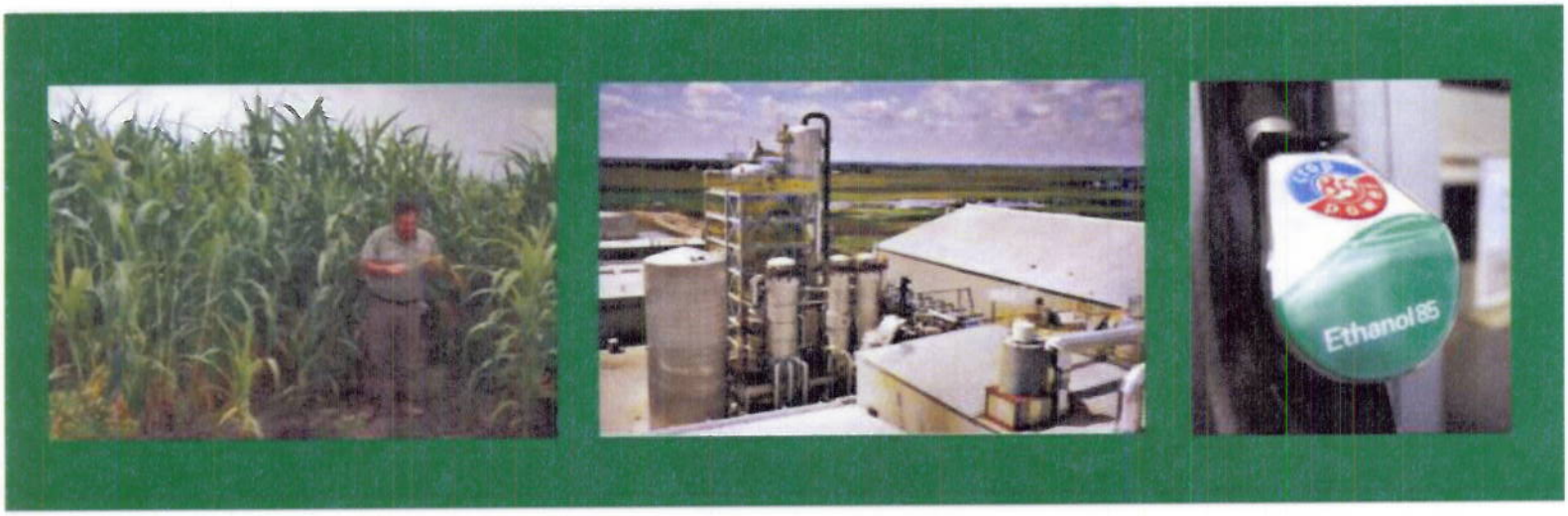
Supplement Analysis

for the

Final
Environmental Impact Statement

for the

Proposed Abengoa Biorefinery Project near Hugoton, Stevens County, Kansas



U.S. Department of Energy
Golden Field Office
Office of Energy Efficiency and Renewable Energy

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ACRONYMS

CFR	*Code of Federal Regulations*
FR	*Federal Register*
GREET	Greenhouse gases, Regulated Emissions, and Energy use in Transportation (Model)
WIMAS	Water Information Management and Analysis System

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1. PURPOSE

The *Final Environmental Impact Statement for the Proposed Abengoa Biorefinery Project near Hugoton, Stevens County, Kansas* (DOE/EIS-0407F; Abengoa Bioenergy FEIS) analyzed the potential direct, indirect, and cumulative environmental impacts of the design, construction, startup of a biomass-to-ethanol and energy production facility—the Biorefinery Project. The analysis considered a Proposed Action and an Action Alternative, where the biorefinery project would be implemented, and a No-Action Alternative, where Abengoa would not build the biorefinery and no changes would be made to the environment.

Under the Proposed Action, the biorefinery would process approximately 2,500 dry short tons per day of feedstock, which would be obtained from producers within 50 miles of the Biorefinery Project site. The biorefinery would produce up to 19 million gallons of denatured ethanol per year and 125 megawatts of electricity. Seventy-five megawatts of electricity would be sold commercially. Under the Action Alternative, the biorefinery would produce approximately 12 million gallons per year of denatured ethanol and 20 megawatts of electricity for use at the facility. Table 1 shows a summary of the design features and products of the Proposed Action and Action Alternative. By its Record of Decision (76 FR 2096, January 12, 2011), DOE decided to provide Federal funding of up to $71 million (2009 dollars), subject to annual appropriations, to Abengoa Bioenergy Biomass of Kansas (Abengoa Bioenergy) for the Proposed Action to support the design, construction, and startup of the Abengoa Biorefinery Project.

Since the Record of Decision, Abengoa Bioenergy has proposed a modification to the Proposed Action. Under the Modified Proposed Action, the biorefinery would process approximately 1,000 dry short tons per day of feedstock, which would be obtained from producers within 50 miles of the Biorefinery Project site. The biorefinery would produce up to 25 million gallons of denatured ethanol per year and 20 megawatts of electricity for use at the facility. Under the Modified Proposed Action, none of the electricity would be sold to the grid. The design features and products of the Modified Proposed Action also are shown in Table 1.

This Supplement Analysis examines the potential environmental impacts of the Modified Proposed Action and addresses whether the potential environmental impacts are within the range of the potential environmental impacts analyzed in the FEIS. The last column of Table 1 summarizes the relationship between the Modified Proposed Action and the Proposed Action and Action Alternative. Except for total ethanol production of 25 million gallons per year, the use of anhydrous ammonia, and the possible need of 5 MW of power during biorefinery peak operations, the Modified Proposed Action is within both the Proposed Action and Action Alternative design features and products.

2. DESCRIPTION OF THE MODIFIED PROPOSED ACTION

Abengoa Bioenergy would construct the biorefinery on a 385-acre parcel near Hugoton, Kansas. Abengoa has optioned an additional 425 acres immediately east of the biorefinery parcel, between the biorefinery and the Hugoton city limits, as a buffer area. The planned usage of the optioned parcel would be to continue its use as irrigated agricultural land and to test production of biomass feedstocks and for biomass storage

The biomass-to-ethanol and -energy facility proposed by Abengoa Bioenergy would use lignocellulosic biomass (biomass) as feedstock to produce biofuels. Biomass, including corn stover, wheat straw, milo

Table 1. Comparison of the design features and products of the biorefinery under the Proposed Action, Action Alternative, and Modified Proposed Action.

