	0.00183	0.000183	0.0002745	0.0002745	0.000915	0.0017019	0.0013725	0.00183	0.00183	
	Count	49	32	13	24	26	9	29	17	199
	Emissions	0.0090	0.0088	0.0036	0.02196	0.0442494	0.0123525	0.05307	0.03111	0.184
Sample Valves	0.015	0.0015	0.00225	0.00225	0.0075	0.01395	0.01125	0.015	0.015	
	Count	1	1	1	1	1	0	0	1	6
	Emissions	0.0015	0.0023	0.0023	0.0075	0.01395	0	0	0.015	0.042
Uncontrolled VOC Total	**kg/hr**									**0.86**
	lb/hr									**1.89**
	ton/yr									**8.30**

EP-2000
Equipment Leaks

Equipment	LDAR Control [1, 2] (% Eff.)	Emissions
Valves:		
Gas	87%	0.012
Light Liquid	84%	0.013
Heavy Liquid	84%	0.000
Pumps:		
Light Liquid	69%	0.026
Heavy Liquid	69%	0.001
Other:		
Relief Valves	87%	0.048
Connectors	55%	0.083
Sample Valves	84%	0.007
Controlled VOC Total	**kg/hr**	**0.190**
	lb/hr	**0.42**
	ton/yr	**1.84**

(1) Control effectiveness for Valves and Pumps obtained with monthly monitoring 10,000 ppmv leak definition, as presented in Table 5-2. Heavy Liquid Valves and Pumps control efficiencies assumed equivalent to the Light Liquid Valves and Pumps.

LDAR control was estimated are included on the following page. Control effectiveness for Sample Valves (Sampling Connections) were assumed equivalent to Light Liquid Valves.

Uncontrolled HAPs Emissions:

ID	Source Description	VOC Emissions (ton/yr)	Acetaldehyde (ton/yr)	Methanol (ton/yr)	Acrolein (ton/yr)	Formaldehyde (ton/yr)	
EP-2000	Equipment Leaks	8.30	0.002	0.002	0.00017	0.00083	**Total**
Total			**0.002**	**0.002**	**0.00017**	**0.00083**	**0.0043**

Controlled HAPs Emissions:

ID	Source Description	VOC Emissions (ton/yr)	Acetaldehyde (ton/yr)	Methanol (ton/yr)	Acrolein (ton/yr)	Formaldehyde (ton/yr)	
EP-2000	Equipment Leaks	1.84	0.000	0.000	0.00004	0.00018	**Total**
Total			**0.000**	**0.000**	**0.00004**	**0.00018**	**0.0010**

EP-2000
Equipment Leaks

SOCMI Connectors LDAR Control Calculation

Initial Leak Rate =
ILR = 0.00183

From Figure 5-4 - SOCMI Connector Average Leak Rate vs Fraction Leaking at Several Leak Definitions (Includes 10,000 ppm lk def)
Precise Value Obtained from EPA-453/R-95-017, Table 2-1, Page 2-12.

Table 5-4 Equations Relating Average Leak Rate to Fraction Leaking at SOCMI Units	
Connector with 10,000 ppmv leak definition:	ALR = (0.11 x LKFRACT) + 8.1E-05

Zi = LKFRACT
0.00183 = (0.11 x LKFRACT) + 8.1E-05

LKFRACT = 0.0159
Z1 = 0.0159

Yi = Zi - (FR x Zi) + (FR x Zi x R) (EPA-453/R-95-017, Page 5-56)
Zi+1 = Oc x (1-Yi) + Yi
Oc = 1.0%

Y1 =	0.00231
Z1 =	0.0159
R =	0.1
FR =	0.95
Y2 =	0.00178
Z2 =	0.01228
R2 =	0.1
FR2 =	0.95
Y3 =	0.001706
Z3 =	0.01176
R3 =	0.1
FR3 =	0.95
Y4 =	0.001695
Z4 =	0.01169
R4 =	0.1
FR4 =	0.95
Y5 =	0.001693
Z5 =	0.01168
R5 =	0.1
FR5 =	0.95
Y6 =	0.001693
Z6 =	0.01168
R6 =	0.1
FR6 =	0.95
Y7 =	0.001693
Z7 =	0.01168
R7 =	0.1
FR7 =	0.95
Y8 =	0.001693 = After LDAR monitoring (%)
Z8 =	0.01168 = Prior to LDAR monitoring (%)
R8 =	0.1
FR8 =	0.95

Avg LDAR monitor = 0.00668

From Table 5-4 Gas Valve Eqn: **FLR = 0.000816**

Eff = (ILR-FLR) / ILR x 100 (EPA-453/R-95-017, Page 5-57)

Where:
Eff = Control Effectiveness (Percent)
FLR = Final Leak Rate (kg/hr/source) **FLR = 0.000816**
ILR = Initial Leak Rate (kg/hr/source) **ILR = 0.00183**

Eff = (0.00183-0.000816) / 0.00183 x 100 = 55 % Conservative LDAR Control Effectiveness

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

AREA 2100
Process and Storage Tanks

Vendor: TBD

Storage Tank Specifications

Criteria: Internal pontoon floating roof with fixed tank roof.
Floating roof to have metallic shoe seal and low profile secondary seal.
Vapor seal and sleeve all penetrations of floating roof.

Ethanol HAPs	Acetaldehyde	200 ppm
	Methanol	200 ppm
	Acrolein	20 ppm
	Formaldehyde	100 ppm

		Tank	Tank Dimensions				Maximum	Tank
		Capacity	Diameter		Height		Throughput	Paint
ID	Source Description	(gals)	(ft)	(m)	(ft)	(m)	(gals/yr)	Color
T-2100A	T-2100A Shift Tank	60,000	20	6.10	26	7.92	9,000,000	White
T-2100B	T-2100B Shift Tank	60,000	20	6.10	26	7.92	9,000,000	White
T-2100C	T-2100C EH Off-Spec Tan	60,000	20	6.10	26	7.92	900,000	White
T-2101	T-2101 Denatured Ethanol	460,000	45	13.72	39	11.89	18,882,000	White
T-2120	T-2120 Denaturant	22,500	16	4.88	15	4.57	882,000	White

Storage Tank Emissions

Basis : *TANKS* , version 4.09D, October 2005.
Denatured ethanol storage tanks contain 4.9% gasoline (denaturant).
HAP composition is the same in all VOC emissions for source identified.

VOC Emissions:

		Rim Seal	Withdrawal	Deck Fitting	Deck Seam	Emission Rate VOC, Tanks 4.09		
		Loss	Loss	Loss	Loss			
ID	Source Description	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/hr)	(lb/yr)	(ton/yr)
T-2100A	T-2100A Shift Tank	70.44	100.18	69.08	0	0.027	239.70	0.1199
T-2100B	T-2100B Shift Tank	70.44	100.18	69.08	0	0.027	239.70	0.1199
T-2100C	T-2100C EH Off-Spec Tan	70.44	10.02	69.08	0	0.017	149.54	0.0748
T-2101	T-2101 Denatured Ethanol	214.93	92.59	121.83	0	0.049	429.35	0.2147
T-2120	T-2120 Denaturant	1,741.88	35.49	1,448.62	0	0.368	3,225.99	1.6130
Total								**2.14**

Etoh HAPs Emissions:

		Acetaldehyde		Methanol		Acrolein		Formaldehyde	
ID	Source Description	(lb/yr)	(ton/yr)	(lb/yr)	(ton/yr)	(lb/yr)	(ton/yr)	(lb/yr)	(ton/yr)
T-2100A	T-2100A Shift Tank	4.79E-02	2.40E-05	4.79E-02	2.40E-05	4.79E-03	2.40E-06	2.40E-02	1.20E-05
T-2100B	T-2100B Shift Tank	4.79E-02	2.40E-05	4.79E-02	2.40E-05	4.79E-03	2.40E-06	2.40E-02	1.20E-05
T-2100C	T-2100C EH Off-Spec Tan	2.99E-02	1.50E-05	2.99E-02	1.50E-05	2.99E-03	1.50E-06	1.50E-02	7.48E-06
T-2101	T-2101 Denatured Ethanol	8.59E-02	4.29E-05	8.59E-02	4.29E-05	8.59E-03	4.29E-06	4.29E-02	2.15E-05
Total	**2.75E-04**		**1.06E-04**		**1.06E-04**		**1.06E-05**		**5.29E-05**

AREA 2100
Process and Storage Tanks

Gasoline HAPs Emissions:

ID	Source Description	Pollutant	Mass Fraction [1]	VOC (ton/yr)	% Gasoline	HAPs [2, 3] (lb/hr)	(lb/yr)	(ton/yr)
T-2101	T-2101 Denatured Ethanol	Benzene	0.0025	0.21	4.90%	6.00E-06	0.05	2.63E-05
		Cumene	0.0001	0.21	4.90%	2.40E-07	0.00	1.05E-06
		Toluene	0.005	0.21	4.90%	1.20E-05	0.11	5.26E-05
		Xylene	0.0005	0.21	4.90%	1.20E-06	0.01	5.26E-06
		Ethylbenzene	0.00005	0.21	4.90%	1.20E-07	0.00	5.26E-07
		Carbon disulfide	0.00002	0.21	4.90%	4.80E-08	0.00	2.10E-07
T-2120	T-2120 Denaturant	Benzene	0.0025	1.61	100%	9.21E-04	8.06	4.03E-03
		Cumene	0.0001	1.61	100%	3.68E-05	0.32	1.61E-04
		Toluene	0.005	1.61	100%	1.84E-03	16.13	8.06E-03
		Xylene	0.0005	1.61	100%	1.84E-04	1.61	8.06E-04
		Ethylbenzene	0.00005	1.61	100%	1.84E-05	0.16	8.06E-05
		Carbon disulfide	0.00002	1.61	200%	1.47E-05	0.13	6.45E-05
Total								**1.33E-02**

(1) Mass fraction is based on Gasoline Specification (RVP-13).
(2) HAPs from Gasoline calculated as (Mass Fraction) x (Gasoline Storage Tank VOCs)
(3) HAPs from Denaturant added to Ethanol calculated as (% Gasoline) x (Denatured Etoh Storage Tank VOCs) x (Mass Fraction)

Corrosion Inhibitor

Vendor recommended adding DCI-11 to the oxygenate (gasoline) so that a concentration of 6-12 mg/L is provided in the finished

Max. Denatured Ethanol Production - Permit	18.90	MMgpy
	1.24E+08	lb/yr
Midpoint of Recommended Concentration	9	mg/L
	7.51E-05	lb/gal
Density of Product	7.84	lb/gal
Required Product	1,419.56	lb/yr
	182	gal/yr
DCI-11 HAPs Composition:		
Methanol (67-56-1)	25%	
	354.89	lb/yr
Xylene (1330-20-7)	10%	
	141.96	lb/yr
Ethylbenzene (100-41-4)	1%	
	14.20	lb/yr

Percent of Total Liquid Weight:	
Methanol (67-56-1)	0.000286%
Xylene (1330-20-7)	0.000115%
Ethylbenzene (100-41-4)	0.000011%

Due to the very small amount of corrosion inhibitor added to the denatured ethanol, the tank emissions are unchanged.

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

EP-2150
Vapor Recovery System and Loading Losses

Loading Losses

Basis: AP-42 Section 5.2 Transportation and Marketing of Petroleum Liquids, Final Section, January 1995.
California Climate Action Registry (CCAR) General Reporting Protocol, Version 2.2, March 2007.
Tanker trucks receiving denatured ethanol previously carried natural gasoline.
All rail cars assumed dedicated to denatured ethanol transportation.
Emissions controlled by John Zink carbon adsorption hydrocarbon vapor recovery system. Emissions guaranteed controlled to at least 0.0835 lb/1000 gallons loaded; or approximately 98.2% destruction efficiency, rounded to 98%.
Volatile organic compounds are absorbed in activated carbon beds, then returned to liquid product tanks.