Design features/products	Proposed Action	Action Alternative	Modified Proposed Action	Relation of MPA to PA and AA
Biomass feedstock	Approximately 2,500 dry short tons per day	800 dry short tons per day	Approximately 1,000 dry short tons per day	Within range of PA and AA
Fermentation facility	One step feedstock hydrolysis/fermentation process	Feedstock pretreatment to remove simple sugar molecules followed by hydrolysis/fermentation process on the remaining cellulose	One step feedstock hydrolysis/fermentation process	Same as PA
Gasifier	No	Yes, syngas production	No	Same as PA
Steam production	Four biomass boilers (500 million Btu/hour each)	Two syngas boilers (132 million Btu/hour each) and one biomass boiler (190 million Btu/hour)	One biomass boiler (315 million Btu/hour)	Less than PA or AA
Denatured Ethanol production	19 million gallons per year	12 million gallons per year	25 million gallons per year	More than PA
Lignin-rich stillage cake (not including distiller's syrup)	120,000 dry short tons per year	45,000 dry short tons per year	100,000 dry short tons per year	Within range of PA and AA
Lignin production	45,000 dry short tons (41,000 dry metric tons) per year	19,000 dry short tons (17,000 dry metric tons) per year	None initially. Lignin-rich stillage cake would be used as solid fuel in the biomass boiler	Within range of PA and AA
Electricity production	125 megawatts (75 megawatts sold to the grid)	20 megawatts (none sold to the grid)	20 megawatts (none sold to the grid)	Same as AA; less than PA
Electricity purchase	None	10 megawatts (15 megawatts during peak demand)	None, except when generator is off, then up to 20 megawatts during peak demand	Like AA with possible 5 megawatts more during biorefinery peak demand
Boiler ash	127,000 tons per year	11,000 tons per year	68,000 tons per year	Within range of PA and AA
Gasifier ash	0	9,000 tons (8,000 metric tons) per year	0	Same as PA
Anhydrous ammonia	None	None	14,400 gallon tank	More than PA

AA = Action Alternative; Btu = British thermal unit; MPA = Modified Proposed Action; PP = Proposed Action.

stubble, mixed warm season grasses (such as switchgrass), and other available materials, would be harvested as feedstock and fermented to produce ethanol and potentially lignin. The biorefinery would also produce biopower, or bioenergy, in the form of electricity. The bioenergy generation facility co-located at the site would use direct-firing (that is, using the biomass as a solid fuel in a boiler) to produce steam. Steam produced in the biomass boiler would be used for facility processes and to produce electricity.

Under the Modified Proposed Action, the biorefinery would process approximately 1,000 dry tons per day of feedstock, which would be obtained from producers within 50 miles of the Biorefinery Project site. The biorefinery would produce up to 25 million gallons of denatured ethanol per year and 20 megawatts of electricity. Under the Modified Proposed Action, generated electricity would be approximately balanced to the grid to meet biorefinery needs but would not be a net producer of electrical power to the grid.

Construction of the Modified Proposed Action biorefinery would take approximately 24 months, versus 18 months for the Proposed Action, and would require infrastructure improvements, such as construction of site roads that would tie to Rural Road P and an approximately 0.5-mile railroad spur on the Biorefinery Project site that would tie into the Cimarron Valley Railroad which, in turn, connects with the BNSF railroad. Temporary connections to utilities would include electricity, data, telephone, potable, and non-potable water. Temporary potable water and sanitary facilities would be provided onsite until construction of permanent, onsite facilities.

Harvested bales of biomass would be transported to the facility for same-day use, to a 10-acre onsite storage yard, or to one of three offsite storage sites to be located within 30 miles of the Biorefinery Project site. Each offsite storage location would be about 160 acres and would have no permanent structures. Combined, these sites could store enough biomass to support biorefinery operations for up to 1 year. Bales of corn stover and other biomass ready for processing at the biorefinery would be transported to a receiving station and sent by conveyor for grinding and enter the production process.

The ethanol production process would involve the following steps: (1) enzymatic hydrolysis and fermentation, (2) distillation and dehydration, (3) ethanol storage, and (4) shipping. During hydrolysis and fermentation, the feedstock would be treated with enzymes (enzymatic hydrolysis) and genetically modified organisms to break down the cellulose and ferment the sugars. The resulting "beer," which would be 4 to 5 percent ethanol at that point, would then be distilled and dehydrated to remove water and residual solids. Distillation would also destroy genetically modified and other organisms.

The facility design incorporates two shift tanks, each with a capacity of approximately 45,000 gallons, to hold the produced anhydrous ethanol until releasing it to the product storage tanks. The storage tanks would be enclosed in a bermed area to contain spills. As needed, gasoline would be added to denature the ethanol and make it unfit for human consumption, prior to temporary storage and loading of the product into tanker railcars for shipment.

Suspended solids would be recovered from the distillation process. The biorefinery would produce approximately 100,000 dry tons of solids, referred to as lignin-rich stillage cake, per year. The stillage cake would be transferred by conveyor for optional lignin production. After lignin extraction, the lignin-poor stillage cake would return to the biorefinery and be used as fuel for the solid biomass boiler. Until a lignin extraction facility is built, the lignin-rich stillage cake also would be used as solid fuel in the

biomass boiler. Soluble materials would be recovered from the distillation process through multiple effect evaporation as a liquid product syrup. Approximately 100,000 dry tons of syrup would be recovered and combusted in the biomass boiler as fuel. Alternatively, the lignin-rich stillage cake and liquid syrup may be sold as a useful bio-product if a market becomes available.

The biomass grinding would be an enclosed system with a positive pressure collection system to transfer airborne particles to a dirt loadout receptacle. The grinding activities and associated transfer points would have fabric filter dust collectors (baghouses).

Volatile organic matter released during processing would be captured in vent scrubbers.

The biomass boiler would burn much of the waste from ethanol production, including fine dirt collected during milling, stillage cake, syrup from the evaporation process, sludge from wastewater treatment, along with additional biomass feedstock as needed. These processes would produce approximately 50,000 tons of fly ash and 18,000 tons of bottom ash annually. The fly ash would contain potassium and phosphorus and would be marketed as a soil amendment or fertilizer. If there is no market for the fly ash, it would be sent to qualified landfills, as would the bottom ash.

3. POTENTIAL ENVIRONMENTAL IMPACTS OF THE MODIFIED PROPOSED ACTION

The potential environmental impacts DOE considered in the Abengoa Biorefinery FEIS, and here for the Modified Proposed Action, include land use; air quality; hydrology; biological resources; utilities, energy, and materials; wastes, byproducts, and hazardous materials; transportation; aesthetics; socioeconomics; cultural resources; health and safety; and environmental justice. Also considered are potential impacts on these resources from accidents and acts of sabotage. No wetlands would be filled and no floodplains would be affected. The following sections discuss the potential impacts of the Modified Proposed Action.

3.1 Land Use

Operation of the biorefinery under the Modified Proposed Action would require approximately 400,000 dry tons of lignocellulosic feedstock per year, which is 400,000 dry tons less than under the Proposed Action. Abengoa Bioenergy anticipates that, at the start of operations, the primary feedstock would be corn stover, with secondary feedstocks consisting of grain sorghum stover, wheat straw, and mixed warm season grasses (such as switchgrass).

DOE conservatively estimates that the total annual demand for crop residue by the biorefinery would equal about 23 percent of the targeted crop residues that could be sustainably removed from the 50-mile region surrounding the Biorefinery Project site, compared with 60 percent under the Proposed Action. The demand for corn residue for ethanol production would be about 10 percent of the amount that could be sustainably removed from irrigated corn acreage. Thus, production of targeted crop residues would exceed biorefinery demand and Abengoa Bioenergy would have the flexibility in feedstock procurement. DOE anticipates the demand for crop residue by the biorefinery would have a negligible impact on changes in land use type, including use of lands in the Conservation Reserve Program, because there would be no incentive to alter land use type for the purpose of meeting demand.