Criteria:

	Annual Ethanol (Denatured) Loadout	18,900,000	gal/yr
	Annual Gasoline (Denaturant) Loadout	900,000	gal/yr
	Receiving Schedule	5,280	hr/yr
	% Loadout by Truck	50%	
	% Loadout by Rail	50%	
Ethanol HAPs:	Acetaldehyde	200	ppm
	Methanol	200	ppm
	Acrolein	20	ppm
	Formaldehyde	100	ppm

Emission Factor Equation: **$L_L = 12.46(SPM)/T$** Equation 5.2-1

where:
L_L = loading loss, pounds per 1000 gallons (lb/1000 gal) of liquid loaded
S = saturation factor
P = true vapor pressure of liquid loaded per square inch absolute (psia)
M = molecular weight of vapors (pounds per pound-mole, lb/lb-mole)
T = temperature on bulk liquid loaded (deg R)

		Tanker Truck	Rail Car	Unit	Notes
Saturation Factor, Submerged Loading	S	0.6	0.5		Table 5.2-1
True Vapor Pressure	P				
Ethanol (Denatured)		0.7494	0.7494	psia	Average vapor pressure from Tanks 4.09
Gasoline (Denaturant)		6.5993	6.5993	psia	Average vapor pressure from Tanks 4.09
Molecular Weight of Vapors	M				
Ethanol (Denatured)		49.60	49.60	lb/lb-mole	From Tanks 4.09
Gasoline (Denaturant)		62.00	62.00	lb/lb-mole	From Tanks 4.09
Temperature of Bulk Liquid	T				
Ethanol (Denatured)		514.87	514.87	deg R	From Tanks 4.09, average ambient temperature for Dodge City, KS
Gasoline (Denaturant)		514.87	514.87	deg R	From Tanks 4.09, average ambient temperature for Dodge City, KS.
Collection Efficiency	%	90%	90%		Vendor
Destruction Efficiency	%	98.0%	98.0%		Vendor
Overall Reduction Efficiency	%	88.2%	88.2%		ColEff x DisEff

Emission Factors:

Material	Loadout Method	Uncontrolled VOC (lb/1000 gal)	Controlled VOC (lb/1000 gal)	Fugitive VOC (lb/1000 gal)
Ethanol	Tanker Truck	0.5397	0.0637	0.054
Ethanol	Rail Car	0.4498	0.0531	0.045
Gasoline	Tanker Truck	5.941	0.7010	0.594

VOC Emissions:

		Uncontrolled VOC		EP-1250 Controlled VOC		EP-2150FUG Fugitive VOC	
Material	Loadout Method	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)
Ethanol	Tanker Truck	0.966	2.55	0.114	0.30	0.097	0.26
Ethanol	Rail Car	0.805	2.13	0.095	0.25	0.080	0.21
Gasoline	Tanker Truck	1.013	2.67	0.119	0.32	0.101	0.27
Total			**7.35**		**0.87**		**0.73**

EP-2150
Vapor Recovery System and Loading Losses

EP-2150 Etoh Uncontrolled HAPs Emissions:

Material	Loadout Method	VOC (ton/yr)	Acetaldehyde (ton/yr)	Methanol (ton/yr)	Acrolein (ton/yr)	Formaldehyde (ton/yr)	
Ethanol	Tanker Truck	2.55	5.10E-04	5.10E-04	5.10E-05	2.55E-04	
Ethanol	Rail Car	2.13	4.25E-04	4.25E-04	4.25E-05	2.13E-04	**Total**
Total			**9.35E-04**	**9.35E-04**	**9.35E-05**	**4.68E-04**	**2.43E-03**

EP-2150 Etoh Controlled HAPs Emissions:

Material	Loadout Method	VOC (ton/yr)	Acetaldehyde (ton/yr)	Methanol (ton/yr)	Acrolein (ton/yr)	Formaldehyde (ton/yr)	
Ethanol	Tanker Truck	0.30	6.02E-05	6.02E-05	6.02E-06	3.01E-05	
Ethanol	Rail Car	0.25	5.02E-05	5.02E-05	5.02E-06	2.51E-05	**Total**
Total			**1.10E-04**	**1.10E-04**	**1.10E-05**	**5.52E-05**	**2.87E-04**

EP-2150FUG Etoh Fugitive HAPs Emissions:

Material	Loadout Method	VOC (ton/yr)	Acetaldehyde (ton/yr)	Methanol (ton/yr)	Acrolein (ton/yr)	Formaldehyde (ton/yr)	
Ethanol	Tanker Truck	0.26	5.10E-05	5.10E-05	5.10E-06	2.55E-05	
Ethanol	Rail Car	0.21	4.25E-05	4.25E-05	4.25E-06	2.13E-05	**Total**
Total			**9.35E-05**	**9.35E-05**	**9.35E-06**	**4.68E-05**	**2.43E-04**

EP-2150 Gasoline (Denaturant) Uncontrolled HAPs Emissions:

Material	Loadout Method	Pollutant	% Gasoline	Mass Fraction [1]	VOC Uncontrolled (ton/yr)	HAPs [2, 3] Uncontrolled (ton/yr)
Ethanol	Tanker Truck	Benzene	4.90%	0.0025	2.55	3.12E-04
		Cumene	4.90%	0.0001	2.55	1.25E-05
		Toluene	4.90%	0.005	2.55	6.25E-04
		Xylene	4.90%	0.0005	2.55	6.25E-05
		Ethylbenzene	4.90%	0.00005	2.55	6.25E-06
		Carbon disulfide	4.90%	0.00002	2.55	2.50E-06
Ethanol	Rail Car	Benzene	4.90%	0.0025	2.13	2.60E-04
		Cumene	4.90%	0.0001	2.13	1.04E-05
		Toluene	4.90%	0.005	2.13	5.21E-04
		Xylene	4.90%	0.0005	2.13	5.21E-05
		Ethylbenzene	4.90%	0.00005	2.13	5.21E-06
		Carbon disulfide	4.90%	0.00002	2.13	2.08E-06
Gasoline	Tanker Truck	Benzene	100%	0.0025	2.67	6.68E-03
		Cumene	100%	0.0001	2.67	2.67E-04
		Toluene	100%	0.005	2.67	1.34E-02
		Xylene	100%	0.0005	2.67	1.34E-03
		Ethylbenzene	100%	0.00005	2.67	1.34E-04
		Carbon disulfide	100%	0.00002	2.67	5.35E-05
Total						**0.02**

(1) Mass fraction is based on Gasoline Specification (RVP-13) MSDS.

(2) HAPs from Gasoline calculated as (Mass Fraction) x (Gasoline Storage Tank VOCs)

(3) HAPs from Denaturant added to Ethanol calculated as (% Gasoline) x (Denatured Etoh Storage Tank VOCs) x (Mass Fraction)

EP-2150
Vapor Recovery System and Loading Losses

Gasoline (Denaturant) Controlled and Fugitive HAPs Emissions:					VOC		HAPs [2, 3]	
Material	Loadout Method	Pollutant	% Gasoline	Mass Fraction [1]	EP-2150 Controlled (ton/yr)	EP-2150FUG Fugitive (ton/yr)	EP-2150 Controlled (ton/yr)	EP-2150FUG Fugitive (ton/yr)
Ethanol	Tanker Truck	Benzene	4.90%	0.0025	0.30	0.26	3.69E-05	3.12E-05
		Cumene	4.90%	0.0001	0.30	0.26	1.47E-06	1.25E-06
		Toluene	4.90%	0.005	0.30	0.26	7.37E-05	6.25E-05
		Xylene	4.90%	0.0005	0.30	0.26	7.37E-06	6.25E-06
		Ethylbenzene	4.90%	0.00005	0.30	0.26	7.37E-07	6.25E-07
		Carbon disulfide	4.90%	0.00002	0.30	0.26	2.95E-07	2.50E-07
Ethanol	Rail Car	Benzene	4.90%	0.0025	0.25	0.21	3.07E-05	2.60E-05
		Cumene	4.90%	0.0001	0.25	0.21	1.23E-06	1.04E-06
		Toluene	4.90%	0.005	0.25	0.21	6.14E-05	5.21E-05
		Xylene	4.90%	0.0005	0.25	0.21	6.14E-06	5.21E-06
		Ethylbenzene	4.90%	0.00005	0.25	0.21	6.14E-07	5.21E-07
		Carbon disulfide	4.90%	0.00002	0.25	0.21	2.46E-07	2.08E-07
Gasoline	Tanker Truck	Benzene	100%	0.0025	0.32	0.27	7.89E-04	6.68E-04
		Cumene	100%	0.0001	0.32	0.27	3.15E-05	2.67E-05
		Toluene	100%	0.005	0.32	0.27	1.58E-03	1.34E-03
		Xylene	100%	0.0005	0.32	0.27	1.58E-04	1.34E-04
		Ethylbenzene	100%	0.00005	0.32	0.27	1.58E-05	1.34E-05
		Carbon disulfide	100%	0.00002	0.32	0.27	6.31E-06	5.35E-06
Total							**0.00**	**0.00**

(1) Mass fraction is based on Gasoline Specification (RVP-13) MSDS.

(2) HAPs from Gasoline calculated as (Mass Fraction) x (Gasoline Storage Tank VOCs)

(3) HAPs from Denaturant added to Ethanol calculated as (% Gasoline) x (Denatured Etoh Storage Tank VOCs) x (Mass Fraction)

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

EP-4001
Cooling Tower

Basis: AP-42, Section 13.4 Wet Cooling Towers, Final Section, January 1995.
Circulation rate, total dissolved solids and drift losses is based on engineering estimate.
Particulate emissions (PM) assumed condensible, therefore all assumed to be less than 1.0 micrometer in diameter.
The circulation rate is based on EH, Gasification and balance of plant needs. Each cell's circulation rate is assumed equivalent.

Emission Factor Equation: $PM/PM_{10}/PM_{2.5}$ Emissions (lb/hr) = (Circulation Rate) x (TDS / 1,000,000) x (Drift Loss) x (Water Density)

Criteria:

Drift Rate	0.0005%	
Number of Cells	5	
Cooling Tower Water Density	8.75	lb/gal
TDS	2,625	ppm
Circulation Rate	14,850	gpm
Circulation Rate	891,000	gal/hr
Annual Operations	8,760	hr/yr

Source Details:

		Stack Flow Rate	Stack Diameter	Release Height	Stack Area	Gas Velocity		Gas Exit Temperature	
ID	Emission Source	(cfm)	(in)	(ft)	(ft^2)	(ft/sec)	(m/s)	(deg F)	(deg K)
EP-4001	EH Cooling Tower								
EP4001A	Cell 1	628,350	480	61	1,256.64	8.33	2.54	82	301
EP4001B	Cell 2	628,350	480	61	1,256.64	8.33	2.54	82	301
EP4001C	Cell 3	628,350	480	61	1,256.64	8.33	2.54	82	301

$PM/PM_{10}/PM_{2.5}$ Emissions:

		PM		PM_{10}		$PM_{2.5}$	
ID	Emission Source	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)
EP-4001	EH Cooling Tower	0.06	0.27	0.06	0.27	0.06	0.27
Total			**0.27**		**0.27**		**0.27**

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

EP-22001 and EP-22002
Cogeneration Wet Surface Air Condensers

Basis: AP-42, Section 13.4 Wet Cooling Towers, Final Section, January 1995.
Circulation rate, total dissolved solids and drift losses is based on engineering estimate.
Particulate emissions (PM) assumed condensible, therefore all assumed to be less than 1.0 micrometer in diameter.
These wet surface air condensers (WSACs) are similar to a cooling water tower (CWT); however, the WSACs uses less circulation per BTU than a typical CWT. This type of condenser allows for higher cycles of concentration of TDS, which reduces raw water makeup and blowdown demand.
Each steam condensing-extracting turbine will be equipped with a WSAC. Each turbine WASC will have two (2) cells.

Emission Factor Equation: $PM/PM_{10}/PM_{2.5}$ Emissions (lb/hr) = (Circulation Rate) x (TDS / 1,000,000) x (Drift Loss) x (Water Density)

Criteria:

Drift Rate	0.0005%	
Number of Cells	4	
Cooling Tower Water Density	8.75	lb/gal
TDS	6,678	ppm
Circulation Rate	40,845	gpm
Circulation Rate	2,450,700	gal/hr
Annual Operations	8,760	hr/yr

Source Details:

ID	Emission Source	Stack Flow Rate (cfm)	Stack Diameter (in)	Release Height (ft)	Stack Area (ft^2)	Gas Velocity (ft/sec)	Gas Velocity (m/s)	Gas Exit Temperature (deg F)	Gas Exit Temperature (deg K)
EP-22001	Go-Gen Air Condenser #1								
EP22001A	Cell 1	656,000	240	35.0	314.16	34.80	10.61	77	298
EP22001B	Cell 2	656,000	240	35.0	314.16	34.80	10.61	77	298
EP-22002	Go-Gen Air Condenser #2								
EP22002A	Cell 1	656,000	240	35.0	314.16	34.80	10.61	77	298
EP22002B	Cell 2	656,000	240	35.0	314.16	34.80	10.61	77	298

$PM/PM_{10}/PM_{2.5}$ Emissions:

ID	Emission Source	PM (lb/hr)	PM (ton/yr)	PM_{10} (lb/hr)	PM_{10} (ton/yr)	$PM_{2.5}$ (lb/hr)	$PM_{2.5}$ (ton/yr)
EP-22001	Go-Gen Air Condenser #1	0.36	1.57	0.36	1.57	0.36	1.57
EP-22002	Go-Gen Air Condenser #2	0.36	1.57	0.36	1.57	0.36	1.57
Total			**3.14**		**3.14**		**3.14**

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

EP-5201 and EP-5202
Mixed Fuel-Fired Boilers #1 and #2

Mixed Fuel Configuration

Basis:

AP-42 Section 1.6 Wood Residue Combustion in Boilers, Final Section, September 2003.

ABNT Cogeneration Baseline Model used to determine final fuel HHV. Final engineering of the Mixed Fuel-Fired Boiler system has not been completed.

California Climate Action Registry (CCAR) General Reporting Protocol, Version 3.1, January 2009.

Feed rates include a 12% overdesign margin due to final engineering for the Mixed Fuel-Fired Boiler system not completed at the time of the potential emission calculations.

Mixed Fuel-Fired Boilers Heat Release assumes EH Stillage Cake + EH Thin Stillage Syrup + Corn Stover = HHV + 25% safety factor. The 25% factor of safety in intended to address the fuel HHV variations, as well as the additional heat input that will be gained from the combustion of biogas and enzymatic hydrolysis vent streams (EP-13150 Vent Scrubber, EP-19005 Biomass Stillage Preheater Vent Condenser, and EP-19010 Biomass Process Evaporator Vent Condenser).

Biomass solids are assumed similar to wood residue in composition and HHV. Wood residue has a heating value that ranges from about 4,500 Btu/lb wet, as-fired basis to 8,000 Btu/lb dry wood. The moisture contents can vary from 5 to 75 wt% depending of residue type and storage operations.

Sodium Sulfate (Na_2SO_4) is not included in the sulfur emission calculations as it will form Na_2S and be collected in ash.

Fuel Components (Dry Basis)	EH Stillage (wt%)	EH Syrup (wt%)	Corn Stover (wt%)	Blended Biomass (wt%)
Carbon	49.68	29.89	46.19	46.18
Hydrogen	7.51	5.25	5.6	5.90
Oxygen	22.98	35.82	40.16	37.18
Nitrogen	2.79	0.34	0.6	0.95
Sulfur	0.15	0.25	0.07	0.09
Ash	16.89	28.45	7.38	9.70
Total wt%	100.00	100.00	100.00	100.00

Moisture	67	80	15	25.88
Feedrate (ton/day)	333	73	1,620	2,026
Feedrate (wet lb/hr)	84,064	30,313	158,857	273,234
HHV (Btu/lb dry)	8,186	5,221	7,840	7,803

Criteria:

Biomass Solids HHV (dry basis)	7,803	Btu/lb dry	
Biomass Solids HHV (dry basis)	15.61	MMBtu/ton dry	
Number of Solids-Fired Boilers	2		
Total Area 5200 MFFB Heat Input	1,647	MMBtu/hr	*Includes 25% factor of safety
Annual Operations	8,760	hr/yr	

Source Details:

ID	Emission Source	Stack Flow Rate (cfm)	Stack Diameter (in)	Release Height (ft)	Stack Area (ft^2)	Gas Velocity (ft/sec)	Gas Velocity (m/s)	Gas Exit Temperature (deg F)	Gas Exit Temperature (deg K)
EP-5201	Mixed Fuel-Fired Boiler #1 (MFFB1)	120,000	48	120	12.57	159.15	48.51	380	466
EP-5202	Mixed Fuel-Fired Boiler #2 (MFFB2)	120,000	48	120	12.57	159.15	48.51	380	466

EP-5201 and EP-5202
Mixed Fuel-Fired Boilers #1 and #2

Mixed Fuel-Fired Boiler Emissions

Emission Factors:				
Criteria Pollutants		(lb/ton)	(lb/MMBtu)	Notes
NO_X		--	0.28	Table 1.6-2 NOx from wood residue combustion, wet wood-fired boiler, plus a 25% factor of safety
SO_2		3.58	0.23	Boiler fuel criteria engineering calculations -100% conversion fuel sulfur to SO_2.
CO		2.30	0.15	ABNT Solid biomass fired in FBC; based on similar boiler operated by Abengo
VOC		--	0.017	Table 1.6-3
PM	Filterable	--	0.560	Table 1.6-1 Filterable PM from wood residue combustion, bark and wet wood.
PM_{10}	Filterable	--	0.500	Table 1.6-1 Filterable PM_{10} from wood residue combustion, bark and wet wood.
$PM_{2.5}$	Filterable	--	0.430	Table 1.6-1 Filterable $PM_{2.5}$ from wood residue combustion, bark and wet wood.
PM	Condensible	--	0.017	Table 1.6-1 Condensible PM from wood residue combustion, bark and wet wood.
PM_{10}	Condensible	--	0.017	Table 1.6-1 Condensible PM from wood residue combustion, bark and wet wood.
$PM_{2.5}$	Condensible	--	0.017	Table 1.6-1 Condensible PM from wood residue combustion, bark and wet wood.
Lead		--	5.50E-08	Table 1.1-16 Trace elements from coal combustion; assume 10 ppmw lead
NH_3		--	3.06E-03	Maximum 5 ppmv NH_3 slip assumed. NH_3 may be in flue gas stream from syngas or added post-combustion.
GHG Pollutants				
CO_2		3,386.40	217.00	Boiler fuel criteria engineering calculations - 100% conversion fuel carbon to CO_2.
CH_4		--	0.071	CCAR Table C.8 (0.032 kg CH_4/MMBtu)
N_2O		--	0.0093	CCAR Table C.8 (0.0042 kg N_2O/MMBtu)

(1) Emission factors for NH_3 in parts per million (ppm) converted to lb/MMBtu as follows:

EF (lb/MMBtu) = (ppm) x (k) x (F) x (20.9/(20.9-%O_2))

Where:

NH_3 =	5	ppm
%O_2 =	7	%
k =	unit conversion, (2.59E-09 x Molecular Weight (M)) lb/dscf = 1 ppm	
k (for NH_3) =	4.41E-08	(lb/scf)/ppm
F =	9240	dscf/MMBtu, From Table 19-2 of Method 19 for Wood Residue
Molecular weight of NH_3 =	17.03	

Emissions:		Control Efficiency	MFFB1 and MFFB2 Uncontrolled		MFFB1 and MFFB2 Controlled		BACT
Criteria Pollutants		(%)	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)	lb/MMBtu
NO_X		50%	452.93	1,983.81	226.46	991.91	0.14
SO_2		90%	378.29	1656.90	37.83	165.69	0.02
CO		0%	242.74	1063.20	242.74	1,063.20	0.15
VOC		0%	28.00	122.64	28.00	122.64	0.02
PM	Filterable	99%	922.32	4039.76	9.22	40.40	0.006
PM_{10}	Filterable	99%	823.50	3606.93	8.24	36.07	0.005
$PM_{2.5}$	Filterable	99%	708.21	3101.96	7.08	31.02	0.004
PM	Condensible	0%	28.00	122.64	28.00	122.64	0.017
PM_{10}	Condensible	0%	28.00	122.64	28.00	122.64	0.017
$PM_{2.5}$	Condensible	0%	28.00	122.64	28.00	122.64	0.017
Lead		95%	9.06E-05	3.97E-04	4.53E-06	1.99E-05	--
NH_3		0%	--	--	5.04	22.07	--
GHG Pollutants							
CO_2		0%	357,397	1,565,398	357,397	1,565,398	--
CH_4		0%	116.21	509.01	116.21	509.01	--
N_2O		0%	15.25	66.81	15.25	66.81	--

EP-5201 and EP-5202
Mixed Fuel-Fired Boilers #1 and #2

HAPs Emissions from Combustion in Areas 5200

Basis: AP-42 Section 1.6 Wood Residue Combustion in Boilers, Final Section, September 2003.
Chlorine in fuel estimates and the resulting chlorine and hydrogen chloride emissions from ABNT.
Control of acetaldehyde, acrolein, benzene, formaldehyde, naphthalene, styrene and toluene assumed 90% reduction assumed for bubbling bed fluidized bed combustion and good combustion practices. Control of particulate HAPs (metals) assumed similar to PM/PM_{10} - 99% control efficiency assumed for baghouse. Other minor HAPs have been included for total HAP calculations.
Chlorine emission factor obtained from AP-42 Section 1.6 Wood Residue Combustion in Boilers.
Hydrogen chloride emission factor and control efficiency obtained from Vendor specifications.
Control options of hydrogen chloride are essentially the same as for other acid gases and particulate matter emissions. The proposed control for acid gases and particulate matter include a dry scrubber and fabric filter, which will provide 99% control efficiency for hydrogen chloride emissions.
Environment and Natural Resources, Division of Air Quality, June 11, 2008 Memorandum: *Emission Factors for Wood-Fired Industrial Boilers for 1,2,3,6,7,8-HxCDD.*
Only factors for pollutants noted as HAPs as defined by Section 112(b) of the Clean Air Act listed.