Over time, Abengoa anticipates that mixed warm season grasses (such as switchgrass) would replace corn residue as the primary feedstock for producing ethanol. This would result in (1) beneficial environmental impacts where marginal cropland was converted and (2) minimal environmental changes where land use types such as nonharvested cropland, former Conservation Reserve Program acreage, and pasture were converted. The beneficial environmental impacts of converting marginal cropland to mixed warm season grasses are related to establishment of a crop that is resistant to many pests and plant diseases; uses relatively less water, fertilizer, and pesticides; and establishes deep roots that store carbon in the soil. Increased mixed warm season grasses production would not be expected to result in an adverse impact to land enrolled in the Conservation Reserve Program.

Contracts between Abengoa Bioenergy and producers of biomass would include a requirement that crop residues would be harvested in accordance with U.S. Department of Agriculture guidelines for minimizing wind erosion. DOE concludes that, on a regional basis, removing crop residue following these guidelines would have a negligible adverse impact on soil organic matter content. On a field-by-field basis, crop residue removal would have a negligible to minor adverse impact on soil organic matter content. Any adverse impact to soil organic matter content would be limited to land for which the producer was compensated for residue removal.

Development of the biorefinery would result in the irreversible conversion of 385 acres from agricultural to industrial use. The Proposed Action is consistent with zoning and existing land use at the Biorefinery Project site. The reduction in irrigated farmland associated with the water rights Abengoa Bioenergy would transfer to industrial use at the biorefinery would be a negligible change in regional irrigated cropland.

Under the Modified Proposed Action, the biorefinery would result in fewer impacts related to land use compared with the Proposed Action.

3.2 Air Quality

Construction of the biorefinery under the Modified Proposed Action would cause emissions from various activities including use of heavy diesel-operated equipment, disturbance of the soil, grading activities, material transport, and material handling. These activities would be short term or intermittent in nature and would only occur during the 24-month construction phase. Best management practices would be employed to minimize these emissions.

Concentrations of criteria pollutants estimated to be released during operation of the biorefinery under the Modified Proposed Action would result in conditions well below the National Ambient Air Quality Standards. The estimated concentrations, combined with ambient background concentrations of pollutants in the region, are about 19 percent of the National Ambient Air Quality Standard for 24-hour PM_{10}, 7 percent for nitrogen dioxide, and less than 10 percent of the standard for other pollutants. Under the Proposed Action, the ambient background concentrations are expected to be 67 percent of the National Ambient Air Quality Standard for 24-hour PM_{10}, 12 percent for nitrogen dioxide. DOE concludes that biorefinery air emissions would not harm human health and the environment under either the Modified Proposed Action or Proposed Action.

Under the Modified Proposed Action, the biorefinery also would be a source of greenhouse gases, with carbon dioxide the most abundant. The boiler would be the main source of such greenhouse gases as

carbon dioxide, methane, and nitrous oxide. Biomass fermentation and distillation processes also would emit carbon dioxide. The total emissions of carbon dioxide equivalents (used to represent the contribution of all gases) from biorefinery operation under the Modified Proposed Action would be 0.55 million tons per year, compared with 3.61 million tons per year under the Proposed Action. According to the DOE Energy Information Administration, the total U.S. greenhouse gas emissions in 2008 was 7,775 million tons of carbon dioxide equivalents, with 6,409 million tons of the total from energy-related carbon dioxide. The projected greenhouse gas emissions from the biorefinery under the Modified Proposed Action would be 0.007 percent of the total U.S. carbon dioxide equivalent value compared with 0.046 percent under the Proposed Action.

Although the biorefinery would be a source of greenhouse gas emissions, operation of the biorefinery would provide a net reduction in greenhouse gas emissions when considering the emissions produced during the lifecycle of ethanol production and use relative to the lifecycle of gasoline production and use. To determine the level of greenhouse gas reduction from the Proposed Action, DOE used the Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET) Model, developed by DOE's Argonne National Laboratory. The GREET Model examines "well-to-wheel" fuel lifecycles by considering factors such as producing raw materials for fuels, refining the raw materials into fuels, and using the fuel in vehicles. The Abengoa Biorefinery Project would reduce greenhouse gas emissions by producing a fuel that displaces gasoline and by producing the power required to operate the facility (bioenergy). The GREET Model combines these reductions and other factors into a single metric to express the net effect on lifecycle greenhouse gas emissions relative to a baseline scenario in which the biorefinery is not built. Under the Modified Proposed Action, the biorefinery would have a 70-percent reduction in greenhouse gases compared with the baseline where the biorefinery is not built and gasoline is used in passenger vehicles. The GREET Model was used to determine this reduction.

Under the Modified Proposed Action, the biorefinery would have less ambient air quality impacts then under the Proposed Action. However, the greenhouse gas reduction under the Modified Proposed Action would be less than under the Proposed Action

3.3 Hydrology

Wastewater, petroleum products, and hazardous chemicals would be present at the biorefinery. Planned releases of wastewater would be limited to the contact and non-contact wastewater that would be used for irrigation of the Abengoa property. Under the Proposed Action and Action Alternative, discharge to the buffer area would be limited to non-contact wastewater with all contact wastewater being treated and recycled within the biorefinery. Under the Modified Proposed Action, the biorefinery would have the option of including treated wastewater with the non-contact wastewater that would go to the Abengoa property for irrigation. To support this change, Abengoa has notified the Kansas Department of Health and Environment, is developing specifications for the combined wastewater that would be used for irrigation, will perform a new agronomy study to evaluate the long-term effects of using the wastewater for irrigation of the Abengoa property, and, using the results of the studies, will apply for a National Pollutant Discharge Elimination System permit from the State for land application of the wastewater. Following these steps would mitigate any adverse effects from including treated contact wastewater in irrigation flow to the Abengoa property. Under the Modified Proposed Action crop irrigation would occur on both the 425-acre buffer area and, to a lesser extent, on the adjacent 385-acre parcel that would include the biorefinery. Petroleum products and hazardous chemicals used during construction and

operation of the biorefinery would be managed within secondary containment on the site, and there are no surface waters in the nearby area that would be affected by accidental releases.

Disturbed and built-up land areas would result in increased runoff; this runoff would be directed to natural low areas within the biorefinery parcel. Changes in infiltration would be minor and likely would be limited to small changes in the exact locations where infiltration would occur. Alterations to surface water drainage would be limited to minor changes within the 385-acre parcel and possibly within the 425-acre buffer area. Natural low areas where runoff accumulates would not be altered. DOE concludes the potential for adverse impacts to surface waters from the Proposed Action is negligible.

Construction of the biorefinery would require approximately 220 acre-feet of water, and operation under the Modified Proposed Action would require about 1,650 acre-feet of water per year. DOE estimates that an additional 46 acre-feet of groundwater would be withdrawn per year by the City of Hugoton to meet the domestic needs of biorefinery workers, bringing the total annual estimated demand to support the biorefinery during operations to approximately 1,700 acre-feet per year. This total is less than 60 percent of the 2,950 acre-feet per year evaluated for the Proposed Action.