Criteria:

Annual Operations	8,760	hr/yr
Boiler Heat Input	1,647	MMBtu/hr

	Emission Factor	Control Efficiency	MFFB1 and MFFB2 Uncontrolled		MFFB1 and MFFB2 Controlled	
Pollutant	(lb/MMBtu)	(%)	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)
TOTAL HAPs	**--**	**--**	**455.65**	**1995.73**	**7.14**	**31.28**
Acetaldehyde	8.30E-04	90%	1.37	5.99	0.14	0.60
Acrolein	4.00E-03	90%	6.59	28.86	0.66	2.89
Benzene	4.20E-03	90%	6.92	30.30	0.69	3.03
Formaldehyde	4.40E-03	90%	7.25	31.74	0.72	3.17
Naphthalene	9.70E-05	90%	0.16	0.70	0.02	0.07
Styrene	1.90E-03	90%	3.13	13.71	0.31	1.37
Toluene	9.20E-04	90%	1.52	6.64	0.15	0.66
Chlorine	7.90E-04	99%	1.30	5.70	0.01	0.06
Hydrogen chloride	2.57E-01	99%	423.28	1,853.96	4.23	18.54
Dichloromethane (methylene chloride)	2.90E-04	90%	0.48	2.09	0.05	0.21

	Emission Factor	Control Efficiency	MFFB1 and MFFB2 Uncontrolled		MFFB1 and MFFB2 Controlled	
Pollutant	(lb/MMBtu)	(%)	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)
Metals:			2.809	12.303	0.028	0.123
Antimony	7.90E-06	99%	1.30E-02	5.70E-02	1.30E-04	5.70E-04
Arsenic	2.20E-05	99%	3.62E-02	1.59E-01	3.62E-04	1.59E-03
Beryllium	1.10E-06	99%	1.81E-03	7.94E-03	1.81E-05	7.94E-05
Cadmium	4.10E-06	99%	6.75E-03	2.96E-02	6.75E-05	2.96E-04
Chromium, total	2.10E-05	99%	3.46E-02	1.51E-01	3.46E-04	1.51E-03
Chromium, hexavalent	3.50E-06	99%	5.76E-03	2.52E-02	5.76E-05	2.52E-04
Cobalt	6.50E-06	99%	1.07E-02	4.69E-02	1.07E-04	4.69E-04
Manganese	1.60E-03	99%	2.64E+00	1.15E+01	2.64E-02	1.15E-01
Mercury	3.50E-06	99%	5.76E-03	2.52E-02	5.76E-05	2.52E-04
Nickel	3.30E-05	99%	5.44E-02	2.38E-01	5.44E-04	2.38E-03
Selenium	2.80E-06	99%	4.61E-03	2.02E-02	4.61E-05	2.02E-04

EP-5201 and EP-5202
Mixed Fuel-Fired Boilers #1 and #2

	Emission Factor	Control Efficiency	MFFB1 and MFFB2 Uncontrolled		MFFB1 and MFFB2 Controlled	
Pollutant	(lb/MMBtu)	(%)	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)
Minor HAPs:			8.09E-01	3.55E+00	8.09E-02	3.55E-01
Acetophenone	3.20E-09	90%	5.27E-06	2.31E-05	5.27E-07	2.31E-06
Benzoic acid (chloramben)	4.70E-08	90%	7.74E-05	3.39E-04	7.74E-06	3.39E-05
bis(2-Ethylhexyl)phthalate (DEHP)	4.70E-08	90%	7.74E-05	3.39E-04	7.74E-06	3.39E-05
Bromomethane (methl bromide)	1.50E-05	90%	2.47E-02	1.08E-01	2.47E-03	1.08E-02
Carbon tetrachloride	4.50E-05	90%	7.41E-02	3.25E-01	7.41E-03	3.25E-02
Chlorobenzene	3.30E-05	90%	5.44E-02	2.38E-01	5.44E-03	2.38E-02
Chloroform	2.80E-05	90%	4.61E-02	2.02E-01	4.61E-03	2.02E-02
Chloromethane (methyl chloride)	2.30E-05	90%	3.79E-02	1.66E-01	3.79E-03	1.66E-02
1,2-Dichloroethane (ethylene dichloride)	2.90E-05	90%	4.78E-02	2.09E-01	4.78E-03	2.09E-02
1,2-Dichloropropane (propylene dichloride)	3.30E-05	90%	5.44E-02	2.38E-01	5.44E-03	2.38E-02
2,4-Dinitrophenol	1.80E-07	90%	2.96E-04	1.30E-03	2.96E-05	1.30E-04
Ethylbenzene	3.10E-05	90%	5.11E-02	2.24E-01	5.11E-03	2.24E-02
Pentachlorophenol	5.10E-08	90%	8.40E-05	3.68E-04	8.40E-06	3.68E-05
4-Nitrophenol	1.10E-07	90%	1.81E-04	7.94E-04	1.81E-05	7.94E-05
Phenol	5.10E-05	90%	8.40E-02	3.68E-01	8.40E-03	3.68E-02
Propionaldehyde	6.10E-05	90%	1.00E-01	4.40E-01	1.00E-02	4.40E-02
Tetrachloroethene	3.80E-05	90%	6.26E-02	2.74E-01	6.26E-03	2.74E-02
1,1,1-Trichloroethane (methyl chloroform)	3.10E-05	90%	5.11E-02	2.24E-01	5.11E-03	2.24E-02
Trichloroethene	3.00E-05	90%	4.94E-02	2.16E-01	4.94E-03	2.16E-02
2,4,6-Trichlorophenol	2.20E-08	90%	3.62E-05	1.59E-04	3.62E-06	1.59E-05
Vinyl chloride	1.80E-05	90%	2.96E-02	1.30E-01	2.96E-03	1.30E-02
o-Xylene	2.50E-05	90%	4.12E-02	1.80E-01	4.12E-03	1.80E-02

	Emission Factor	MFFB1 and MFFB2 Uncontrolled		MFFB1 and MFFB2 Controlled	
Pollutant	(lb/MMBtu)	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)
Dibenzo furans:		3.08E-06	1.35E-05	3.08E-06	1.35E-05
Heptachlorodibenzo-p-furans	2.40E-10	3.95E-07	1.73E-06	3.95E-07	1.73E-06
Hexachlorodibenzo-p-furans	2.80E-10	4.61E-07	2.02E-06	4.61E-07	2.02E-06
Octachlorodibenzo-p-furans	8.80E-11	1.45E-07	6.35E-07	1.45E-07	6.35E-07
Pentachlorodibenzo-p-furans	4.20E-10	6.92E-07	3.03E-06	6.92E-07	3.03E-06
2,3,7,8-Tetrachlorodibenzo-p-furans	9.00E-11	1.48E-07	6.49E-07	1.48E-07	6.49E-07
Tetrachlorodibenzo-p-furans	7.50E-10	1.24E-06	5.41E-06	1.24E-06	5.41E-06

	Emission Factor	MFFB1 and MFFB2 Uncontrolled		MFFB1 and MFFB2 Controlled	
Pollutant	(lb/MMBtu)	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)
Polychlorinated biphenyls:		1.31E-05	5.72E-05	1.31E-05	5.72E-05
Decachlorobiphenyl	2.70E-10	4.45E-07	1.95E-06	4.45E-07	1.95E-06
Dichlorobiphenyl	7.40E-10	1.22E-06	5.34E-06	1.22E-06	5.34E-06
Heptachlorobiphenyl	6.60E-11	1.09E-07	4.76E-07	1.09E-07	4.76E-07
Hexachlorobiphenyl	5.50E-10	9.06E-07	3.97E-06	9.06E-07	3.97E-06
Pentachlorobiphenyl	1.20E-09	1.98E-06	8.66E-06	1.98E-06	8.66E-06
Trichlorobiphenyl	2.60E-09	4.28E-06	1.88E-05	4.28E-06	1.88E-05
Tetrachlorobiphenyl	2.50E-09	4.12E-06	1.80E-05	4.12E-06	1.80E-05

EP-5201 and EP-5202
Mixed Fuel-Fired Boilers #1 and #2

Pollutant	Emission Factor (lb/MMBtu)	MFFB1 and MFFB2 Uncontrolled (lb/hr)	MFFB1 and MFFB2 Uncontrolled (ton/yr)	MFFB1 and MFFB2 Controlled (lb/hr)	MFFB1 and MFFB2 Controlled (ton/yr)
Polycyclic Organic Matter:		4.61E-02	2.02E-01	4.61E-02	2.02E-01
Benzo(a)anthracene	6.50E-08	1.07E-04	4.69E-04	1.07E-04	4.69E-04
Benzo(a)pyrene	2.60E-06	4.28E-03	1.88E-02	4.28E-03	1.88E-02
Benzo(b)fluoranthene	1.00E-07	1.65E-04	7.21E-04	1.65E-04	7.21E-04
Benzo(e)pyrene	2.60E-09	4.28E-06	1.88E-05	4.28E-06	1.88E-05
Benzo(g,h,i)perylene	9.30E-08	1.53E-04	6.71E-04	1.53E-04	6.71E-04
Benzo(j,k)fluoranthene	1.60E-07	2.64E-04	1.15E-03	2.64E-04	1.15E-03
Benzo(k)fluoranthene	3.60E-08	5.93E-05	2.60E-04	5.93E-05	2.60E-04
Chrysene	3.80E-08	6.26E-05	2.74E-04	6.26E-05	2.74E-04
Dibenzo(a,h)anthracene	9.10E-09	1.50E-05	6.56E-05	1.50E-05	6.56E-05
Indeno(1,2,3,c,d)pyrene	8.70E-08	1.43E-04	6.28E-04	1.43E-04	6.28E-04
Acenaphthene	9.10E-07	1.50E-03	6.56E-03	1.50E-03	6.56E-03
Fluorene	3.40E-06	5.60E-03	2.45E-02	5.60E-03	2.45E-02
Anthracene	3.00E-06	4.94E-03	2.16E-02	4.94E-03	2.16E-02
Phenanthrene	7.00E-06	1.15E-02	5.05E-02	1.15E-02	5.05E-02
Fluoranthene	1.60E-06	2.64E-03	1.15E-02	2.64E-03	1.15E-02
Pyrene	3.70E-06	6.09E-03	2.67E-02	6.09E-03	2.67E-02
Perylene	5.20E-10	8.56E-07	3.75E-06	8.56E-07	3.75E-06
Acenaphthylene	5.00E-06	8.24E-03	3.61E-02	8.24E-03	3.61E-02
2-Methylnaphthalene	1.60E-07	2.64E-04	1.15E-03	2.64E-04	1.15E-03
2-Chloronaphthalene	2.40E-09	3.95E-06	1.73E-05	3.95E-06	1.73E-05

Pollutant	Emission Factor (lb/MMBtu)	MFFB1 and MFFB2 Uncontrolled (lb/hr)	MFFB1 and MFFB2 Uncontrolled (ton/yr)	MFFB1 and MFFB2 Controlled (lb/hr)	MFFB1 and MFFB2 Controlled (ton/yr)
Dioxins:		1.15E-04	5.05E-04	1.15E-04	5.05E-04
Heptachlorodibenzo-p-dioxins	2.00E-09	3.29E-06	1.44E-05	3.29E-06	1.44E-05
Hexachlorodibenzo-p-dioxins	3.19E-11	5.25E-08	2.30E-07	5.25E-08	2.30E-07
Octachlorodibenzo-p-dioxins	6.60E-08	1.09E-04	4.76E-04	1.09E-04	4.76E-04
Pentachlorodibenzo-p-dioxins	1.50E-09	2.47E-06	1.08E-05	2.47E-06	1.08E-05
2,3,7,8-Tetrachlorodibenzo-p-dioxins	8.60E-12	1.42E-08	6.20E-08	1.42E-08	6.20E-08
Tetrachlorodibenzo-p-dioxins	4.70E-10	7.74E-07	3.39E-06	7.74E-07	3.39E-06

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

EP-6001
Firewater Pump Engine (Emergency)

Basis: AP-42 Section 3.3 Gasoline and Diesel Industrial Engines, Final Section, October 1996.
New Source Performance Standard (NSPS) Subpart IIII (Tier 3 standards from 40 CFR 89.112 Table 1, 450≤kW≤560). For emergency engines with maximum engine power greater than 50 horsepower (hp) the manufacturer must certify, pursuant to 40 CFR 60.4202(a)(2), that the engine meets the standards for new non-road compression ignition engines for the same model year and maximum power listed in 40 CFR 89.112. It is assumed that the model to be chosen for this facility will be a 2008 or newer model. The NSPS Subpart IIII does not have individual limits for NOx or VOC. Instead the limit is applicable to the sum of the two pollutants. Therefore, each pollutant has been estimated at their worst-case, while the limit is applicable to their sum.
California Climate Action Registry (CCAR) General Reporting Protocol, Version 3.1, January 2009.
Emergency firewater pump engine assumed to be a 460 Hp diesel engine. This size engine falls into the NSPS emission standards Equipment for emergency purposes only.
The firewater pump will be limited to operational testing of 100 hr/yr to comply with the proposed rule, 40 CFR Part 60 Subpart IIII – Standards of Performance Compression Ignition Internal Combustion Engines. This rule does not regulate hours of operations during an emergency.

Criteria:

Annual Operations	100	hrs/yr
Weekly Operations	115.4	min/wk
Brake Specific Fuel Consumption	7,000	Btu/hp-hr
Diesel Heating Value	19,300	Btu/lb
Density of Diesel	7.1	lb/gal
Unit Size Rating	460	Hp
Unit Size Rating	343.02	kW
Unit Size Rating	3,220,000	Btu/hr

Source Details:

		Stack Flow Rate	Stack Diameter	Release Height	Stack Area	Gas Velocity		Gas Exit Temperature	
ID	Emission Source	(cfm)	(in)	(ft)	(ft^2)	(ft/sec)	(m/s)	(deg F)	(deg K)
EP-6001	Firewater Pump	1,750	6	14	0.20	148.54	45.27	770	683

Emission Factors:

Criteria Pollutants	EF	Unit	Notes
NO_x	4.0	g/kW-hr	NSPS Subpart IIII
SO_2	0.002050	lb/hp-hr	Table 3.3-1
CO	3.50	g/kW-hr	NSPS Subpart IIII
VOC	4.0	g/kW-hr	NSPS Subpart IIII
$PM/PM_{10}/PM_{2.5}$	0.20	g/kW-hr	NSPS Subpart IIII
GHG Pollutants			
CO_2	8.24	lb/hp-hr	CCAR Table C.7 (73.15 kg CO_2/gallon, 100% Oxidization)
CH_4	0.000338	lb/hp-hr	CCAR Table C.8 (0.003 kg CH_4/gallon)
N_2O	0.000068	lb/hp-hr	CCAR Table C.8 (0.0006 kg N_2O/gallon)

Emissions:

Criteria Pollutants	(lb/hr)	(ton/yr)
NO_x	3.03	0.15
SO_2	0.94	0.047
CO	2.65	0.132
VOC	3.03	0.151
$PM/PM_{10}/PM_{2.5}$	0.15	0.008
GHG Pollutants		
CO_2	3,790.2	189.5
CH_4	0.1554	0.0078
N_2O	0.0311	0.0016

EP-6001
Firewater Pump Engine (Emergency)

HAPs from Diesel Combustion

Basis: AP-42 Section 3.3 Gasoline and Diesel Industrial Engines, Final Section, October 1996.
HAPs emission from diesel combustion in the Firewater Pump.
Only factors for pollutants noted as HAPs as defined by Section 112(b) of the Clean Air Act listed.
AP-42 factors marked as "less than" are omitted as emissions from such pollutants are negligible.

Criteria:

Annual Operations	100	hrs/yr
Weekly Operations	115.4	min/wk
Unit Size Rating	460	Hp

Pollutant	Emission Factor [(1)] (lb/hp-hr)	Emissions (lb/hr)	Emissions (ton/yr)
Benzene	6.53E-06	3.00E-03	1.50E-04
Toluene	2.86E-06	1.32E-03	6.58E-05
Xylenes	2.00E-06	9.18E-04	4.59E-05
Propylene	1.81E-05	8.31E-03	4.15E-04
Formaldehyde	8.26E-06	3.80E-03	1.90E-04
Acetaldehyde	5.37E-06	2.47E-03	1.23E-04
Naphthalene	5.94E-07	2.73E-04	1.37E-05
Total			**1.00E-03**

(1) Table 3.3-2. Emission factor converted from lb/MMBtu to lb/hp-hr using a conversion factor of 7,000 Btu/hp-hr.

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

EP-6051
Power Back-up Generator (Emergency)

Basis: AP-42 Section 3.4 Large Stationary Diesel and All Stationary Dual-fuel Engines, Final Section, October 1996.
New Source Performance Standard (NSPS) Subpart IIII (Tier 2 standards from 40 CFR 89.112 Table 1, kW>560). For emergency engines with maximum engine power greater than 50 horsepower (hp) the manufacturer must certify, pursuant to 40 CFR 60.4202(a)(2), that the engine meets the standards for new non-road compression ignition engines for the same model year and maximum power listed in 40 CFR 89.112. It is assumed that the model to be chosen for this facility will be a 2008 or newer model. The NSPS Subpart IIII does not have individual limits for NOx or VOC. Instead the limit is applicable to the sum of the two pollutants. Therefore, each pollutant has been estimated at their worst-case, while the limit is applicable to their sum.
California Climate Action Registry (CCAR) General Reporting Protocol, Version 3.1, January 2009.
Power Back-up Generator assumed to be a 1,495 Hp diesel engine. This size engine falls into the NSPS emission standards Equipment for emergency purposes only.
The power back-up generator will be limited to operational testing of 100 hr/yr to comply with the proposed rule, 40 CFR Part 60 Subpart IIII – Standards of Performance Compression Ignition Internal Combustion Engines. This rule does not regulate hours of operations during an emergency.

Criteria:

Annual Operations	100	hrs/yr
Weekly Operations	115.4	min/wk
Brake Specific Fuel Consumption	7,000	Btu/hp-hr
Diesel Heating Value	19,300	Btu/lb
% Sulfur in Diesel	0.05	%
Density of Diesel	7.1	lb/gal
Unit Size Rating	1,495	Hp
Unit Size Rating	1,114.82	kW
Unit Size Rating	10,465,000	Btu/hr

Source Details:

		Stack Flow Rate	Stack Diameter	Release Height	Stack Area	Gas Velocity		Gas Exit Temperature	
ID	Emission Source	(cfm)	(in)	(ft)	(ft^2)	(ft/sec)	(m/s)	(deg F)	(deg K)
EP-6051	Power Back-up Generator	3,200	8	12	0.35	152.79	46.57	770	683

Emission Factors:

Criteria Pollutants	EF	Unit	Notes
NO_x	6.4	g/kW-hr	NSPS Subpart IIII
SO_2	0.0004	lb/hp-hr	Table 3.4-1
CO	3.50	g/kW-hr	NSPS Subpart IIII
VOC	6.4	g/kW-hr	NSPS Subpart IIII
$PM/PM_{10}/PM_{2.5}$	0.20	g/kW-hr	NSPS Subpart IIII
GHG Pollutants			
CO_2	8.24	lb/hp-hr	CCAR Table C.7 (73.15 kg CO_2/gallon, 100% Oxidization)
CH_4	0.000338	lb/hp-hr	CCAR Table C.8 (0.003 kg CH_4/gallon)
N_2O	0.000068	lb/hp-hr	CCAR Table C.8 (0.0006 kg N_2O/gallon)

Emissions:

Criteria Pollutants	(lb/hr)	(ton/yr)
NO_x	15.73	0.79
SO_2	0.60	0.030
CO	8.60	0.430
VOC	15.73	0.787
$PM/PM_{10}/PM_{2.5}$	0.49	0.025
GHG Pollutants		
CO_2	12,318.2	615.9
CH_4	0.5052	0.0253
N_2O	0.1010	0.0051

EP-6051
Power Back-up Generator (Emergency)

HAPs from Diesel Combustion

Basis: AP-42 Section 3.4 Large Stationary Diesel and All Stationary Dual-fuel Engines, Final Section, October 1996.
HAPs emission from diesel combustion in the Power Back-up Generator.
Only factors for pollutants noted as HAPs as defined by Section 112(b) of the Clean Air Act listed.
AP-42 factors marked as "less than" are omitted as emissions from such pollutants are negligible.

Criteria:

Annual Operations	100	hrs/yr
Weekly Operations	115.4	min/wk
Unit Size Rating	1,495	Hp

Pollutant	Emission Factor [(1)] (lb/hp-hr)	Emissions (lb/hr)	Emissions (ton/yr)
Benzene	7.76E-04	1.16E+00	5.80E-02
Toluene	2.81E-04	4.20E-01	2.10E-02
Xylenes	1.93E-04	2.89E-01	1.44E-02
Propylene	2.79E-03	4.17E+00	2.09E-01
Formaldehyde	7.89E-05	1.18E-01	5.90E-03
Acetaldehyde	2.52E-05	3.77E-02	1.88E-03
Acrolein	7.88E-06	1.18E-02	5.89E-04
Total			**3.10E-01**

(1) Table 3.3-2. Emission factor converted from lb/MMBtu to lb/hp-hr using a conversion factor of 7,000 Btu/hp-hr.

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

EP-9001
Biogas Flare (SSM Equipment)

Biogas Flare Configuration

Basis: AP-42 Section 1.4 Natural Gas Combustion, Final Section, July 1998.
AP-42 Section 13.5 Industrial Flares, Final Section, September 1991.
California Climate Action Registry (CCAR) General Reporting Protocol, Version 3.1, January 2009.
Pilot heat input based on typical size.
Flare will be equipped with an electric igniter.
Flare will not operate more than 500 hours per year in support of the Mixed Fuel-Fired Boiler system operations.

Fuel Component	Molecular Weight	Biogas Flow mole fraction	Component HHV (Btu/scf)	Component LHV (Btu/scf)
H_2S	34.08	0.0003	647	596
Methane, CH_4	16.04	0.65	1013	913
CO_2	44.01	0.35	--	--
H_2O/Inerts	--	0	--	--
	Total moles	1.00		
	Gas HHV (Btu/scf)	658.5428		
	Gas LHV (Btu/scf)	593.5375		

Energy Usage:

Gas Volumetric Flow (lb-mol/hr)	60.40
Gas Volumetric Flow (MMscf/hr)	0.03
Energy (MMBtu/hr)	18.87

Fuel Component	Combustion Reaction	Combustion (Stoichiometric Calculations) CO_2	SO_2
H_2S	$2H_2S + 3O_2 \rightarrow 2SO_2 + 2H_2O$	0	1
Methane, CH_4	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$	1	0
Component Fraction Sums		0.65	0.0003

Combustion Exhaust	Value	Units	Notes/Equations:
Biogas SO_2	40.51	lb/MMscf	$\frac{[\text{Gas Flow}_{\text{lb-mol/hr}} * [(\text{S (Component} * \text{Component Ratio to } SO_2) * 100\%) * SO_2 \text{ MW}]}{\text{Gas Flow}_{\text{MMscf/hr}} \textbf{ OR } \text{Gas Flow}_{\text{MMBtu/hr}}}$
Assumes 100% Conversion H_2S to SO	0.06	lb/MMBtu	
Biogas CO_2	60,306.50	lb/MMscf	$\frac{[\text{Gas Flow}_{\text{lb-mol/hr}} * [(\text{C (Component} * \text{Component Ratio to } CO_2)) + (CO_2 \text{ Component})] * CO_2 \text{ MW}]}{\text{Gas Flow}_{\text{MMscf/hr}} \textbf{ OR } \text{Gas Flow}_{\text{MMBtu/hr}}}$
Assumes 100% Conversion CH_4 to CO	140.86	lb/MMBtu	

Natural Gas Pilot Emission Factors:

Criteria Pollutants	EF	Unit	Notes
NO_x	100.00	lb/MMscf	Table 1.4-1 Small Boilers, Uncontrolled
SO_2	0.60	lb/MMscf	Table 1.4-2
CO	84	lb/MMscf	Table 1.4-1 Small Boilers, Uncontrolled
VOC	5.5	lb/MMscf	Table 1.4-2
$PM/PM_{10}/PM_{2.5}$	7.6	lb/MMscf	Table 1.4-2 All PM is assumed to be less than 1.0 micrometer in diameter.
Lead	0.0005	lb/MMscf	Table 1.4-2
GHG Pollutants			
CO_2	119,337	lb/MMscf	CCAR Table C.7 (53.06 kg CO_2/MMBtu, 100% Oxidization)
CH_4	2.25	lb/MMscf	CCAR Table C.8 (0.001 kg CH_4/MMBtu)
N_2O	0.22	lb/MMscf	CCAR Table C.8 (0.0001 kg N_2O/MMBtu)