Abengoa Bioenergy has optioned existing irrigation water rights from five wells to meet the water demand for construction and operation of the biorefinery under the Modified Proposed Action. According to the Kansas Water Information Management and Analysis System (WIMAS) database, the maximum permitted withdrawal associated with those water rights is about 3,500 acre-feet per year, and the total volume discharged from those wells in 2008 was about 3,440 acre-feet. Thus, use of the water rights for operation of the biorefinery would result in a reduction of 1,800 acre-feet compared with the permitted annual volume, and a reduction of 1,740 acre-feet compared with withdrawals during 2008. With regard to the five wells that Abengoa would use, the water rights shown in the WIMAS database are less than those shown in Appendix C of the Abengoa Biorefinery FEIS (a total of about 4,700 acre-feet for the five wells in the FEIS compared with 3,500 acre-feet in the WIMAS). However, the reduced estimates of annual water demand (from 2,950 acre-feet in the FEIS to 1,700 acre-feet) for the biorefinery operation, along with the reduced number of wells, still supports DOE's conclusion that operation of the biorefinery would result in a beneficial decrease in groundwater withdrawals from the High Plains aquifer under either the Modified Proposed Action or the Proposed Action.

Changes in cropping practices as a result of the Modified Proposed Action or the Proposed Action are not expected to occur. Further, increases in water withdrawals for agricultural purposes in Kansas are limited by State water appropriation regulations, although increases in Oklahoma and Colorado may be allowed. Thus, DOE concludes that changes in water use in the region resulting from changes in land use to meet the demand of the biorefinery for biomass are not expected to occur.

Any spills of hazardous materials would be handled in accordance with a spill prevention, control, and countermeasures plan, which would minimize or eliminate potential impacts to the groundwater quality from construction and operation of the biorefinery.

Under the Modified Proposed Action, the biorefinery generally would have less impact on hydrology then under the Proposed Action, although the Modified Proposed Action would result in a smaller decrease in groundwater withdrawals.

3.4 Biological Resources

There are no Federal- or State-endangered and/or threatened species, candidate species, or State species in need of conservation present or within 1 mile of the Biorefinery Project site. DOE concludes that construction and operation of the biorefinery would have no impacts on threatened or endangered species or their designated critical habitat.

To construct the biorefinery, the biorefinery parcel, which is currently used for dry-land farming, would be converted to industrial use. There would be some minor, short-term adverse impacts to biological resources from the construction and some minor, long-term adverse impacts from the operation of the biorefinery. Any such impacts would affect only common species on or within 1 mile of the Biorefinery Project site. The analysis of potential changes in land use resulting from the Modified Proposed Action indicated that conversion of Conservation Reserve Program lands to tilled cropland is not expected, and other changes in land use would be minimal. Thus, DOE does not expect the Modified Proposed Action to impact biological resources within the region surrounding the Project site.

The impacts to biological resources would be the same or less under the Modified Proposed Action compared with the Proposed Action because overall operations are similar and the power transmission line would not be required for the Modified Proposed Action.

3.5 Utilities, Energy, and Materials

Biorefinery workers and their families would rely on the City of Hugoton water system, the City of Hugoton sewage system, and the Stevens County landfill. The Hugoton water system also would supply potable water for the biorefinery facilities. Even with a 50 percent increase in the number of workers during operations under the Modified Proposed Action (65 workers compared with 43 workers for the Proposed Action); anticipated demands are well below the excess capacity of the City water system. The sewage collection system in Hugoton has sufficient capacity to accommodate use of the system by construction and operation workers and their families. As with the City's water system, the increased population in Hugoton under the Modified Proposed Action would be below the design capacity of the wastewater treatment system. In addition, the Stevens County landfill has enough capacity to handle the increase in solid waste during construction and operation due to the influx of workers and their families living in Hugoton under either the Modified Proposed Action or the Proposed Action.

The biorefinery would require no electric power from the regional grid during normal operations; however, unlike the Proposed Action, the Modified Proposed Action would not be a net supplier of electric power to the grid. During times of peak electrical demand or when the generator was not at full power, the biorefinery under the Modified Proposed Action could require electricity from the grid in amounts similar to those evaluated for the Action Alternative, which was 15 megawatts peak load and 10 megawatts normal load. It is reasonable to assume that biorefinery operations under the Modified Proposed Action, which has a nominal demand of 20 megawatts, would be at lower electrical demands until the generator was at full power. Under the Proposed Action, the amount of natural gas and diesel fuel required for normal operation of the biorefinery is approximately 0.1 and 0.05 percent, respectively, of the amounts of these fuels used in Kansas and would not adversely impact their supply and distribution in the region. Under the Modified Proposed Action, natural gas usage would be expected to be about the same as under the Proposed Action, and the amount of diesel fuel required would be less than that required under the Proposed Action due to decreases in the transportation numbers.

Under either the Modified Proposed Action or Proposed Action, the biorefinery would involve a commitment of building materials. With the possible exception of stainless steel, these materials would be available and their procurement would not decrease availability to other users in regional markets. Components used in stainless steel production (such as chromium and nickel) are in high demand and, at times, affect availability of stainless steel. However, the amount of stainless steel required for construction of the biorefinery is a very small portion of the amount that moves through the U.S. market annually.

3.6 Wastes, Byproducts, and Hazardous Materials

The wastes and byproducts the biorefinery would produce include construction wastes, wastewater, solid biomass boiler fly ash and bottom ash, distiller's residual biomass solids (stillage cake), stillage syrup, wastewater treatment facility sludge, lignin, genetically modified organisms, dirt and fines resulting from biomass processing, municipal solid waste, and hazardous waste.

Solid biomass boiler fly ash and lignin are byproducts that could be sold to consumers within the 50-mile region of influence. Under the Modified Proposed Action, Abengoa Bioenergy would burn stillage cake, syrup, dirt and fines from biomass processing, wastewater treatment sludge, and genetically modified organisms in the solid biomass boiler. The Proposed Action evaluated in the FEIS did not include syrup and wastewater treatment sludge; however, Abengoa assumes that, at least in the short-term, there will be no market or other use for these materials and included them in the Modified Proposed Action. Domestic and process wastewater would be treated in the onsite wastewater treatment facilities, and treated process wastewater would be recycled in the ethanol production process or discharged to a holding pond along with non-contact wastewater. Abengoa would use non-contact and contact wastewater for crop irrigation on the Abengoa property, and would treat, recycle, and/or dispose of boiler bottom ash, municipal solid waste, hazardous waste, and construction debris at permitted facilities.

The Stevens County landfill would not have adequate capacity to receive the construction wastes generated and maintain its small arid landfill exempt permit status (limited to 20 tons per day); revising that permit would be expensive. The non-recycled construction waste streams would be split among other permitted landfills and transfer stations within 35 miles of the biorefinery without significantly affecting their capacity. Less than 1 ton per day of municipal solid waste would be generated during the expected 30-year operating life of the biorefinery and would be sent to the Stevens County landfill. This waste stream would be about a 3 percent increase to the landfill's current waste stream and would reduce the life of the landfill by less than 1 year. The preceding descriptions of construction and municipal solid wastes associated with the Proposed Action would be expected to be essentially the same under the Modified Proposed Action.