Biogas Flaring Emission Factors:

Criteria Pollutants	EF	Unit	Notes:
NO_X	0.068	lb/MMBtu	Table 13.5-1 Thermal NOx emissions from combustion.
SO_2	0.06	lb/MMBtu	Boiler Fuel Criteria Engineering Calculations. Based on 100% conversion fuel sulfur to SO_2.
CO	0.37	lb/MMBtu	Table 13.5-1 Product of incomplete combustion.
GHG Pollutants			
CO_2	140.86	lb/MMBtu	Boiler Fuel Criteria Engineering Calculations.
CH_4	0.00	lb/MMBtu	CH_4 conversion to CO_2 is assumed 100%

EP-9001
Biogas Flare (SSM Equipment)

Criteria:

Flare Size	18.87	MMBtu/hr
Heating Value	658.54	Btu/scf
Pilot Fuel Gas	100	scf/hr
Flare Annual Operations	500	hr/yr
Pilot Annual Operations	8,760	hr/yr

Emissions:	Pilot Emissions		Flaring Emissions		Total Emissions	
Criteria Pollutants	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)
NO_x	1.00E-02	4.38E-02	1.28	0.32	1.29	0.36
SO_2	6.00E-05	2.63E-04	1.16	0.29	1.16	0.29
CO	8.40E-03	3.68E-02	6.98	1.75	6.99	1.78
VOC	5.50E-04	2.41E-03	0.00	0.00	5.50E-04	2.41E-03
$PM/PM_{10}/PM_{2.5}$	7.60E-04	3.33E-03	0.00	0.00	7.60E-04	3.33E-03
Lead	5.00E-08	2.19E-07	0.00	0.00	5.00E-08	2.19E-07
GHG Pollutants						
CO_2	11.93	52.27	2,658	664	2,669.87	716.75
CH_4	2.25E-04	9.85E-04	0.00	0.00	2.25E-04	9.85E-04
N_2O	2.25E-05	9.85E-05	0.00	0.00	2.25E-05	9.85E-05

HAPs from Natural Gas Combustion

Basis: AP-42 Section 1.4 Natural Gas Combustion, Final Section, July 1998
HAPs emission from Natural Gas Combustion in the Flare and Pilot.
Only factors for pollutants noted as HAPs as defined by Section 112(b) of the Clean Air Act listed.
AP-42 factors marked as "less than" are omitted as emissions from such pollutants are negligible.

Criteria:

Pilot Fuel Gas	100	scf/hr
Annual Operations	8,760	hr/yr

	Emission Factor [1]	Emissions		
Pollutant	($lb/10^6$ scf)	(lb/hr)	(lb/yr)	(ton/yr)
2-Methylnaphthalene	2.40E-05	2.40E-09	2.10E-05	1.05E-08
Benzene	2.10E-03	2.10E-07	1.84E-03	9.20E-07
Dichlorobenzene	1.20E-03	1.20E-07	1.05E-03	5.26E-07
Fluoranthene	3.00E-06	3.00E-10	2.63E-06	1.31E-09
Fluorene	2.80E-06	2.80E-10	2.45E-06	1.23E-09
Formaldehyde	7.50E-02	7.50E-06	6.57E-02	3.29E-05
Hexane	1.80E+00	1.80E-04	1.58E+00	7.88E-04
Naphthalene	6.10E-04	6.10E-08	5.34E-04	2.67E-07
Phenanathrene	1.70E-05	1.70E-09	1.49E-05	7.45E-09
Pyrene	5.00E-06	5.00E-10	4.38E-06	2.19E-09
Toluene	3.40E-03	3.40E-07	2.98E-03	1.49E-06
Arsenic	2.00E-04	2.00E-08	1.75E-04	8.76E-08
Cadmium	1.10E-03	1.10E-07	9.64E-04	4.82E-07
Chromium	1.40E-03	1.40E-07	1.23E-03	6.13E-07
Cobalt	8.40E-05	8.40E-09	7.36E-05	3.68E-08
Manganese	3.80E-04	3.80E-08	3.33E-04	1.66E-07
Mercury	2.60E-04	2.60E-08	2.28E-04	1.14E-07
Nickel	2.10E-03	2.10E-07	1.84E-03	9.20E-07
Total		**1.89E-04**		**8.27E-04**

(1) Tables 1.4-3 and Table 1.4-4

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

AREA 11000
Biomass Grinding, Hammermilling, Handling and Storage Baghouse Emissions

Biomass Grinding, Hammermilling, Handling and Storage Baghouse Emissions

Basis: AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.
Emission factors for grinding operations assumed equivalent to grain cleaning.
Emission factors for grain shipping used as a appropriate estimate for emissions from grinded biomass shipping.

AP-42 Section 9.9.1 states that, recent research on dust emissions from grain handling operations have indicated that the fraction of dust particles equal to or less than 10 micrometers in aerodynamic diameter (PM_{10}) averages approximately 25 percent of total PM, and the fraction of dust particles less than 2.5 micrometers in aerodynamic diameter ($PM_{2.5}$) averages about 17 percent of PM_{10}.

The ground biomass grinding, transfer and handling system is a completely closed system designed with high velocity pickup of grains; therefore capture efficiency is assumed 100%.
Uncontrolled emissions represent potential-to-emit in the absence of controls.

Straight grain delivery trucks are not typically used in bulk grain transfer operations; however, these trucks are assumed to most similar to the truck type that will be used for biomass delivery.

Criteria:

Grinding Design Rate	4,156,800	lb/day	
Grinding Design Rate	86.6	ton/hr	
Biomass Usage Rate	912,500	ton/yr	
Receiving Schedule	5,280	hr/yr	**Based on 16 hr/day, 330 day/yr
Maximum Hours of Operations	8,760	hr/yr	
% Loadout by Straight Truck	100%		

Emission Factor Equation: $PM/PM_{10}/PM_{2.5}$ Emissions (lb/hr) = (cfm) x (gr/dscf) x (60 min/hr) / (gr/lb)

BACT Emission Factor	0.004	gr/dscf	All PM is assumed to be less than 1.0 micrometer in diameter.
Conversion Factor	7,000	gr/lb	
Conversion Factor	60	min/hr	

Source Details:

ID	Emission Source	Stack Flow Rate (cfm)	Stack Diameter (in)	Release Height (ft)	Stack Area (ft^2)	Gas Velocity (ft/sec)	Gas Velocity (m/s)	Gas Exit Temperature (deg F)	Gas Exit Temperature (deg K)
EP-11025	Gasification Metering Bin #1 (GMB1) DC-1113	10,700	18	105	1.77	100.92	30.76	Ambient	Ambient
EP-11026	Gasification Metering Bin #2 (GMB2) DC-1123	10,700	18	105	1.77	100.92	30.76	Ambient	Ambient
EP-11027	EH Metering Bin #1 (EMB1) DC-11339	10,700	18	95	1.77	100.92	30.76	Ambient	Ambient
EP-11028	EH Metering Bin #2 (EMB2) DC-11439	10,700	18	95	1.77	100.92	30.76	Ambient	Ambient
EP-11030	Gasification Day Bin #1 (GB1) Rotary Valve Ve	400	3	6	18.3	0.36	0.11	Ambient	Ambient
EP-11033	Gasification Day Bin #2 (GB2) Rotary Valve Ve	400	3	6	18.3	0.36	0.11	Ambient	Ambient
EP-11037	Gasification Day Bin #1 (GB1) DC-11172	10,700	18	120	1.77	100.92	30.76	Ambient	Ambient
EP-11039	Gasification Day Bin #2 (GB2) DC-11272	10,700	18	120	1.77	100.92	30.76	Ambient	Ambient
EP-11041	EH Day Bin (EDB1) Rotary Valve Vent	400	3	6	10.8	0.62	0.19	Ambient	Ambient
EP-11044	EH Day Bin (EDB1) DC-11372	10,700	18	120	1.77	100.92	30.76	Ambient	Ambient
EP-11071	Biomass Grinding Line DC #1	97,100	52	65	14.75	109.73	33.44	Ambient	Ambient
EP-11072	Biomass Grinding Line DC #2	97,100	52	65	14.75	109.73	33.44	Ambient	Ambient
EP-11080	Floor Sweep System DC-11234	10,900	52	40	14.75	12.32	3.75	Ambient	Ambient
EP-11081	Dirt Load-Out Silo DC-11190	900	6	65	0.20	76.39	23.28	Ambient	Ambient
EP-11082	Dirt Load-Out Silo Spout DC-11168	2,100	8	40	0.35	100.27	30.56	Ambient	Ambient

AREA 11000
Biomass Grinding, Hammermilling, Handling and Storage Baghouse Emissions

PM, PM_{10} & $PM_{2.5}$ Emissions:

ID	Emission Source	System Feed Rate	PM		PM_{10}		$PM_{2.5}$		Notes:
		(ton/hr)	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)	
EP-11025	Gasification Metering Bin #1 (GMB1) DC-1113	27.2	0.367	1.61	0.37	1.61	0.37	1.61	
EP-11026	Gasification Metering Bin #2 (GMB2) DC-1123	27.2	0.367	1.61	0.37	1.61	0.37	1.61	
EP-11027	EH Metering Bin #1 (EMB1) DC-11339	16.1	0.367	1.61	0.37	1.61	0.37	1.61	
EP-11028	EH Metering Bin #2 (EMB2) DC-11439	16.1	0.367	1.61	0.37	1.61	0.37	1.61	
EP-11030[2]	Gasification Day Bin #1 (GB1) Rotary Valve Ve	27.2	0.0137	0.036	0.0137	0.036	0.0137	0.036	Note 2
EP-11033[2]	Gasification Day Bin #2 (GB2) Rotary Valve Ve	27.2	0.0137	0.036	0.0137	0.036	0.0137	0.036	Note 2
EP-11037[2]	Gasification Day Bin #1 (GB1) DC-11172	27.2	0.367	0.969	0.37	0.969	0.37	0.969	Note 2
EP-11039[2]	Gasification Day Bin #2 (GB2) DC-11272	27.2	0.367	0.969	0.37	0.969	0.37	0.969	Note 2
EP-11041[2]	EH Day Bin (EDB1) Rotary Valve Vent	16.1	0.0137	0.036	0.0137	0.036	0.0137	0.036	Note 2
EP-11044[2]	EH Day Bin (EDB1) DC-11372	16.1	0.367	0.969	0.37	0.969	0.37	0.969	Note 2
EP-11071	Biomass Grinding Line DC #1	27.2	3.33	14.58	3.33	14.58	3.33	14.58	
EP-11072	Biomass Grinding Line DC #2	27.2	3.33	14.58	3.33	14.58	3.33	14.58	
EP-11080[3]	Floor Sweep System DC-11234	0.1	0.37	0.99	0.37	0.99	0.37	0.99	Note 3
EP-11081[1]	Dirt Load-Out Silo DC-11190	1.8	0.03	0.08	0.03	0.08	0.03	0.08	Note 1
EP-11082[1]	Dirt Load-Out Silo Spout DC-11168	1.8	0.07	0.19	0.07	0.19	0.07	0.19	Note 1
Total				**39.86**		**39.86**		**39.86**	

(1) Stream 11081 from the PFD is associated with the dust generated within the silo while the silo is being filled. Stream 11082 from the Process Flow Diagram (PFD) is associated with a dust handling system for the load-out spout specifically. Stream 11082 will be equipped with a fabric filter to control dust emissions generated from dumping material into a truck. Stream 11802 will operate intermittent, assumed not more than 16 hours per days, 330 days per year.

(2) The flow rates shown are instantaneous (these bins will only be operated in a batch manner during process upset situations). For the purposes of PTE calculations, these day bins will are assumed to operated similar to the receiving equipment, operating not more than 16 hours per day, 330 days per year.

(3) The flow rate shown is instantaneous (the floor sweeps will be operated intermittently). For the purposes of PTE calculations, the floor sweep system has been assumed to operate not more than 16 hours per days, 330 days per year.

AREA 11000
Biomass Grinding, Hammermilling, Handling and Storage Baghouse Emissions

Biomass Grinding, Hammermilling, Handling Fugitive Emissions

Basis: AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003.
Emission factors for grinding operations assumed equivalent to grain cleaning.
Emission factors for grain handling used as a appropriate estimate for emissions from biomass handling (legs, conveyors, belts, scale, etc.).

AP-42 Section 9.9.1 states that, recent research on dust emissions from grain handling operations have indicated that the fraction of dust particles equal to or less than 10 micrometers in aerodynamic diameter (PM_{10}) averages approximately 25 percent of total PM, and the fraction of dust particles less than 2.5 micrometers in aerodynamic diameter ($PM_{2.5}$) averages about 17 percent of PM_{10}.

The ground biomass transfer and handling system is a closed system designed with high velocity pickup of grains; therefore capture efficiency is assumed 100%. For conveyor lines, loading openings will not be closed, however the lines will be maintained under negative pressure; therefore, a capture efficiency of 95% was estimated.
Uncontrolled emissions represent potential-to-emit in the absence of controls.

Straight grain delivery trucks are not typically used in bulk grain transfer operations; however, these trucks are assumed to most similar to the truck type that will be used for biomass delivery.

Criteria:

Module Grinding Loading Schedule	5,280 hr/yr
% Loadout by Straight Truck	100%

Emission Factors:	PM	PM_{10}	$PM_{2.5}$	Unit	Notes
Emission Factor for Headhouse and Grain Handling	0.061	0.034	0.0058	lb/ton	Table 9.9.1-1
Emission Factor for Grain Cleaning w/Cyclone (Controlled Emission Factor from AP-42)	0.075	0.019	0.0032	lb/ton	Table 9.9.1-1
Emission Factor for Grain Cleaning (Uncontrolled Emission Factor Back-calculated Using a 85.0% Control Efficiency for Cyclones)	0.5	0.127	0.021	lb/ton	Table 9.9.1-1
Emissions for Straight Trucks	0.18	0.059	0.01	lb/ton	Table 9.9.1-1
Emission Factor for Hopper Truck	0.035	0.0078	0.0013	lb/ton	Table 9.9.1-1
Emission Factor for Railcar	0.032	0.0078	0.0013	lb/ton	Table 9.9.1-1

PM Emissions:

ID	Emission Source	Throughput (ton/yr)	Emission Factor (lb/ton)	Uncontrolled PM (ton/yr)	Capture Efficiency (%)	Fugitive Emissions (lb/hr)	Fugitive Emissions (ton/yr)
EP-11000FUG	Biomass Handling	912,500	0.061	27.83	100%	0	0
EP-11000FUG	Biomass Cleaning	912,500	0.075	34.22	100%	0	0
EP-11000FUG	Biomass Grinding	912,500	0.5	228.13	100%	0	0
Subtotal		**912,500**		**290.18**		**0**	**0**
EP-11000FUG	Straight Trucks	912,500	0.18	82.13	95%	1.56	4.11
Subtotal		**912,500**		**82.13**		**1.56**	**4.11**
Total				**372.30**		**1.56**	**4.11**

PM_{10} Emissions:

ID	Emission Source	Throughput (ton/yr)	Emission Factor (lb/ton)	Uncontrolled PM_{10} (ton/yr)	Capture Efficiency (%)	Fugitive Emissions (lb/hr)	Fugitive Emissions (ton/yr)
EP-11000FUG	Biomass Handling	912,500	0.034	15.51	100%	0	0
EP-11000FUG	Biomass Cleaning	912,500	0.019	8.67	100%	0	0
EP-11000FUG	Biomass Grinding	912,500	0.127	57.94	100%	0	0
Subtotal		**912,500**		**82.13**		**0**	**0**
EP-11000FUG	Straight Trucks	912,500	0.059	26.92	95%	0.51	1.35
Subtotal		**912,500**		**26.92**		**0.51**	**1.35**
Total				**109.04**		**0.51**	**1.35**

$PM_{2.5}$ Emissions:

ID	Emission Source	Throughput (ton/yr)	Emission Factor (lb/ton)	Uncontrolled $PM_{2.5}$ (ton/yr)	Capture Efficiency (%)	Fugitive Emissions (lb/hr)	Fugitive Emissions (ton/yr)
EP-11000FUG	Biomass Handling	912,500	0.0058	2.65	100%	0	0
EP-11000FUG	Biomass Cleaning	912,500	0.0032	1.46	100%	0	0
EP-11000FUG	Biomass Grinding	912,500	0.021	9.58	100%	0	0
Subtotal		**912,500**		**13.69**		**0**	**0**
EP-11000FUG	Straight Trucks	912,500	0.01	4.56	95%	0.09	0.23
Subtotal		**912,500**		**4.56**		**0.09**	**0.23**
Total				**18.25**		**0.09**	**0.23**

AREA 11000
Biomass Grinding, Hammermilling, Handling and Storage Baghouse Emissions

Biomass Conveyors and Storage Fugitive Emissions

Basis: AP-42 Section 9.9.1, Grain Elevators and Processes, Final Section, April 2003
The biomass transfer and storage system is a completely closed system designed with high velocity pickup of grains; therefore capture efficiency is assumed 100%.
Uncontrolled emissions represent potential-to-emit in the absence of controls.

Criteria:

Grinding Delivery Rate	156	lb/hr
Annual Biomass Usage	912,500	ton/yr
Module Grinding Loading Schedule	5,280	hr/yr

Emission Factors:	PM	PM_{10}	$PM_{2.5}$	Unit	Notes
Emission Factor for Headhouse and Grain Handling	0.061	0.034	0.0058	lb/ton	Table 9.9.1-1
Emission Factor for Storage Bin (Vent)	0.025	0.0063	0.0011	lb/ton	Table 9.9.1-1

PM Emissions:

		Throughput		Emission Factor	Uncontrolled PM		Capture Efficiency	Fugitive Emissions	
ID	Emission Source	(lb/hr)	(ton/yr)	(lb/ton)	(lb/hr)	(ton/yr)	(%)	(lb/hr)	(ton/yr)
EP-11000FUG	Headhouse and Biomass Handling	156	912,500	0.061	0.00	27.83	100%	0	0
EP-11000FUG	Storage Bin (Vent)	156	912,500	0.025	0.00	11.41	100%	0	0
Total						**39.24**			**0**

PM_{10} Emissions:

		Throughput		Emission Factor	Uncontrolled PM_{10}		Capture Efficiency	Fugitive Emissions	
ID	Emission Source	(lb/hr)	(ton/yr)	(lb/ton)	(lb/hr)	(ton/yr)	(%)	(lb/hr)	(ton/yr)
EP-11000FUG	Headhouse and Biomass Handling	156	912,500	0.034	0.00	15.51	100%	0	0
EP-11000FUG	Storage Bin (Vent)	156	912,500	0.0063	0.00	2.87	100%	0	0
Total						**18.39**			**0**

$PM_{2.5}$ Emissions:

		Throughput		Emission Factor	Uncontrolled $PM_{2.5}$		Capture Efficiency	Fugitive Emissions	
ID	Emission Source	(lb/hr)	(ton/yr)	(lb/ton)	(lb/hr)	(ton/yr)	(%)	(lb/hr)	(ton/yr)
EP-11000FUG	Headhouse and Biomass Handling	156	912,500	0.0058	0.00	2.65	100%	0	0
EP-11000FUG	Storage Bin (Vent)	156	912,500	0.0011	0.00	0.50	100%	0	0
Total						**3.15**			**0**

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

EP-13150
Enzymatic Hydrolysis Vent Scrubber

Vendor: Abengoa Bioenergy

Basis: ASPEN simulation used to project emissions from this emission unit. Preliminary emissions from the vent scrubber (EP-13150) were estimated using ASPEN model, EM0902MM-21, which predicts 0.48 lb/hr of furfural. This scrubber controls all non-distillation or fermentation vents including those from A19000 (evaporator), conditioning (A14000), and non-condensibles from pretreatment (A12000). Enzymatic hydrolysis vent stream to be vented to the Mixed Fuel-Fired Boiler system for additional heat input.

VOM Composition (best engineering estimate from York, NE pilot plant):

Uncontrolled VOM Emissions	9.6	lb/hr		
Furfural (Aldehyde), CAS 98-01-1, $C_5H_4O_2$	9.6	lb/hr	% Furfural	100%

Criteria:

EH Anhydrous ETOH Production	2,055	gal/hr
EH Anhydrous ETOH Production	18	MMgpy
Hours of Operations	8,760	hr/year

Control Equipment: Caustic, Packed Bed Scrubber

Source Details:

ID	Emission Source	Stack Flow Rate (cfm)	Stack Diameter (in)	Release Height (ft)	Stack Area (ft^2)	Gas Velocity (ft/sec)	Gas Velocity (m/s)	Gas Exit Temperature (deg F)	Gas Exit Temperature (deg K)
EP-13150	EH Vent Scrubber	2,900	12	70	0.79	61.54	18.76	59	288

Emission Factors:

Pollutant	Composition of VOM	EF	Unit	Removal Efficiency	Notes
$PM/PM_{10}/PM_{2.5}$	N/A	0.25	lb/hr	N/A	Condensible PM only, all PM is assumed to be less than 1.0 micrometer in diameter.
VOC (VOM assumed VOC)	100%	9.6	lb/hr	95%	BACT % Removal Efficiency
CO_2	--	0.00	lb/hr	NA	See EP-18185

$PM/PM_{10}/PM_{2.5}$ Emissions:

ID	Source Description	(lb/hr)	(ton/yr)
EP-13150	EH Vent Scrubber	0.3	1.10
Total			**1.10**

VOC Emissions:

ID	Source Description	Uncontrolled VOC (lb/hr)	Uncontrolled VOC (ton/yr)	Controlled VOC Before Boilers (lb/hr)	Controlled VOC Before Boilers (ton/yr)
EP-13150	EH Vent Scrubber	9.60	42.05	0.48	2.10
Total			**42.05**		**2.10**

CO_2 Emissions:

ID	Source Description	Uncaptured CO_2 (lb/hr)	Uncaptured CO_2 (ton/yr)
EP-13150	EH Vent Scrubber	0	0
Total			**0**

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

EP-18185
Enzymatic Hydrolysis CO_2 Scrubber

Vendor: Abengoa Bioenergy

Basis: ASPEN simulation used to project emissions from this emission unit. Preliminary emissions from the CO_2 scrubber (EP-18185) were estimated using ASPEN and were predicted at 2.51 lb/hr VOCs from the scrubber stack. As the final design has not been completed, a factor of safety of 2 was applied.
CO_2 emissions expected from the entire enzymatic hydrolysis fermentation and distillation process included with this emission point.