The onsite wastewater treatment facility would treat all contact process wastewater generated at the Biorefinery Project site and would not discharge any to the Hugoton wastewater system. Most of the process wastewater treated onsite would be reused in the ethanol production process, but unlike the Proposed Action, the Modified Proposed Action includes the option of combining treated process water with non-contact water for land application. Treated wastewater that would not be recycled and reused in the production process and the non-contact wastewater would be produced at an approximate rate of 300 gallons per minute and would be used to irrigate biomass crops on the Abengoa property (that is, the 425-acre buffer area and the adjacent 385-acre parcel that would include the biorefinery). This compares to 370 gallons per minute of just non-contact water evaluated in the Proposed Action. This water would be

conveyed to storage pond(s) prior to application to the Abengoa property. Because the volume of water designated for irrigation would be less, the storage pond(s) could be smaller than the combination of the two 11.5-acre ponds evaluated in the Proposed Action. Wastewater treatment facility sludge would be used in the boiler fly ash pelletization process or burned in the solid biomass boiler. In order to meet anticipated stipulations of a required discharge permit for the irrigation water, Abengoa Bioenergy will be required to complete a new agronomy study addressing the chemical composition of the combined contact and non-contact wastewater and the long-term effects of its application to the Abengoa property. As a result, DOE does not anticipate adverse impacts from the land application of wastewater, including odor or aesthetic impacts. Abengoa Bioenergy would have to modify the facility water balance and wastewater treatment facility design if lignin was extracted from the stillage cake, thereby generating additional wastewater.

Chemicals required for operation of the biorefinery would be received by truck or rail and off-loaded and transferred by an enclosed chemical delivery system to storage tanks, silos, or other chemical storage facilities. Chemicals would have to be obtained from outside the region. The demand for chemicals for the biorefinery would be an insignificant percentage of the production in the United States.

Under either the Modified Proposed Action or the Proposed Action, the biorefinery would generate approximately 2,000 pounds per year of hazardous waste (for example, spent solvents, waste ethanol, and caustics). These wastes would be collected and treated/disposed of by licensed hazardous waste facilities. DOE does not anticipate adverse impacts from the handling and disposal of hazardous wastes generated at the biorefinery because Abengoa Bioenergy's proposed hazardous waste management practices will be implemented.

Genetically modified organisms used in the enzymatic hydrolysis process would be killed by a heat sterilization process and would be contained in the beer column bottoms. The bottoms stream would be dewatered and the residual solids sent to the solid biomass boiler for burning.

Consistent with the significantly reduced boiler capacity under the Modified Proposed Action, the solid biomass boiler would generate up to 180 tons of ash per day compared with the 370 tons per day estimated under the Proposed Action. However, under the Modified Proposed Action, the biomass boiler would be a stoker-type boiler, which produces much more bottom ash than the fluidized bed boiler considered in the Proposed Action. As a result, the reduced quantity of ash produced under the Modified Proposed Action would contain a much higher percentage of bottom ash, estimated at 50 tons per day compared with 16 tons per day of bottom ash for the Proposed Action. The bottom ash would be sent to a qualified landfill, potentially the Seward County landfill. Disposal of the bottom ash at this landfill over the life of the biorefinery would reduce the life of permitted landfill space by about 7.5 years, compared with the life reduction of 2.2 years estimated for the Proposed Action. Abengoa Bioenergy plans to sell the fly ash (produced at 130 tons per day under the Modified Proposed Action compared to about 350 tons per day under the Proposed Action) as a nutrient replacement co-product. If the ash could not be sold or otherwise used in a beneficial manner, it would require disposal at permitted solid waste disposal facilities. The Stevens County landfill does not have adequate capacity to receive this amount of ash without a permit modification, so this waste stream would be split among permitted landfills and transfer stations within 35 miles of the biorefinery. However, impacts on existing permitted solid waste disposal facilities could be problematic if a significant percentage of the boiler fly ash was not marketable as a soil amendment byproduct. The loss of land used for landfill disposal of solid wastes generated during construction and operation of the biorefinery would be an irreversible and irretrievable loss of resources.

Although a larger volume of ash is identified for definite landfill disposal under the Modified Proposed Action, if fly ash also requires landfill disposal, the total volume (bottom ash and fly ash) would be much reduced compared with the Proposed Action.

3.7 Transportation

There would be approximately 35,000 truck shipments of materials during construction, and about 25,000 to 60,000 truck and 1,000 to 2,500 rail shipments per year during the 30-year operations phase of the biorefinery. Shipping volume, as summarized in Table 2 and discussed in the following paragraphs, for the combined construction and operation of the Modified Proposed Action would be lower than for the Proposed Action. Correspondingly, the estimates for traffic fatalities under the Modified Proposed Action would be 21 to 26 fatalities during construction and the 30-year operations phase due to fewer shipments than under the Proposed Action. For perspective, over the 30-year operations phase, there would be an estimated 13,400 traffic fatalities in the entire state of Kansas and 820 traffic fatalities in the nine counties surrounding the Biorefinery Project site.

Under the Modified Proposed Action, DOE estimates that 1,500 rail carloads of denatured ethanol, co-products, and chemicals would be shipped to and from the biorefinery per year of operation, which is equivalent to about 60 additional trains per year, resulting in a lower volume of train traffic compared with the Proposed Action. This would result in an increase in the approximately 600 trains per year that currently travel on the Cimarron Valley Railroad, but less than the capacity of 40 to 60 trains per day on that line. Thus, the additional rail traffic for the Proposed Action would not adversely affect the operations of the Cimarron Valley Railroad.

Increased truck traffic would result in increased pavement deterioration. For biomass, chemical, and waste shipments associated with the Proposed Action, DOE estimated the annual cost of this pavement damage from the Modified Proposed Action to range from $310,000 to $539,000, which is less than that under the Proposed Action.

Table 2 summarizes the expected traffic changes between the Modified Proposed Action and Proposed Action discussed above. Under the Modified Proposed Action, impacts related to transportation during construction would be 9 percent higher than under the Proposed Action. Under the Modified Proposed Action, impacts related to transportation during operations would be less than under the Proposed Action.

Table 2. Comparison of transportation volumes under the Proposed Action and Modified Proposed Action.

	Proposed Action	Modified Proposed Action	Relation of MPA to PA	
			Difference	Comment
Construction				
Truck	32,000	35,000	3,000	Increase of 3,000
Operations				
Truck range	80,000 to 116,000	25,000 to 60,000	(55,000) to (56,000)	Decrease in traffic
Truck road damage	$580,000 to $840,000	$310,000 to $539,000	($260,000) to ($229,000)	Decrease in road damage
Rail car range	300 to 6,600	1,000 to 2,500	700 to (4,100)	
Expected rail cars	6,000	1,500	(4,500)	Expected decrease in overall train traffic
Traffic fatalities for shipments and commuters	35 to 41	21 to 26	(14) to (15)	Decrease in fatalities

MPA = Modified Proposed Action; PA = Proposed Action.

3.8 Aesthetics

DOE considered the potential impacts of the Abengoa Biorefinery Project on views in the area surrounding the Biorefinery Project site and evaluated how noise and odor from the biorefinery could affect residents in the area.

3.8.1 VISUAL RESOURCES

Under the Modified Proposed Action, the tallest structure, a boiler smoke stack, at the biorefinery would be approximately 200 feet, which is 85 feet taller than the tallest structure under the Proposed Action. All other structures under the Modified Proposed Action would be 40 feet tall or less. Under the Modified Proposed Action, the biorefinery would be visually similar to the grain storage silos and elevators, chemical tanks, and other structures located adjacent to the Biorefinery Project site and would be visible from surrounding vantage points, such as the city of Hugoton and the Forewinds Golf Course.

The biorefinery would operate 24 hours a day, 350 days a year, and thus would be a source of night lighting.

Under the Modified Proposed Action, visual impacts would be the same as those under the Proposed Action except for the boiler smoke stack, which would be 85 feet taller and visible in the surrounding area.

3.8.2 NOISE

Workers would be exposed to noise during construction from construction equipment and trucks traveling to and from the biorefinery construction site. Workers would also be exposed to noise from equipment and biorefinery processes during operations. Best management practices would be employed to limit noise, and a hearing conservation program would be implemented; therefore, Abengoa does not expect to exceed permissible noise exposure levels.

The nearest residence to the construction site, approximately 0.6 mile away, may experience some annoyance from construction noise. The noise level at that distance would be approximately 56 decibels, which is approximately the same noise level as a normal conversation. In addition to being temporary, the U.S. Environmental Protection Agency states that this noise level should not interfere with daily activities such as conversing, working, or recreating. As such, the impact would be small.

Noise from biorefinery operations would attenuate to below background levels beyond 0.6 mile. Therefore, except for the residence at the northwest property boundary, DOE does not anticipate impacts to members of the public from construction or operation of the biorefinery due to noise.

During construction, there would be about 77 truck shipments to the biorefinery site per day, or about one truck arriving every 11 minutes (assuming all traffic occurs from 7:00 a.m. to 9:00 p.m.). During operations, approximately 164 trucks per day are expected (one truck every 5 minutes). The routes taken by those trucks through and around Hugoton would vary, but it is anticipated that at least 50 percent of the traffic (one truck every 10 minutes during operations) would use the truck bypass and affect two residences along Road Q. Along a route that passes the Stevens County Hospital, several schools, and places of worship, trucks are anticipated to pass at a rate of one every 26 minutes during operations. Noise from these passing trucks would frequently interfere with outdoor conversations and cause annoyance indoors. Rail traffic would increase by about 60 trains per year.

The Modified Proposed Action and Proposed Action are expected to have similar noise impacts because the same basic processes would be implemented and controlled.

3.8.3 ODOR

Odors may result from emissions of volatile organic compounds, including ethanol, and hazardous air pollutants, and from nitrogen dioxide and sulfur dioxide. Engineered controls implemented to minimize these emissions would reduce odors from the biorefinery. Air dispersion modeling indicates that no odorous compounds would be detected at the biorefinery parcel fence line or offsite locations where the public would commonly be located. Therefore, DOE anticipates no impacts to the public from the release of odorous compounds.

The Modified Proposed Action and Proposed Action are expected to have similar odor impacts because the same basic processes would be implemented and controlled.

3.9 Socioeconomics

DOE evaluated the potential impacts of construction and operation of the biorefinery on socioeconomic variables, including population and housing, employment and income, taxes, and public services, in Stevens County and the three surrounding counties; that is, Morton and Seward counties in Kansas and Texas County in Oklahoma.

Under the Modified Proposed Action, the Abengoa Biorefinery Project would require around 260 workers at the peak of construction. About 195 of those positions likely would be filled by people who would migrate into the four-county region, which would result in a temporary increase in the population in the region of less than 1 percent and would have little impact on the availability or cost of housing or on public services. In addition to the jobs directly associated with the construction of the biorefinery, about

90 indirect jobs are expected to be created during the peak period of construction. DOE estimates that during construction, there would be about 110 additional students enrolled in local school districts. This represents a 1.0 percent increase in enrollment in the region. During the 12-month period of the most-intense construction activity, the region could experience an approximately $22-million infusion of earnings, which represents about a 1-percent increase in the 2006 per capita personal income in the region.

The anticipated life of the biorefinery is 30 years, during which it would employ around 65 people. This would result in a regional increase in the local population of about 0.1 percent, and would have little or no impact on housing, public services, or educational services. During operations, the region would experience an annual $6.7 million infusion in earnings compared to $4.4 million for the Proposed Action. In addition, 34 indirect jobs are expected to be created during the operations phase compared to 23 indirect jobs for the Proposed Action.

The Modified Proposed Action has higher local employment compared to the Proposed Action to construct and operate the biorefinery.

3.10 Cultural Resources

No properties listed on the *National Register of Historic Places* are within or on properties adjoining the Biorefinery Project site. Based on a DOE review of published information, coordination with the State Historic Preservation Officer, and the results of a Phase I/II investigation of a 160-acre portion (areas investigated were coordinated with the State Historic Preservation Officer) of the Project site, construction and operation of the biorefinery would not result in adverse impacts to State-preserved or National Historic Register sites, sites of prehistoric or early historic occupation, or historic resources of local significance. When selected, offsite biomass storage locations will be evaluated for cultural resources in coordination with the Kansas State Historic Preservation Office to ensure no adverse impacts.

The Modified Proposed Action and Proposed Action are expected to have similar cultural resources impacts because the same lands would be impacted.

3.11 Health and Safety

DOE estimated health and safety impacts to workers from industrial hazards using incidence rates for 2007 for both nonfatal occupational injuries and occupational fatalities from the U.S. Department of Labor, Bureau of Labor Statistics. Members of the public would not be located within the Biorefinery Project site and would not be affected by industrial hazards at the biorefinery.

The potential for adverse impacts to health and safety under the Modified Proposed Action would be very minor. During construction, the industrial health and safety impacts to workers are estimated to be 14 total recordable cases (that is, work-related deaths, illnesses, or injuries that result in the loss of consciousness, days away from work restricted work activity or job transfer, or required medical treatment beyond first aid), 7 days away from work, and 0.026 fatality. Under the Modified Proposed Action during operations, the total annual industrial health and safety impacts to workers from all operations at the biorefinery (such as, ethanol manufacturing, milling and grinding operations, and electric power generation) are estimated to be 4.1 total recordable cases, 1.42 days away from work, and

0.00221 fatality compared with 2.7 total recordable cases, 1.42 days away from work and 00014 fatality under the Proposed Action. Based on these results, DOE concludes that a fatality would be unlikely. No adverse health impacts to members of the public from air emissions under normal operations are anticipated.

Under the Modified Proposed Action, health and safety impacts would be greater than under the Proposed Action due to the increase in operational staffing from 43 (Proposed Action) to 65 people (Modified Proposed Action).

3.12 Facility Accidents and Sabotage

Under the Modified Proposed Action, a 14,400-gallon tank of anhydrous ammonia would be added to the process to allow 33,000 gallons of anhydrous ammonia to be used annually with the new biomass boiler for nitrous oxide control. Aqueous ammonia, which was considered under the Proposed Action, would continue to be used under the Modified Proposed Action.

DOE determined that the bounding accident would be failure of the anhydrous ammonia storage tank that has been added for the Modified Proposed Action (see Appendix A). For this accident, life-threatening effects could occur to residents living near the site if no mitigating action were implemented. However, since the amount of ammonia stored would exceed the EPA threshold of 10,000 pounds (the 14,400 gallons of ammonia stored at the facility would weigh over 80,000 pounds), an emergency response program would be required as specified at 10 CFR 68 Part 180, "Emergency Response Program." This program would require the implementation of a strategy (either sheltering in place or evacuation) to mitigate the adverse health effects of ammonia exposure from the postulated accident. The emergency plan would include a list of residences and other places that would be notified and instructed in the event of an accidental ammonia release. This is the same strategy that is being implemented at the ethanol plant planned for Jasper County, Indiana (DOE 2005). Therefore, it is expected that if mitigating strategies were in place as required at 10 CFR Part 68, such strategies would eliminate life-threatening effects for offsite residents in the event of failure of the ammonia storage tank.