VOM Composition:

Uncontrolled VOM Emissions	502.0	lb/hr		
Ethanol	502.0	lb/hr	% Ethanol	100%
rfural (Aldehyde), CAS 98-01-1, $C_5H_4O_2$	100	ppm	% Furfural	0.01%

Criteria:

Biomass Feed Rate	610	dT/day
Biomass Feed Rate	672	ton/day
EH Anhydrous ETOH Production	2,055	gal/hr
EH Anhydrous ETOH Production	18	MMgpy
Hours of Operations	8,760	hr/year

Control Equipment: Wet Scrubber with Packing
Auxiliary Material: Water and Chemical Agents

Source Details:

		Stack Flow Rate	Stack Diameter	Release Height	Stack Area	Gas Velocity		Gas Exit Temperature	
ID	Emission Source	(cfm)	(in)	(ft)	(ft^2)	(ft/sec)	(m/s)	(deg F)	(deg K)
EP-18185	EH CO_2 Scrubber	8,762	18	70	1.77	82.64	25.19	60	289

Emission Factors:

Pollutant	Composition of VOM	EF	Unit	Removal Efficiency	Notes
VOC (VOM assumed VOC)	100%	502.0	lb/hr	99%	BACT % Removal Efficiency
CO_2	--	6.29	lb/gal	NA	Assumed equivalent to similar sized facilities

VOC Emissions:

		Uncontrolled VOC		Controlled VOC	
ID	Source Description	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)
EP-18185	EH CO_2 Scrubber	502.0	2,199	5.02	21.99
Total			**2,199**		**21.99**

CO_2 Emissions:

		Uncaptured CO_2	
ID	Source Description	(lb/hr)	(ton/yr)
EP-18185	EH CO_2 Scrubber	12,926.0	56,616
Total			**56,616**

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

EP-18180
Enzymatic Hydrolysis Distillation Vent Scrubber

Vendor: Abengoa Bioenergy

Basis: Uncontrolled VOM emissions were assumed equivalent to the a starch ethanol plant, scaled to 18 MMgal/yr, plus a factor of safety of 2.

VOM Composition (assumed equivalent to grain ethanol stream):

Uncontrolled VOM Emissions 78.7 lb/hr

Ethanol	37.7 lb/hr	% Ethanol	47.96%
Acetaldehyde	0.68 lb/hr	% Acetaldehyde	0.86%
Methanol	0.49 lb/hr	% Methanol	0.62%
Acrolein	0.90 lb/hr	% Acrolein	1.14%
Formaldehyde	0.90 lb/hr	% Formaldehyde	1.14%
Other VOM	0.25 lb/hr	% Other VOM	0.32%

Criteria:

EH Anhydrous ETOH Production	2,055	gal/hr
EH Anhydrous ETOH Production	18	MMgpy
Hours of Operations	8,760	hr/year

Control Equipment: Wet Scrubber with Packing
Auxiliary Material: Water and Chemical Agents

Source Details:

ID	Emission Source	Stack Flow Rate (cfm)	Stack Diameter (in)	Release Height (ft)	Stack Area (ft^2)	Gas Velocity (ft/sec)	Gas Velocity (m/s)	Gas Exit Temperature (deg F)	Gas Exit Temperature (deg K)
EP-18180	EH Distillation Vent Scrubbe	250	4	80	0.09	47.75	14.55	57	287

Emission Factors:

Pollutant	Composition of VOM	EF	Unit	Removal Efficiency	Notes
VOC (VOM assumed VOC)	100%	78.7	lb/hr	99%	BACT % Removal Efficiency
CO_2	--	0	lb/hr	NA	See EP-18185
HAPs					
Acetaldehyde	0.86%	0.7	lb/hr	78.38%	% Removal Efficiency
Methanol	0.62%	0.5	lb/hr	99.29%	% Removal Efficiency
Acrolein	1.14%	0.9	lb/hr	99.00%	% Removal Efficiency
Formaldehyde	1.14%	0.9	lb/hr	99.00%	% Removal Efficiency

VOC Emissions:

ID	Source Description	Uncontrolled VOC (lb/hr)	Uncontrolled VOC (ton/yr)	Controlled VOC (lb/hr)	Controlled VOC (ton/yr)
EP-18180	Distillation Vent Scrubber	78.7	345	0.79	3.45
Total			**345**		**3.45**

CO_2 Emissions:

ID	Source Description	Uncaptured CO_2 (lb/hr)	Uncaptured CO_2 (ton/yr)
EP-18180	Distillation Vent Scrubber	0.0	0
Total			**0**

HAPs Emissions:

Pollutant	Uncontrolled HAPs (lb/hr)	Uncontrolled HAPs (ton/yr)	Controlled HAPs (lb/hr)	Controlled HAPs (ton/yr)
Acetaldehyde	0.68	2.96	0.146	0.64
Methanol	0.49	2.14	0.003	0.02
Acrolein	0.90	3.93	0.009	0.04
Formaldehyde	0.90	3.93	0.009	0.04
Total	**2.96**	**12.96**	**0.17**	**0.74**

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

EP-19005 & EP-19010
Enzymatic Hydrolysis Preheater and Process Evaporator Vent Condensers

Vendor: Abengoa Bioenergy

Basis: Stream composition assumed equivalent to the enzymatic hydrolysis CO_2 scrubber, EP-18185.
Enzymatic hydrolysis vent streams to be vented to the Mixed Fuel-Fired Boiler system for additional heat input.

VOM Composition:
Uncontrolled VOM Emissions 6 lb/hr

Criteria:

EH ETOH Production	2,055	gal/hr
EH ETOH Production	18	MMgpy
Annual Operations	8,760	hr/year

Control Equipment: Vacuum Jet and Condenser
Auxiliary Material: Water

Source Details:

ID	Emission Source	Stack Flow Rate (cfm)	Stack Diameter (in)	Release Height (ft)	Stack Area (ft^2)	Gas Velocity (ft/sec)	Gas Velocity (m/s)	Gas Exit Temperature (deg F)	Gas Exit Temperature (deg K)
EP-19005	Preheater Vent Condenser	24	2	30	0.02	18.33	5.59	120	322
EP-19010	Evaporator Vent Condenser	24	2	30	0.02	18.33	5.59	120	322

Emission Factors:

Pollutant	EF	Unit	% Device Efficiency	Notes
VOC (VOM assumed VOC)	6.00	lb/hr	98.0%	BACT % Removal Efficiency

VOC Emissions:

ID	Source Description	Uncontrolled VOC (lb/hr)	Uncontrolled VOC (ton/yr)	Controlled VOC Before Boilers (lb/hr)	Controlled VOC Before Boilers (ton/yr)
EP-19005	Preheater Vent Condenser	6.00	26.28	0.12	0.53
EP-19010	Evaporator Vent Condenser	6.00	26.28	0.12	0.53
Total			**26.28**		**0.53**

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

EP-19001
Lignin-Rich Stillage Storage and Loadout

Lignin-Rich Stillage Storage

Basis: Emissions calculated for lignin-rich stillage storage and loadout assumed equivalent to WDGS emission rates. November 2004 stack test at the Diversified Energy Co. (DENCO) ethanol facility located in Morris, Minnesota.

Criteria:

Lignin-Rich Stillage Percent Moisture	65%	by weight
Lignin-Rich Stillage Handling Rate	27,741	lb/hr wet
Lignin-Rich Stillage Handling Rate	13.87	ton/hr
Annual Lignin-Rich Stillage Handling Rate	121,507	ton/yr
Annual Operations	8,760	hr/yr

Emission Factors:			
Pollutant	EF	Unit	Notes
VOC	0.0083	lb/ton Stillage , Wet	DENCO EF
HAPs			
Acetaldehyde	1.110E-04	lb/ton Stillage , Wet	DENCO EF
Methanol	4.440E-05	lb/ton Stillage , Wet	DENCO EF
Acrolein	1.670E-05	lb/ton Stillage , Wet	DENCO EF
Formaldehyde	2.220E-04	lb/ton Stillage , Wet	DENCO EF

Emissions:	Emissions	
Pollutant	(lb/hr)	(ton/yr)
VOC	0.12	0.50
HAPs		
Acetaldehyde	1.54E-03	6.74E-03
Methanol	6.16E-04	2.70E-03
Acrolein	2.32E-04	1.01E-03
Formaldehyde	3.08E-03	1.35E-02

Total Lignin-Rich Stillage Storage VOC:	**0.50 ton/yr**
Total Lignin-Rich Stillage Storage HAPs:	**0.02 ton/yr**

Abengoa Bioenergy Biomass of Kansas, LLC **Rev. 2**
Biorefinery Facility
Hugoton, Kansas

Areas 1900 and 20000
Materials and Chemical Handling

Materials and Chemical Handling

Basis: BACT emission factor used to calculate emissions from vents associated with ash, sand and calcium hydroxide handling.
Uncontrolled emissions represent potential-to-emit in the absence of controls.
The transfer, handling and storage systems are completely closed systems designed with high velocity pickup of grains; therefore capture efficiency is assumed 100%.
Calcium hydroxide (lime) has an unloading rate of 25,000 lb/hr and a storage period of 6 days.

Criteria:

Maximum Hours of Operations	8,760	hr/yr	
Receiving Schedule	5,280	hr/yr	**Based on 16 hr/day, 330 day/yr

Emission Factor Equation: $PM/PM_{10}/PM_{2.5}$ Emissions (lb/hr) = (cfm) x (gr/dscf) x (60 min/hr) / (gr/lb)

BACT Emission Factor	0.004	gr/dscf	All PM is assumed to be less than 1.0 micrometer in diameter.
Conversion Factor	7,000	gr/lb	
Conversion Factor	60	min/hr	

Source Details:

ID	Emission Source	Stack Flow Rate (cfm)	Stack Diameter (in)	Release Height (ft)	Stack Area (ft^2)	Gas Velocity (ft/sec)	Gas Velocity (m/s)	Gas Exit Temperature (deg F)	Gas Exit Temperature (deg K)
EP-20501	Boiler Ash Handling Dust Collector #1	10,000	18	45	1.77	94.31	28.75	Ambient	Ambient
EP-20502	Boiler Ash Handling Dust Collector #2	10,000	18	45	1.77	94.31	28.75	Ambient	Ambient
EP-20511	Sand Handling Dust Collector #1	20,000	26	105	3.69	90.41	27.55	Ambient	Ambient
EP-20512	Sand Handling Dust Collector #2	20,000	26	105	3.69	90.41	27.55	Ambient	Ambient
EP-1901	Lime Storage Silo #1 Dust Collector	1,500	8	45	0.35	71.62	21.83	Ambient	Ambient
EP-1902	Lime Storage Silo #2 Dust Collector	1,500	8	45	0.35	71.62	21.83	Ambient	Ambient
EP-1903	Lime Day Silo Dust Collector	1,500	8	45	0.35	71.62	21.83	Ambient	Ambient

PM, PM_{10} & $PM_{2.5}$ Emissions:

ID	Emission Source	PM (lb/hr)	PM (ton/yr)	PM_{10} (lb/hr)	PM_{10} (ton/yr)	$PM_{2.5}$ (lb/hr)	$PM_{2.5}$ (ton/yr)
EP-20501	Boiler Ash Handling Dust Collector #1	0.34	1.50	0.34	1.50	0.34	1.50
EP-20502	Boiler Ash Handling Dust Collector #2	0.34	1.50	0.34	1.50	0.34	1.50
EP-20511	Sand Handling Dust Collector #1	0.69	1.81	0.69	1.81	0.69	1.81
EP-20512	Sand Handling Dust Collector #2	0.69	1.81	0.69	1.81	0.69	1.81
EP-1901	Lime Storage Silo #1 Dust Collector	0.05	0.14	0.05	0.14	0.05	0.14
EP-1902	Lime Storage Silo #2 Dust Collector	0.05	0.14	0.05	0.14	0.05	0.14
EP-1903	Lime Day Silo Dust Collector	0.05	0.14	0.05	0.14	0.05	0.14
Total			**7.03**		**7.03**		**7.03**

(1) The flow rate shown for the sand handling and the lime storage silos dust collectors is instantaneous (these sources will be operated intermittently). For the purposes of PTE calculations, the sand handling and lime storage silos have been assumed to operate not more than 16 hours per days, 330 days per year.