DOE considered the hazardous intentional destructive act to be the deliberate destruction of a toxic chemical storage tank. The consequences of such an act would be similar to the accidental failure of a toxic chemical tank and would be limited to injury and, in unlikely circumstances, death to nearby workers.

The inclusion of anhydrous ammonia for use at the facility does not represent a unique or unusual hazard in the Hugoton, Kansas area. Large amounts of the chemical are used in the United States, including use at other ethanol production facilities (DOE 2005). Further, anhydrous ammonia is already stored in tanks in the Hugoton area for agricultural use (see Appendix A). Similar-size tanks (between 12,000 and 18,000 gallons) are located in the West Industrial Park, about 1.2 to 1.3 miles from Hugoton, and a tank is located near the intersection of Northwest Avenue and the Atchison Topeka & Santa Fe Railroad on the western border of Hugoton. Both locations are closer to Hugoton than the proposed biorefinery site.

Based on the operational history of existing ethanol plants, DOE concludes that the hazards of ethanol production to members of the public would be minor, and that accidents during biorefinery operations are not likely to result in permanent health effects to offsite members of the public. In some accident scenarios, such as the failure of an ammonia, ethanol, or gasoline storage tank, workers could be injured

or killed depending on the location of the worker at the time of the event. With the aforementioned mitigating strategies, the Modified Proposed Action and Proposed Action are expected to have similar facility accident and sabotage impacts.

3.13 Environmental Justice

No impacts to communities with high percentages of minority or low-income populations were identified under either the Modified Proposed Action or Proposed Action that would exceed those identified for the general population. In addition, during the scoping process, DOE identified no unique exposure pathways, sensitivities, or cultural practices that would result in different impacts on minority or low-income populations. Disproportionately high and adverse impacts would be unlikely as a result of the Modified Proposed Action.

4. CONCLUSION AND DETERMINATION

Based upon the comparisons above, the following conclusions can be drawn:

- The Modified Proposed Action—with proposed mitigating strategies for anhydrous ammonia implemented—operational parameters have been evaluated as part of the alternatives considered in the Abengoa Biorefinery FEIS.

- Individually, with one exception, the potential environmental impacts from the Modified Proposed Action are within the range of environmental impacts presented in the FEIS for the Proposed Action, Action Alternative, and cumulative impacts. It can also be concluded that collectively, with one exception, the environmental impacts under the Modified Proposed Action are within those presented in the FEIS. The exception is accident impacts from failure of the anhydrous ammonia tank that has been added to the facility. In this case, it has been determined that offsite, life-threatening effects from one-hour exposure to ammonia vapors from an accident involving complete evaporation of the entire contents of the ammonia storage tank could occur to residents within 1.5 miles of the site if mitigation actions were not taken. However, it is expected that in the event of such an accident, mitigating actions, which could include indoor sheltering or evacuation, would be taken to eliminate such effects.

Determination:

The Department has determined that the Modified Proposed Action would not constitute a substantial change in actions previously analyzed and would not present any new circumstances or information relevant to the environmental concerns and bearing on the previously analyzed actions or impacts, within the meaning of 40 CFR 1502.9(c) and 10 CFR 1021.314. Accordingly, the Department has determined that a supplement to the FEIS is not required.

Signed this 7th day of July 2011 in Golden, CO.

Carol Battershell
Golden Field Office Manager
Office of Energy Efficiency and Renewable Energy
United States Department of Energy

APPENDIX A

An Evaluation of the Accident Impacts Involving a Storage Tank Containing Anhydrous Ammonia at the Abengoa Ethanol Plant near Hugoton, Kansas

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1. Introduction

This report provides an evaluation of the public health impacts from accidents involving release of anhydrous ammonia from a storage tank at the Abengoa ethanol plant to be located near Hugoton, Kansas. A previous evaluation of accidents from the plant was provided in the Final Environmental Impact Statement prepared for the proposed plant (DOE 2010). However, that evaluation considered accidents from release of aqueous ammonia (ammonia containing water) which was the only ammonia storage contemplated in the original design. Anhydrous ammonia presents a significantly greater hazard than aqueous ammonia.

2. Anhydrous Ammonia

Anhydrous ammonia is ammonia containing no water. It is normally stored as a liquid, but must be kept under pressure to maintain the liquid state since the boiling point is -28°F. If the liquid is released into the atmosphere, it will evaporate and produce a cloud of gas. The gas is colorless and is highly irritating with a sharp, suffocating odor. At low concentrations, the gas produces coughing and throat and eye irritation. At higher concentrations (750 parts per million and above) the gas can be life threatening for exposure times exceeding 1 hour.

Anhydrous ammonia is used in a variety of applications; most domestic use (80 percent) is as a fertilizing agent for agriculture crops. The U.S. production of anhydrous ammonia in 2004 was about 9 million metric tons.

While anhydrous ammonia is considered hazardous and, as noted previously, can lead to serious health effects from exposure to higher concentrations, the extensive use of the chemical in the United States has not resulted in significant public health impacts from accidental releases. This is due in large measure to the numerous safety requirements for storing and handling the chemical that have been developed by government and private agencies. From 1984 until 2006, the Occupational Safety and Health Administration responded to a total of 224 accidents involving the release of ammonia, or about 10 events per year. These accidents resulted in a total of 50 fatalities, or an average of about 2.2 fatalities per year (WDHS 2011). By comparison, the annual average number of fatalities from lightning strikes in the United States is 58 (NOAA 2009).

3. Anhydrous Ammonia Risks

The anhydrous ammonia to be added to the facility includes 14,400 gallons of the chemical stored in an aboveground tank. The inclusion of anhydrous ammonia for use at the facility does not represent a unique or unusual hazard in the Hugoton, Kansas area. As noted previously, large amounts of the chemical is used in the United States, including use at other ethanol production facilities (DOE 2005). Further, anhydrous ammonia is already stored in tanks in the Hugoton area for agricultural use (see Figure A-1). Similar-size tanks (between 12,000 and 18,000 gallons) are located in the West Industrial Park, about 1.2 to 1.3 miles from Hugoton, and a tank is located near the intersection of Northwest Avenue and the Atchison Topeka & Santa Fe Railroad on the western border of Hugoton.

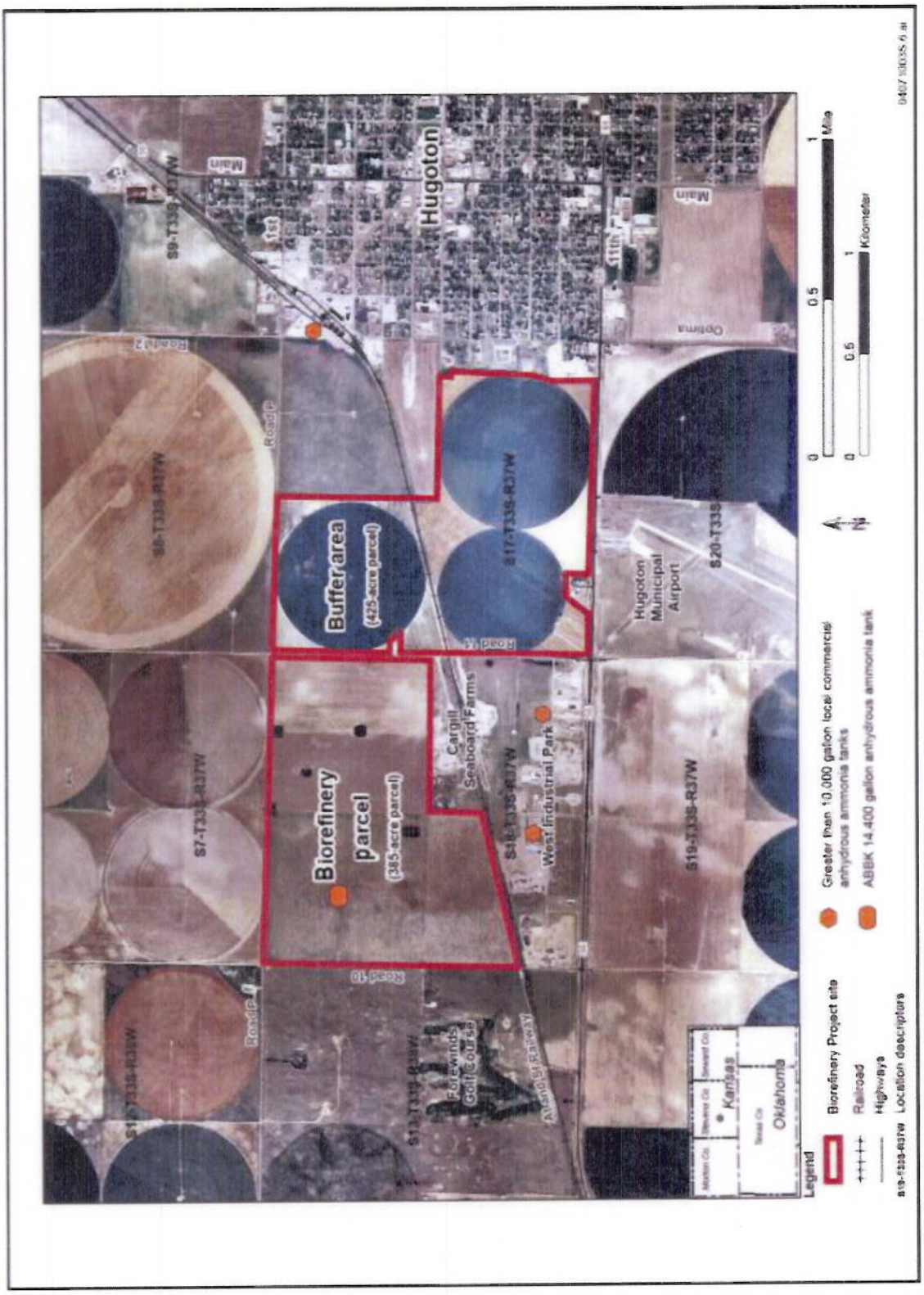

Figure A-1. Anhydrous ammonia to be located at the Biorefinery Project site and some existing commercial anhydrous ammonia tanks in the vicinity.

To assess the public risk from accidents involving the anhydrous ammonia stored at the Abengoa facility, an estimate was first made of the failure probability of the storage tank. Failure of the tank would release liquid ammonia that would quickly evaporate, forming a cloud of ammonia gas that would be dispersed downwind from the site and could adversely impact members of the public living in the vicinity of the plant. Tank failure is considered to be the bounding (worse-case) accident. Other failures, including pipe and process equipment failures, would result in a slower and limited release compared to tank failure. To complete the risk assessment, the consequences of ammonia tank failure was also evaluated.

4. Anhydrous Ammonia Tank Failure Probability

Two classes of tank failure initiating events were considered: external events (events that originate outside the site boundary) and internal events (mishaps internal to the facility). External events with the potential to cause ethanol tank failures at the site were evaluated for a previous plant design (DOE 2010). In this evaluation, it was determined that the probability of ethanol tank failure from external events would not be a significant contributor compared to internal events. This conclusion is also assumed to apply to the ammonia tank failure since the major contributors to external event failure probability was found to be aircraft and tornado impacts, and the impact target area of the ammonia tank is less than the four ethanol tanks previously evaluated.

For internal events, it was found (DOE 2010, Sect 4.12.1.1.1) that the probability of tank failure ranged from 8.8×10^{-4} to 1.9×10^{-5} per year. These same results are assumed to apply to the ammonia tank failure. The probability of exposure to specific members of the public (receptor) from a tank failure would also depend on the probability that the wind is blowing in the direction of the receptor. For example, for the residents of Hugoton located east of the plant, the wind blows toward the city about 12 percent of the time (directions east, east-northeast, and east-southeast of the plant; from DOE 2010, Volume 2, Figure A-7). Therefore, the probability of exposure to residents of Hugoton from ammonium tank failure is estimated to be between 1.1×10^{-4} and 2.3×10^{-6} per year.

5. Anhydrous Ammonia Tank Failure Consequences

To evaluate the consequences of ammonia release from a tank failure, results from DOE (2005, Appendix E) were applied with appropriate adjustment. In that analysis, four accidents involving ammonia release were evaluated. The bounding accident (resulting in the highest offsite consequences) was failure of a tank containing 15,750 gallons of anhydrous ammonia, assuming all the ammonia evaporated into the atmosphere in a period of 3 minutes. The downwind dispersion calculation was performed with the ALOHA code, and average weather conditions were assumed (3 meters per second wind speed, Pasquill D atmospheric stability, air temperature of 770°F, inversion layer height of 500 meters, cloud cover at 80 percent, and relative humidity of 50 percent). The distance from the release to three airborne concentration levels were evaluated: distance to where airborne concentration falls below 25 parts per million, distance to where airborne concentration falls below 150 parts per million, and distance to where airborne concentration falls below 750 parts per million. Table A-1 shows the human health effects for each of these concentrations.

The distances for each of these concentration values was calculated by adjusting the results from DOE (2005, Appendix E, Table 3-10) to account for the volume of ammonium involved in the accident. The ammonium tank to be added to the Abengoa facility will hold a total volume of 14,400 gallons.

Table A-1. Effect of ammonium concentrations.

Concentration (ppm)	Effect
25	Individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable order
150	Individuals could be exposed for up to 1 hr. without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action
750	Individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects

Consistent with the assumption in DOE (2005), the tank is assumed to be filled to a maximum volume of 87.5 percent, or 12,600 gallons. Since the airborne concentrations from the tank failure accident would be proportional to the evaporated volume, DOE (2005) results were adjusted by a factor of 0.8 (12,600 divided by 15,750). The results are shown in Table A-2. This table shows the maximum distance at which the listed concentration would be experienced.

Table A-2. Concentration versus distance for tank failure accident.

Concentration (ppm)	Distance (miles)
25	> 4.8
150	3.2
750	1.7

Since the city of Hugoton starts about 1.7 miles from the boundary of the biorefinery (DOE 2010, Figure 1-2), very few, if any, Hugoton residents would experience ammonia concentrations of 750 parts per million or greater from the tank failure accident. The nearest resident to the facility resides at a distance of 0.6 mile (DOE 2010, Sect. 4.12.1.1.2). Individuals at this location would be expected to experience ammonia concentrations in excess of 750 parts per million if they were downwind of the release. However, sheltering and evacuation of these individuals would significantly reduce the exposure. Workers at the facility could experience concentrations considerably higher than 750 parts per million and, thus, could receive life-threatening exposures.

6. References

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